NASA Technical Paper 1913

Computer Program To Predict Aircraft Noise Levels

Bruce J. Clark

SEPTEMBER 1981

NASA

NASA Technical Paper 1913

Computer Program To Predict Aircraft Noise Levels

Bruce J. Clark
Lewis Research Center
Cleveland, Ohio

NASA
National Aeronautics
and Space Administration

Scientific and Technical
Information Branch

1981

Summary

Methods developed at the NASA Lewis Research Center for predicting the noise contributions from various aircraft noise sources have been programmed to predict aircraft noise levels either in flight or in ground tests. The noise sources include fan inlet and exhaust, jet, flap (for powered lift), core (combustor), turbine, and airframe (from the NASA Langley Research Center). Noise propagation corrections are available for atmospheric attenuation, ground reflections, extra ground attenuation, and shielding. Outputs can include spectra, overall sound pressure level, perceived noise level, tone-weighted perceived noise level, and effective perceived noise level at locations specified by the user. Footprint contour coordinates and approximate footprint areas can also be calculated. Inputs and outputs can be in either System International or U.S. customary units.

The subroutines for each noise source and propagation correction are described in detail. Inputs required and some sample inputs and outputs are given in tables. A complete listing is given in appendix B. Symbols are defined in appendix A. The program is available through COSMIC to qualified users.

Introduction

In addition to the prediction procedures for aircraft noise available through the Aircraft Noise Prediction (ANOP) program at the Langley Research Center, it is often valuable to have a user-owned prediction procedure that can be run on a modest-sized computer and modified by the user as the need arises. The program described in this report was written in Fortran IV for an IBM 360 machine, but it can be run on any Fortran-language computer with at least 120 000 bytes (30 000 words on IBM 360) of program storage available. The inputs and outputs of the program are straightforward, compact, and easy to understand. It should not be difficult for the user to modify the program or to add subroutines to those described.

Various source noise prediction methods were developed at the Lewis Research Center (refs. 1 to 5) in support of the ANOP program at Langley. During the development of these prediction methods, it became obvious that computer-programmed versions were required for adequate checkout. By adding to these computer programs the capacity to solve the geometrical relationships between an aircraft in flight and an observer on the ground, these programmed predictions were made useful in evaluating noise estimates and footprints for various proposed engine installations being studied. For example, such studies have included simulated flights of the Quiet Clean Shorthaul Experimental Engine (QCSEE) and of the Quiet Shorthaul Research Aircraft (QSRA) with Avco-Lycoming YF-102 engines that were tested at Lewis (ref. 6). Test stand acoustic measurement results were compared with static predictions for the engine sources. The degree of correspondence between these predicted and measured results indicated the applicability of the predictions to these particular engine systems. Predictions for these engines in flight were then made, with corrections for installation and flight effects contributing most of the uncertainty.

There are two main program versions for using these prediction routines: The first (FOOTPR) is a procedure to calculate at various observer stations the time history of the noise (as spectra, OASPL, PNL, and PNLT) for an aircraft flying a specified set of speeds, orientations, and space coordinates. The various components of the noise are predicted by methods prepared at Lewis under ANOP activity (except for the airframe). For each individual source the levels are free field with no corrections for propagation losses other than spherical divergence. The total spectra can be corrected for the usual effects of atmospheric attenuation, extra ground attenuation, ground reflection, and aircraft shielding, and the corresponding values for overall sound pressure level (OASPL), perceived noise level (PNL), and tone-weighted perceived noise level (PNLT) are then calculated. From the time history at each point, true effective perceived noise levels (EPNL) are calculated. Values of EPNL, maximum PNL, or maximum PNLT are thus found as desired for a grid of specified points on the ground. It is worth noting that time-integrated EPNL's are calculated in this program. This implies that a time history is generated for each desired point on the ground, and hence a substantial amount of calculation time may be required.

The second main program is called RADIUS and is designed to give the usual format of one-third-octave sound pressure level (SPL) values at a fixed radius for a number of angles selected by the user. This program uses the same noise source subroutines as does FOOTPR and has served as a convenient method for checking the programming accuracy of the predictions.

Each noise source subroutine (except AIRFR) has been checked against the sample problems and calculated results in the source documents. For example, the fan noise predictions made by using RADIUS were compared with the output spectra at each fan speed and microphone angle as plotted in reference 1. Although in a few cases there were discrepancies of up to 2 decibels at some points within a spectrum, these were checked with the author (Heidmann) and the results from the FAN subroutine were judged to be as good as or superior to the published curves. Where no example or reference calculations are shown in the source documents, hand calculations were used to check representative levels from the source subroutines of this program. The results from AIRFR were checked with results from the ANOP program at Langley and were found to be within 1 decibel.

The main programs and their subroutines are discussed in detail in this report. The programs are written to facilitate rapid calculations. Several blocks of COMMON are shared by different parts of the program to avoid repeated transfers of values through calling arguments from one subroutine to another. Fairly consistent patterns are followed for naming inputs and internal variables. Inputs are of the NAMELIST type and are grouped for convenience and clarity. Default values are supplied for many of the variables so that, if no value is given in the NAMELIST block, the default value is used in the calculation. Since data statements are used for some of the default values, the programs must be unloaded and reloaded between problems for any of these defaults to be reset. It is important that the NAMELIST blocks be supplied in the proper order, but any input block will be ignored if not called for. All calculations are made in U.S. customary (English) units of feet, seconds, pounds mass, pounds force, and degrees Rankine. When using the optional input in System International (SI) units, all dimensioned variables must be input in these units, and conversions are then made to U.S. customary units. Dimensions for all inputs are given in the input variable list.

Detailed Program Descriptions

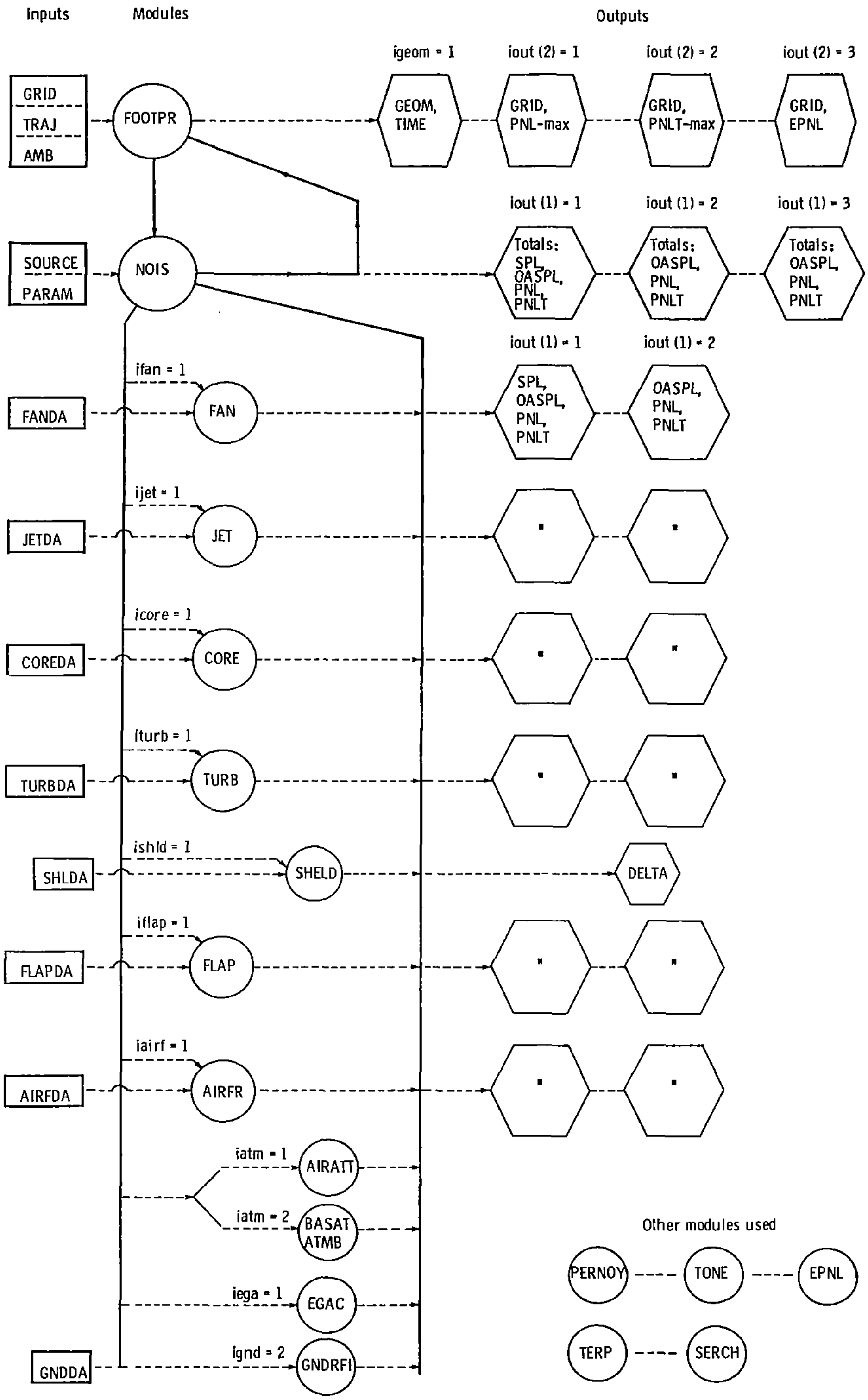
Main programs FOOTPR and RADIUS and their subroutines are discussed in detail, and where appropriate the basic equations are presented, to give the user a familiarity with the general approach of the programs. Table I presents the equation numbers in the prediction documents for the individual noise sources. It is not intended that the following descriptions give a comprehensive view of the prediction methods themselves; the reader should consult the original documents (see reference list) for a more complete treatment of each subject. In figures 1(a) and (b) flow diagrams are given for programs FOOTPR and RADIUS. The input data namelist blocks and the types of output available are illustrated along with the flow of information between the main programs and the subroutines. Most subroutines read their own namelist block of data the first time they are called. The order of these inputs is shown in table II. A complete list of variables for each of the input data blocks is given in table III. In FOOTPR the individual subroutines can be directed to print their own outputs as shown; total noise outputs come from NOIS and FOOTPR. In RADIUS all outputs from individual subroutines are returned to the calling program, which assembles them in the proper format for printing. In the Fortran coding (appendix B), all read statements for the inputs are identified with device number 5, and all output write statements with device number 6; for example,

```
READ(5,TRAJ)        WRITE(6,117)
```

Main Program FOOTPR

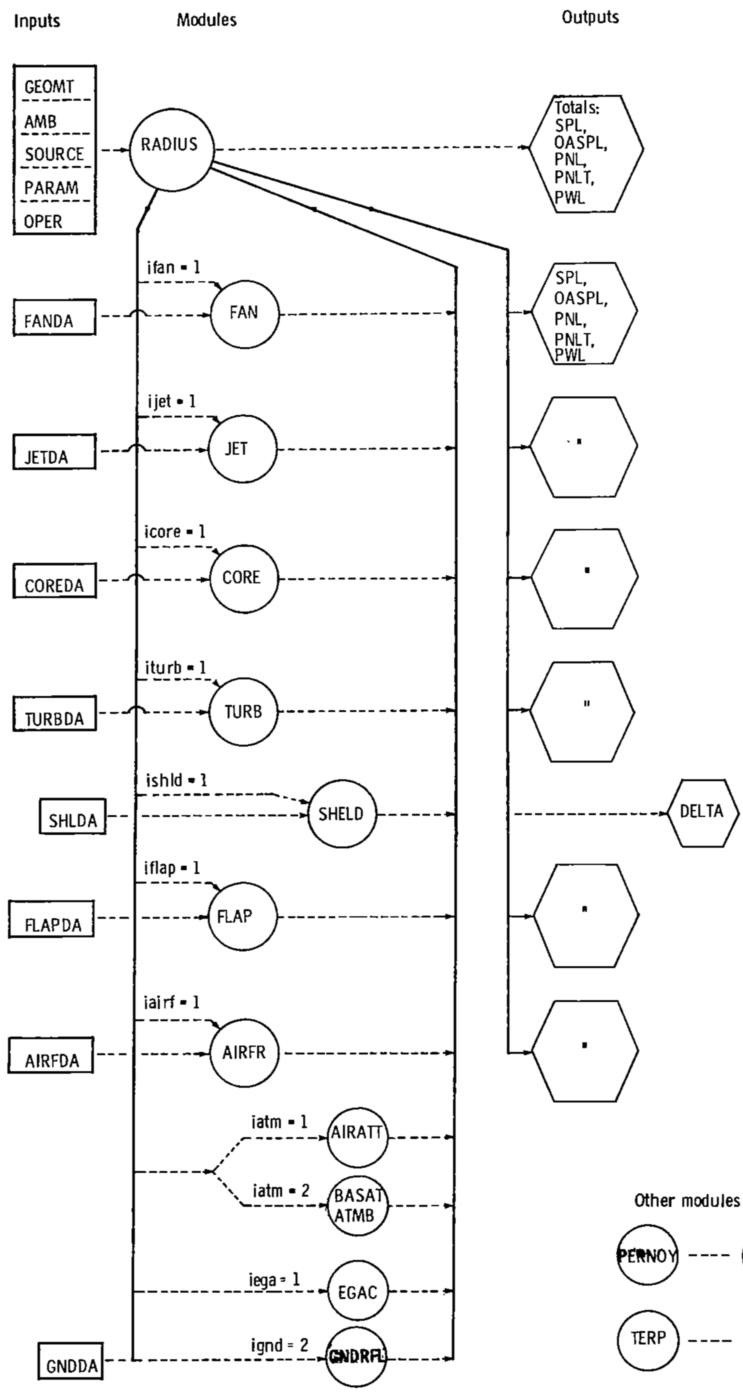
FOOTPR is the main program to calculate the needed geometric parameters between the aircraft source and the observer as a function of time. Observer locations are specified as a grid with NXO values of XO and NYO values of YO and one value of ZO. The aircraft flies past each observer, one at a time, along a path specified in XA, YA, and ZA (fig. 2). As illustrated in the flow diagram of figure 1(a), FOOTPR calls subroutine NOIS for noise predictions at time increments TD along the aircraft path. The user has the option of centering the time history on the closest point of approach of the aircraft to each observer or of starting the history at the first aircraft position given. FOOTPR also finds the maximum noise levels or calls for the EPNL calculation from the time history of the sum of the noise contributions. An iterative approach to finding contour coordinates for specified noise level contours is included in this program although it is not highly developed.

After each time interval the position of the aircraft is calculated with respect to the X,Y,Z coordinate system (fig. 3). The orientation of the aircraft is



(a) FOOTPR.

Figure 1. - Flow diagrams for programs FOOTPR and RADIUS.



(b) RADIUS.

Figure 1. - Concluded.

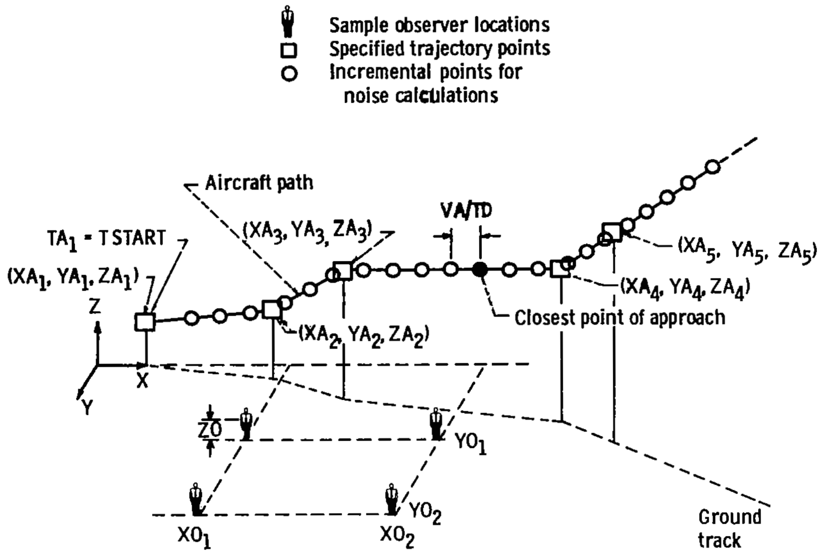


Figure 2. - Observer locations, aircraft trajectory, and points for noise calculations. Number of time increments (NT), 21.

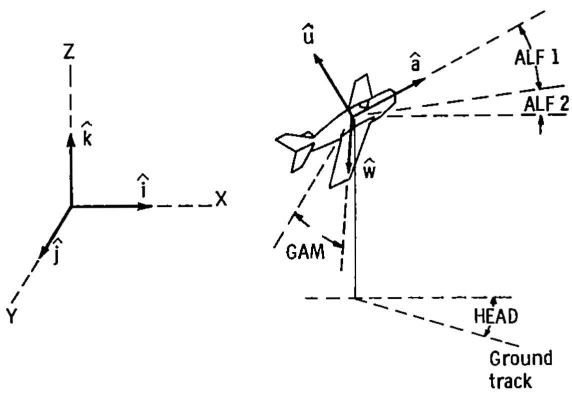


Figure 3. - Aircraft orientation geometry.

defined by its angle of attack (ALF1), the slope (ALF2) and heading (HEAD) of its trajectory, and its banking angle (GAM), where

$$\tan(\mathrm{ALF2}) = dZ/\mathrm{SQRT}(dX^2 + dY^2)$$

and

$$\sin(\mathrm{HEAD}) = dY/\mathrm{SQRT}(dX^2 + dY^2)$$

For convenience, let

$$\mathrm{ALF} = \mathrm{ALF1} + \mathrm{ALF2}$$

Unit vectors ($\hat{a}$, $\hat{w}$, and $\hat{u}$) on the aircraft can then be related to the X,Y,Z coordinate system unit vectors ($\hat{i}$, $\hat{j}$, and $\hat{k}$). Briefly, when $\hat{a}$ is in the engine inlet direction, $\hat{w}$ is in the direction of the wingtip, and $\hat{u}$ is vertical to the aircraft ($\hat{u} = \hat{w} \times \hat{a}$)(fig. 3), then for HEAD = ALF = GAM = 0,

$$\hat{a} = \hat{i}, \qquad \hat{w} = \hat{j}, \qquad \hat{u} = \hat{k}$$

for HEAD ≠ 0 and ALF = GAM = 0,

$$\hat{a} = \hat{i}\cos(\mathrm{HEAD}) + \hat{j}\sin(\mathrm{HEAD})$$

$$\hat{w} = -\hat{i}\sin(\mathrm{HEAD}) + \hat{j}\cos(\mathrm{HEAD})$$

$$\hat{u} = \hat{k}$$

for HEAD ≠ 0, ALF ≠ 0, and GAM = 0,

$$\hat{a} = \hat{i}\cos(\mathrm{ALF})\cos(\mathrm{HEAD}) + \hat{j}\cos(\mathrm{ALF}) \times \sin(\mathrm{HEAD}) + \hat{k}\sin(\mathrm{ALF})$$

$$\hat{w} = -\hat{i}\sin(\mathrm{HEAD}) + \hat{j}\cos(\mathrm{HEAD})$$

$$\hat{u} = -\hat{i}\sin(\mathrm{ALF})\cos(\mathrm{HEAD}) - \hat{j}\sin(\mathrm{ALF}) \times \sin(\mathrm{HEAD}) + \hat{k}\cos(\mathrm{ALF})$$

and for HEAD ≠ 0, ALF ≠ 0, and GAM ≠ 0,

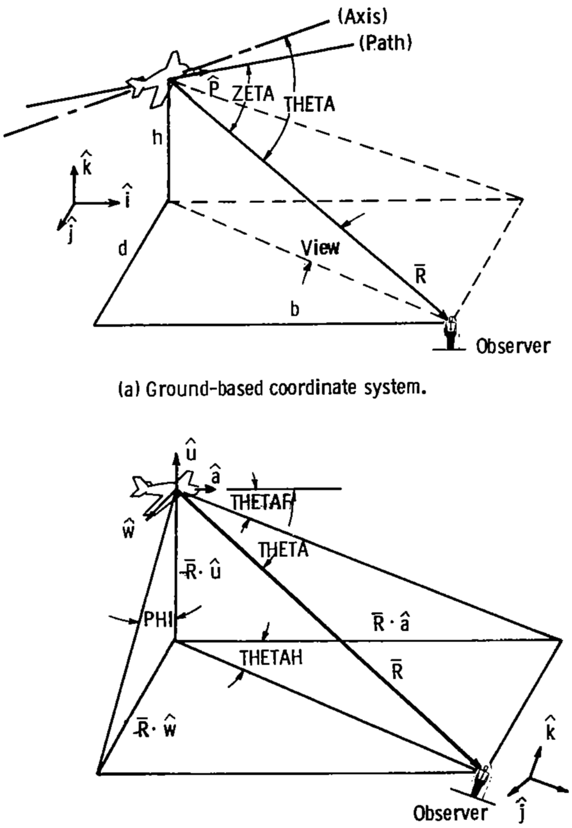
$$\hat{a} = \hat{i}\cos(\mathrm{ALF})\cos(\mathrm{HEAD}) + \hat{j}\cos(\mathrm{ALF}) \times \sin(\mathrm{HEAD}) + \hat{k}\sin(\mathrm{ALF})$$

$$\hat{w} = \hat{i}[\sin(ALF)\cos(HEAD)\sin(GAM) - \sin(HEAD)$$
$$\times \cos(GAM)] + \hat{j}[\cos(HEAD)\cos(GAM)$$
$$+ \sin(ALF)\sin(HEAD)\sin(GAM)]$$
$$- \hat{k}\cos(ALF)\sin(GAM)$$

$$\hat{u} = -\hat{i}[\sin(ALF)\cos(HEAD)\cos(GAM) + \sin(HEAD)$$
$$\times \sin(GAM)] + \hat{j}[\cos(HEAD)\sin(GAM)$$
$$- \sin(ALF)\sin(HEAD)\cos(GAM)]$$
$$+ \hat{k}\cos(ALF)\cos(GAM)$$

The position vector to the observer (fig. 4(a)) is $\bar{R} = b\hat{i} + d\hat{j} - h\hat{k}$, where $b = XA - XO$, $d = YA - YO$, $h = ZA - ZO$. Then by letting

$$BPD = b\cos(HEAD) + d\sin(HEAD)$$



(a) Ground-based coordinate system.

(b) Aircraft-based coordinate system.

Figure 4. - Source-observer geometrical relationships.

$$DMB = d\cos(HEAD) - b\sin(HEAD)$$

$$BPDPH = BPD\sin(ALF) + h\cos(ALF)$$

the dot products can be simplified to

$$\bar{R} \cdot \hat{a} = BPD\cos(ALF) - h\sin(ALF)$$

$$\bar{R} \cdot \hat{w} = DMB\cos(GAM) + BPDPH\sin(GAM)$$

$$\bar{R} \cdot \hat{u} = DMB\sin(GAM) - BPDPH\cos(GAM)$$

and the source-related angles THETA, THETAF, THETAH, and PHI (fig. 4(b)) are derived from

$$\cos(THETA) = (\bar{R} \cdot \hat{a})/R$$

$$\tan(THETAF) = -(\bar{R} \cdot \hat{u})/(\bar{R} \cdot \hat{a})$$

$$\tan(THETAH) = (\bar{R} \cdot \hat{w})/(\bar{R} \cdot \hat{a})$$

$$\tan(PHI) = -(\bar{R} \cdot \hat{w})/(\bar{R} \cdot \hat{u})$$

In these geometrical relationships the assumption is made that the engines are concentrated at a central point on the aircraft with their centerlines coincident with the aircraft centerline. No attempt is made to account for the effects due to the placement of the engines on the aircraft, other than the overall effects applied for shielding. For cases when the engine centerlines are elevated with respect to the aircraft centerline, the inputs ALF1 should be given as the engine angle of attack, and a minor error in airframe noise directivity will result.

The factor FDOP is calculated for Doppler corrections to the source frequencies and amplitudes; it is based on the angle ZETA, the direction of aircraft motion with respect to the observer (fig. 4(a)); that is,

$$\cos(ZETA) = \bar{R} \cdot \hat{p}/R = (b\, dX/dS + d\, dY/dS - h\, dZ/dS)/R$$

where

$$dS = SQRT(dX^2 + dY^2 + dZ^2)$$

and $\hat{p}$ is the unit vector in the direction of aircraft motion. The Doppler shift factor is then

$$FDOP = 1 - (VI/C)\cos(ZETA)$$

Frequencies are divided by FDOP, and predicted levels are divided by FDOP to the EDOP power, where EDOP depends on the type of noise source.

Hence frequencies and levels both are increased as the aircraft approaches the observer and are decreased as the aircraft moves away. The angle VIEW is calculated by FOOTPR for use in calculating extra ground attenuation.

The program includes default values set for a 6° aircraft climb to 5000-foot altitude at an aircraft velocity of 150 feet per second and 100 percent engine power, starting from XA = YA = 0, and ZA = 8 feet. Two observer default locations are at XO = 500 feet, YO = 500 and 1000 feet, and ZO = 4 feet.

The first input read by FOOTPR is a title line supplied by the user in alphanumeric format (20A4). The remaining user inputs to FOOTPR are made in namelist blocks &GRID, &TRAJ, and &AMB (tables II and III). Block &GRID accepts inputs for the choice of SI or U.S. customary units (UNITS), the coordinates for the grid of observer points, and the number and level of noise contours to be calculated. Block &TRAJ accepts inputs for the number and coordinates of the points used to define the aircraft path. Aircraft orientation, velocity, engine power, flap and landing gear settings, choice of the number and size of time increments, and choice of some printout options are also entered in this block. The ambient conditions of temperature, pressure, and relative humidity are entered in block &AMB. Default values are supplied for many of the inputs to these blocks.

After the program reads the inputs, times are defined along the aircraft path, starting with TSTART (default = 0) at the first aircraft position given (fig. 2). When the aircraft changes velocity between points, the acceleration is assumed to be constant so that the time between points is simply the distance divided by the average of the velocities.

The time history used for noise calculations is controlled by the user's input of the number (NT) and the size (TD) of the time increments and by ICPA: When ICPA = 0, the history starts with the first point of the aircraft trajectory. When ICPA = 1, the time history is centered on the closest point of approach of the aircraft to the observer. When the closest point of approach is not well defined by the aircraft trajectory (such as in circling the observer), use ICPA = 0 to start the time history.

For most aircraft trajectories the noise will maximize somewhere near the closest point of approach to each observer. Using the default value of ICPA = 1, the program calculates the coordinates of the closest point of approach. The first point for noise calculations (fig. 2) is then found as half (NT/2) of the time intervals (TD) before the closest point of approach. Succeeding noise point calculations are made at intervals of time (TD) along the flight path defined by XA, YA, ZA, and velocities VA. Note in figure 2 that for NT = 21 there are 10 points before and 10 points after the closest point of approach. The maximum number of time increments (NT) is 100.

At time increments between the specified points of the aircraft trajectory, the aircraft velocity (VI)(as well as XI, YI, and ZI) is a calculated value assuming constant acceleration. Other trajectory inputs (as EPP, ALF1, GAM, PSY, FLAPA, ILGR, and IREVR) change only at specified trajectory points where new values are given. FOOTPR checks for changes in EPPI or VI between points, and if both are unchanged, sets ISKIP = 1. ISKIP is used in the NOIS and JET subroutines to skip repeated calculations of variables that are unchanging. Subroutine NOIS returns values of PNL and PNLT to FOOTPR, which then stores the appropriate ones and selects PNL–max or PNLT–max or calculates EPNL as indicated by the user choice of IOUT(2) and IOUT(3)(table III). Note that if IOUT(3) > 0, then IOUT(2) must either be zero or agree with IOUT(3).

In the noise contour routine, for each value of XO the program calculates the noise level at two given (or default) values of YO and then extrapolates in a direction in Y for the first approximation for the Y coordinate of that contour level at XO, assuming that the level varies logarithmically with Y. As many as 10 iterative linear interpolations are then made to arrive at within 0.1 decibel of the desired level. The X,Y coordinates of that contour level are printed out, and the program proceeds to the next specified contour level. If the aircraft banks (GAM ≠ 0) or has a flight path with nonzero YA values, the footprint will be asymmetric about the X axis. In this case the noise contour calculation should be repeated with negative inputs of YO to force the program to converge to the opposite side of the footprint.

In calculating EPNL contours the program will have difficulty in converging for the Y coordinates if the number of time increments is too small or the increment size too large. The convergence routine assumes a smooth dependence of the level on the Y distance. If an inadequate time history is given, the EPNL subroutine extrapolates to the time when the noise history is 10 decibels below the maximum, based on the first two or last two points given. Any scatter or nonuniform behavior at these end points can result in sizable changes in the extrapolated end points for the time history and hence in the time interval over which the EPNL integration occurs. This can result in "wild" estimates being generated in the solution for the Y coordinate of the contour. If the program does not converge in 10 iterations, it prints a warning message and advances to the next point. If the user asks for the Y coordinate of a contour level higher than can be predicted at that XO position, the program cannot converge and prints the warning. For a well-specified problem the routine usually converges in two to four iterations beyond the initial tries at YO = 500 and 1000 feet (default values).

Noise contour (or footprint) areas are calculated by integrating the area between the first and last XO points on the contour, assuming that the contour is symmetric about the X axis. Sizable errors in area will occur if an insufficient span of XO locations is specified so that the contour points will not approach the end of the footprint. When the contour calculation fails to converge or erroneously terminates with a negative value for the Y coordinate, the calculated contour area will be in error. When the anticipated contours are not symmetric about the X axis, the user is advised to examine the contour shapes carefully and to be skeptical of the area calculations. In some of these cases, negative coordinates can be calculated (as mentioned earlier) by inserting negative starting values for YO; the footprint area can be found by averaging the two areas calculated for positive and negative values of Y. It should be obvious that the contour for a level aircraft flyover would extend without limit, and hence its area would be infinite; the calculation would only give the footprint area between the extremes of XO locations.

The noise contour feature of this program should be used with some caution because of these cases where the simple interpolative iterations may not converge or where the area integration can be faulty. For accurate footprint contours and areas it is recommended that these procedures be limited to aircraft flight paths along the X axis. Exploratory calculations should be made by the user to find the noise levels along the X axis near the start and end (closure points) of the noise contours. From these, XO values near the closure points (but within the contour) can be chosen and made inputs, along with up to 18 intermediate XO values, for the footprint contour and area calculations. The number of XO points actually needed will depend on the complexity of the contour. The computer calculation time will be considerably shortened if each contour is separately calculated, with XO values entered that are appropriate to the footprint length of that particular contour.

The indicator IGEOM was initially included when checking for proper geometry calculations in FOOTPR. However, the printout for IGEOM = 1 has frequently been found useful in understanding complex geometry effects during noise calculations. Hence, it has been left available to the user as an option. When IGEOM = 1 and ICPA = 1, a printout message indicates the closest point of approach of the aircraft to the observer.

Subroutine NOIS

Subroutine NOIS is called by the main program FOOTP and then in turn calls the individual noise source subroutines, as shown in figure 1(a). In the input namelist block &SOURCE, NOIS reads the user choices of sources, propagation corrections, and output options. In this input the user may call for suppression to be applied (ISUPP = 1) to each source where a suppression spectrum is supplied. This choice can be overridden by the input of ISUPPR to each noise source subroutine. This subroutine also reads the input matrix of engine variables in &PARAM as an "engine map" and interpolates for the specific variables for each noise source. It will make standard corrections to these variables for actual-day conditions of ambient temperature and pressure, if desired. As can be seen for the inputs under &PARAM in table III, the names of the arrays of variables for the engine map are formed by prefixing "A" to the variable name itself. Because of the interpolation routine used, the engine parameters must be entered in order of increasing engine performance parameter (AEPP).

The band center frequencies for other subroutines are generated in subroutine NOIS. One-tenth-decade frequency ratios are used rather than either one-third-octave frequency ratios or the "preferred" center frequencies. The frequency range for all calculations is from 50 to 10 000 hertz. Filter characteristics can be modified by entering FILBW in &SOURCE (default = 1.). FILBW is the fraction of the "ideal" filter bandwidth that has a gain of 1 (fig. 5). In NOIS the frequency ratios where the filter gain is 1 and 0 are calculated for use in the apportionment of tone energy between adjacent bands in the FAN and TURB subroutines.

Each noise source is then called in turn (fig. 1(a)) and results are summed for the total noise spectrum. Propagation corrections for atmospheric attenuation, extra ground attenuation, shielding, and ground reflection are made to the total spectrum as requested by the user, and then PNL and PNLT calculations are made. The propagation corrections are discussed individually later.

Printouts from NOIS depend on the user input in IOUT(1). The choices include the total noise spectrum with OASPL, PNL, and PNLT or only OASPL, PNL, and PNLT at each trajectory point (table IV). Examples of these printouts are included later in this report.

Main Program RADIUS

The program RADIUS was devised to predict engine noise source levels at a fixed radius and at

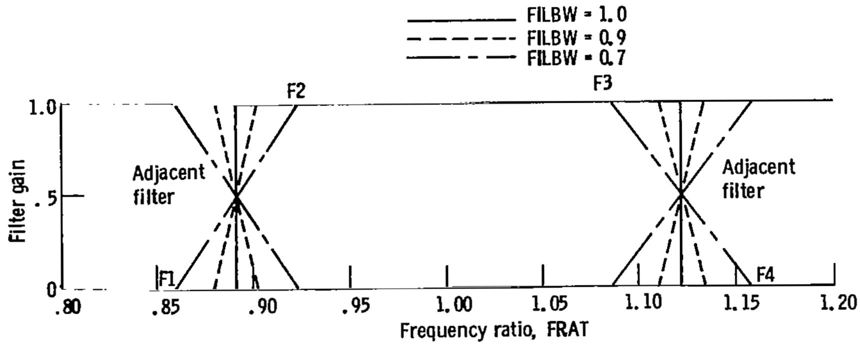


Figure 5. - Idealized filter shapes for apportionment of fan and turbine tones.

various angles, such as would simulate the ground acoustic testing of an engine. This program replaces programs FOOTPR and NOIS in calling the noise source subroutines, as shown in the flow diagram of figure 1(b). The first input is a title line supplied by the user in alphanumeric format. The remaining input data are entered in namelist blocks &GEOMT, &AMB, &SOURCE, &PARAM, and &OPER.

The input block &GEOMT contains variables for defining the geometry (fig. 6) of the noise field. The polar and azimuthal angles are specified as arrays ATHETA and APHI, with NTHETA and NPHI values of each. The user indicates his choice of units also in this input. The angle VIEW can be entered if extra ground attenuation (IEGA = 1) calculations are desired. The source and observer heights (ZI and ZO) are also entered for use in the detailed ground reflection calculations (IGND = 2).

Blocks &AMB, &SOURCE, and &PARAM serve the same purpose and include exactly the same variables as the same input blocks to FOOTPR and NOIS. This simplifies data input when both flyover calculations (by FOOTPR) and constant-radius predictions (by RADIUS) are desired. Ambient conditions of temperature, pressure, and relative humidity are entered in &AMB. In &SOURCE the user indicates the number of engines and selects the sources and sound propagation corrections to be used. The engine operating map is entered in &PARAM.

The user indicates the operating point for the engine within the engine map by the value of EPPI input in block &OPER. For forward-velocity source level corrections, or for Doppler shift and source motion amplification, a single value of aircraft forward velocity (VI) is also entered in this block. For flap noise predictions the trailing flap angle (PSYI) must also be specified here. For airframe noise calculations the angle (FLAPI) of the slotted flaps (if present) and the indicator (ILG) for landing gear up or down must also be included.

RADIUS interpolates from the engine map in &PARAM for the specific engine variables needed for each noise source and corrects these for actual-day ambient conditions in the same way that NOIS does. The actual input values used in the calculations for each source are listed in the output. Each noise source subroutine is called repeatedly for the angles required. RADIUS constructs a table of SPL values at each angle and frequency; calculates the acoustic power, OASPL, PNL, and PNLT; and prints a page of output for each source. If the data input block

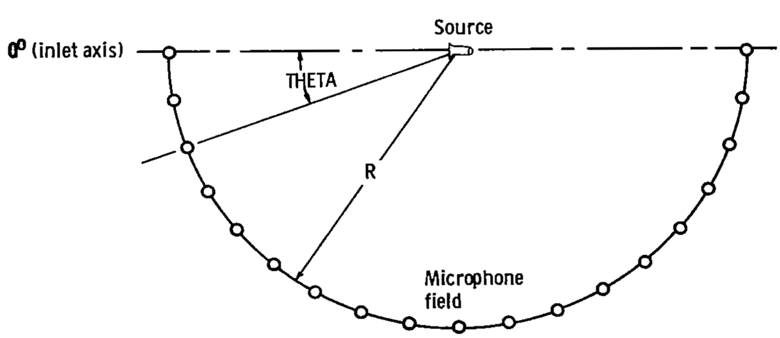


Figure 6. - Typical geometry of noise field for RADIUS predictions. Shown here for default values of NTHETA = 19 microphone or observer positions and ATHETA located every 10° from 0° to 180°.

&OPER is repeated, RADIUS will repeat the previous calculations and printout at a new operating condition specified in &OPER.

The calculated acoustic power spectrum is an area-weighted integration of the SPL values at the specified angles, assuming that the source is axisymmetric. For nonaxisymmetric sources, the levels calculated at the first value of APHI (usually at PHI = 0°) are assumed to be axisymmetric and are integrated for an approximation to the acoustic power. True acoustic power for these sources would require a two-dimensional integration over both THETA and PHI. This sophistication is not programmed into RADIUS. The reference level in this program for the acoustic power is 0.1 picowatt, whether U.S. customary or SI units are used. Caution is advised when comparing acoustic power levels from these predictions with published power levels, especially from Europe, where the usual reference level is 1.0 picowatt.

It should be remembered that PHI, the angle in the sideline direction (fig. 4(b)), is defined with respect to the aircraft coordinates. When making acoustic measurements on a static test stand, in the case where the noise source is not axisymmetric, the experimental package is frequently rotated so that the PHI = 0° plane is parallel to the ground. Microphones at the source height are then measuring in the flyover plane. Predictions to simulate this case using RADIUS are made with PHI = 0°.

Subroutine FAN

Subroutine FAN is programmed from reference 1 (Heidmann). It predicts the total fan noise from inlet and exhaust ducts. By specifying IEXH the user can choose to exclude inlet or exhaust noise. Combination tones ("buzz" or multiple pure tones) are included when the rotor relative tip speed is supersonic (TIPM > 1). Tone and broadband noise contributions are predicted separately and added. For a two-stage fan the noise from both stages is added; no attenuation is applied to first-stage fan exhaust noise because of the second stage.

This subroutine requires that the inputs of fan mass flow (AWAFAN), fan speed (ARPM), and temperature rise (ADELT) or pressure ratio (AFPR) be entered in the &PARAM input to subroutine NOIS. Inputs of the fan tip relative Mach number (ATIPM) (including second-stage ATIPM2, if appropriate) should be made also in &PARAM if available. If DELT is not supplied as ADELT in &PARAM, the fan pressure ratios (AFPR) are required in &PARAM, and DELT is calculated from FPR and the fan efficiency (FANEFF).

The temperature at the fan face is found by interpolation based on the specific weight flow and is used to calculate the speed of sound (CX) at the fan face. This is used in the rotor tip (RTSM) and rotor relative tip (TIPM) Mach number calculations. When available, TIPM should be obtained from velocity diagrams for the rotor blades and supplied as ATIPM in &PARAM, especially when the fan has inlet guide vanes (IGV = 1). If ATIPM is not supplied, TIPM is calculated as the right-angle vector sum of the inlet air flow (AIRM) and rotor tip (RTSM) Mach numbers. If TIPM2 is not supplied for the second stage, it is approximated as TIPM times the ratio of design relative tip Mach numbers (TIPMD2/TIPMD).

The rotor fundamental tone cutoff number is calculated from RTSM and the vane-blade ratio. As prescribed in reference 1, when the cutoff number is below 1.05 and the rotor tip speed is subsonic (RTSM < 1), the tone level is reduced 8 decibels.

Combination tones are treated as three broadband sources with spectra peaked at one-half, one-fourth, and one-eighth of the blade passing frequency. These three sources are added for the total combination tone levels. It has been recognized that reference 1 overpredicts the combination tone levels for most fans by as much as 5 decibels. For the convenience of the user an option has been made available to lower the combination tones by specifying a decrement DECMPT (in decibels) in the &FANDA input.

In fans without inlet guide vanes (IGV = 0), the rotor-stator spacing (RSS) to be entered is the axial spacing between rotor and stator divided by the axial projection of the rotor mean chord, in percent. In fans with inlet guide vanes RSS is the lesser of this rotor-stator spacing and the vane-rotor spacing found by dividing the space between the inlet guide vanes and the rotor by the chord of the vanes (fig. 6(a) of ref. 1). When IGV = 1, the broadband and tone levels from the exhaust duct are increased 3 and 6 decibels, respectively; the harmonics above the fundamental in the inlet duct are reduced 6 decibels; and combination tones (if present) are reduced 5 decibels.

Doppler shift and source motion amplification are applied if IDOP = 1. The exponents for the source amplification are set at 4 for both the fan first and second stages, assuming that both sources behave as convected compact dipoles; the user can modify these exponents by inputs of EDOP and EDOP2. Values of EDOP are not passed between subroutines so that a change in EDOP in FAN will not affect the default values for EDOP in other subroutines. When there is inlet flow distortion to the fan, IFD should be set equal to 1 and (as prescribed) tone and broadband levels will be modified by allowing no benefit for rotor-stator spacing over 100 percent; tone harmonics will also fall off more rapidly.

Tones and their harmonics (except for combination tones) are sorted by frequency and added to the appropriate band levels. When FILBW = 1., the filters for these bands are *ideal.* When FILBW < 1., the energy of the tones that fall near the edge of a band is divided proportionally between that band and the adjacent band (fig. 5). Simple suppression spectra can be applied to the fan inlet and exhaust duct noise levels. The suppression spectra are SUPPIN for the inlet duct and SUPPEX for the exhaust duct; 24 values of each are entered in &FANDA. The indicator ISUPP in &SOURCE, or ISUPPR in &FANDA, must be set equal to 1; if ISUPPR is supplied here, it will override the value of ISUPP from NOIS in controlling suppression imposed on the fan spectra.

The 1979 printing of reference 1 corrects the 1975 printing, which contains two errors in the equations shown in the figures for inlet broadband noise levels and inlet tone levels. In the 1975 printing the third equation in figure 4(a) must be modified by subtracting 0.91515 from the right side. In figure 10(a) the fourth equation should omit the term 20 log MTRD.

Subroutine JET

Subroutine JET is based on reference 2 (Stone), excluding the portion for predicting reverser noise. The user must specify the type of nozzle (simple conical, conical with plug, slot, or coannular). The effects of forward velocity or flight on the source intensity level can be included by setting IFWD = 1. When engine conditions and aircraft velocity are unchanging between calculation points, FOOTPR sets ISKIP = 1 and a shortened set of calculations is used in JET.

For the core flow this subroutine requires inputs of the velocity (AVC) and the temperature (ATC) of the flow from the nozzle to be entered in the &PARAM input. The program can calculate the values of the core specific heat ratio (GAMMAC) and gas constant (GASRC), if the user includes values of the core weight flow (AWCORE) and fuel flow (AFUEL) in &PARAM. This calculation is based on typical values for "A-1" jet fuel (fig. 7), with a hydrogen-carbon ratio of 0.16 and a lower heating value of 43 242 joules per gram (18 600 Btu/lb) of fuel.

The geometry for different types of exhaust nozzles is shown in figure 8. For a plug nozzle the annular height around the plug (ANNHT) must be supplied. For a slot nozzle the hydraulic diameter (DHC) of the nozzle is required.

For coannular flow the fan velocity (AVF) and temperature (ATF) must be included in the &PARAM input. Note that the coannular noise prediction is not valid for a fan flow heated with

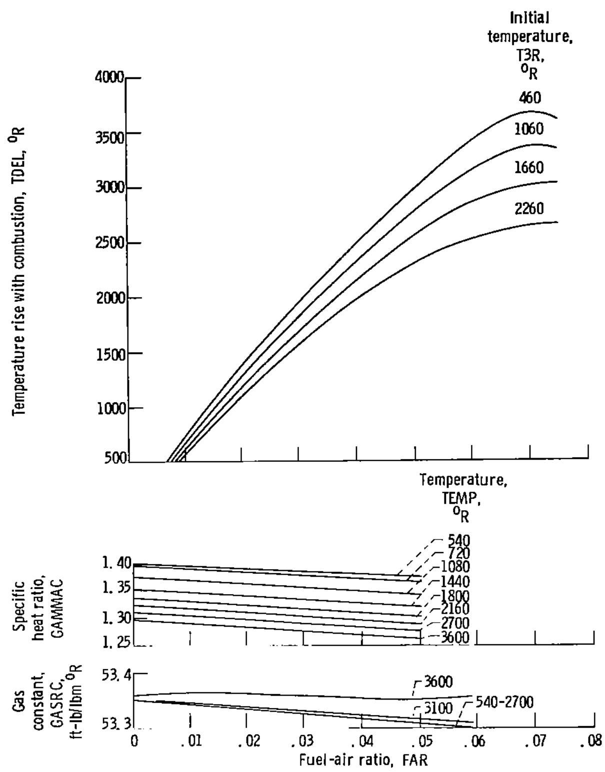


Figure 7. - Properties of burned gas in core flow.

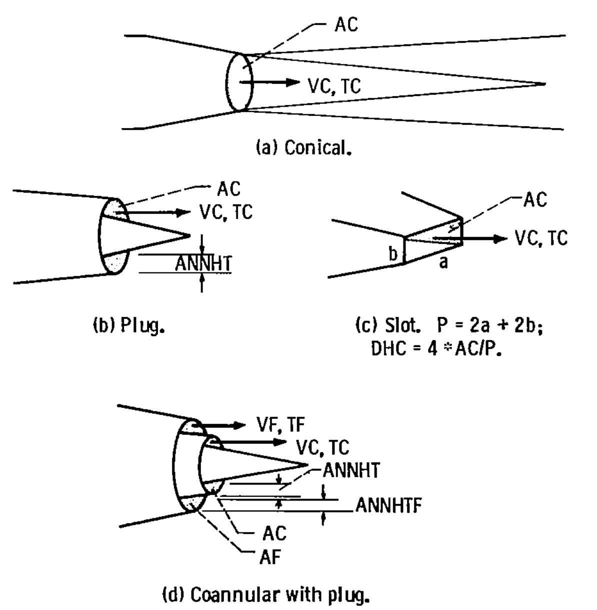


Figure 8. - Nozzle geometries for jet noise calculations.

respect to the core flow. The annulus height (ANNHTF) may be given as input; otherwise it will be calculated from the areas, assuming that the nozzle contours are circular and that the inner fan nozzle wall is of negligible thickness. If the annulus is noncircular, the hydraulic diameter DHF must be given.

For both core and fan flows, when the flow is supersonic, the shock noise is calculated separately and added to the subsonic noise calculation. Source motion amplification (Doppler) is applied to the shock noise contributions if IDOP = 1; the user can modify the exponent for this amplification from its default value of 1 (assumes a distributed monopole source) by inputting EDOP.

Several modifications to this method of jet noise prediction have been suggested by Stone (refs. 7 to 9) but have not yet been incorporated into this programmed version. These modifications include improvements in predicting the effects of flight velocity and a capacity to predict jet noise in the case of a heated fan stream (inverted velocity profile).

Subroutine CORE

Subroutine CORE predicts the low-frequency core noise resulting from the combustor, as in reference 3 (Huff, et al.). Inputs of core flow (AWCORE) and combustor pressure (AP3) are required in &PARAM. Combustor inlet and exit temperatures (AT3 and AT4) should also be supplied in &PARAM if available. If AT3 values are not supplied in &PARAM, the value of T3 will be calculated assuming isentropic compression and using the user-supplied or default value of the core flow specific heat ratio (GAMMA). If AT4 values are not supplied, the temperature rise in the combustor will be calculated from the fuel-air ratio, assuming "A-1" fuel, to give an approximate T4. If desired (setting IMOD = 1), the program will use a modified noise level prediction based on the correlation equation of reference 10 (Matta, et al.). The modified prediction requires the added input of the design temperature drop through the turbine (DTEMD); both methods predict the same levels when DTEMD is 728.62° R. Both versions use the same simple directivity curve and single spectrum. The peak frequency of the spectrum is arbitrarily set at 400 hertz if the calculated peak is less than 300 hertz or greater than 1000 hertz, as recommended in reference 3.

Doppler frequency shift and source motion amplification can be effected by setting IDOP = 1; the exponent on the amplification factor is normally 2 (ref. 2) but can be modified by inputting EDOP. Core suppression can be applied by setting ISUPP = 1 in &SOURCE input or ISUPPR = 1 in &COREDA and supplying a suppression spectrum (CSUPP).

Subroutine TURB

In subroutine TURB the tones and broadband noise produced by the turbine are calculated by the recommended procedure of reference 4 (Krejsa, et al.). The prediction is basically for the last stage of the turbine but, by proper input of parameters, could apply approximately to any one of the low-pressure turbine stages. Inputs of the turbine exit temperature (ATCTUR), fan speed (ARPM), and core weight flow (AWCORE) are required in &PARAM. The turbine rotor relative tip speed (ATURTS) should also be included in the &PARAM input if available. Otherwise, the program estimates TURTS as 0.7 of the rotor tip speed.

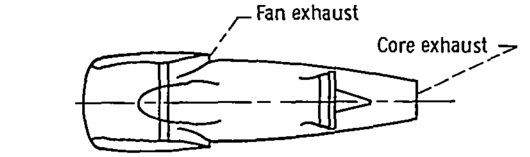
In many cases involving some mixing in the exhaust nozzle, the turbine exit temperature (TCTUR) is not the same as the core nozzle temperature (TC) for jet noise calculations. However, if ATCTUR is omitted in &PARAM, the NOIS subroutine assumes TCTUR = TC for use in the turbine noise prediction.

The turbine rotational speed is obtained from the fan speed (RPM) and the gear ratio between the low-pressure turbine and the fan (GEAR). The levels of the first four harmonics of the rotor blade passing tone are calculated, although some are usually above the frequency range of interest.

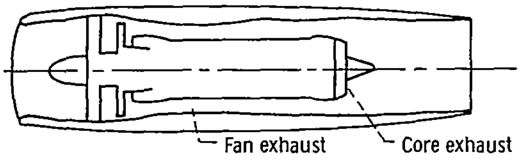
As in subroutine FAN the frequency bands into which the tones are sorted are one-tenth decade rather than one-third octave. When FILBW < 1 in &SOURCE, tones near the band edges are split between adjacent bands by applying a gain factor (FR) (fig. 5). The broadband noise peaks at the center frequency of the band containing the fundamental tone, unless this is above 10 000 hertz. In that case the broadband peak is set at the actual fundamental tone frequency; only the lower frequency side of the spectrum is then of importance in the noise predictions.

The level of the turbine tones is decreased by 10 decibels depending on the type of exhaust configuration (fig. 9). For turbojet configurations, or turbofans with the fan nozzle coplanar with or shorter than the core nozzle exit, set ITYPTB equal to 0 and no adjustment will be made. For turbofans with the fan nozzle extending beyond the core nozzle (such as on the JT8D), set ITYPTB equal to 1 and the tone levels will be decreased by 10 decibels. This adjustment is specified in reference 4.

Particular attention should be given the spacing factor CS as used in this program; it is the ratio in



(a) Short fan nozzle (ITYPTB = 0).



(b) Extended fan nozzle (ITYPTB = 1).

Figure 9. - Types of exhaust nozzle affecting turbine noise levels.

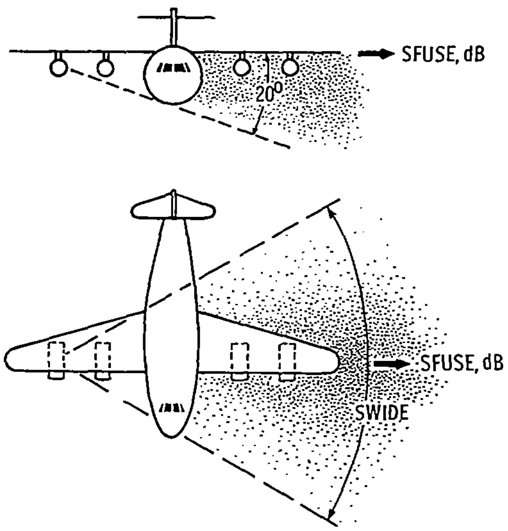
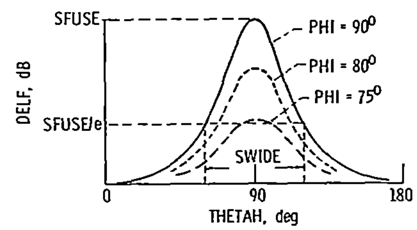
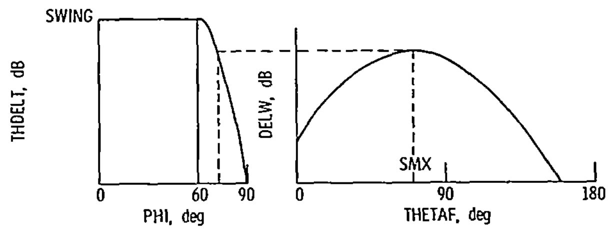


Figure 10. - Region of fuselage-shielding component for approximate shielding calculations.



(a) Fuselage shielding, for PHI > 70°.



(b) Wing shielding, for over-the-wing configuration.

Figure 11. - Approximations used for shielding calculations. Total shielding = DELF for fuselage + DELW for wing.

percent of the axial projection of the upstream stator chord to the axial spacing between the stator and the rotor (100 × c/s in fig. 7 of ref. 4). For most cases, CS in greater than 100 percent.

The exponent on source motion amplification when IDOP = 1 can be modified from its default value of 4 (ref. 4) by inputting EDOP. If turbine noise suppression is desired (ISUPP = 1 or ISUPPR = 1), a suppression spectrum (TSUPP) must be supplied.

The prediction equations and curves of reference 4 include standard-day atmospheric attenuation at a distance of 45.7 meters (150 ft). In TURB the amount of this attenuation is added to the calculated levels to give an output spectrum for free-field "lossless" conditions.

Subroutine SHLD

Subroutine SHLD is a temporary approach for making a shielding correction based separately on shielding by the wings and by the fuselage. This subroutine is not intended as a prescribed method of calculating shielding effects; it only allows the user an option for making some approximate corrections based on his own experience. It is an attenuation approximation in decibels to be applied in certain directions, as a function of frequency. It assumes that only the fan, jet, core, and turbine noise sources can be shielded. This subroutine is called by NOIS or RADIUS.

Fuselage shielding is applied only when the direction (fig. 10) is within 20° of the wingtip direction (PHI > 70°). It maximizes at THETAH = 90° with a user-supplied maximum of SFUSE in decibels. The width of the intense region of shielding can be specified by SWIDE (figs. 10 and 11(a)), defined as the angle, in degrees, over which the fuselage shielding is within 1/e of SFUSE, or SFUSE/2.718... . At low frequencies, when the sound wavelength exceeds a user-supplied characteristic dimension of the fuselage (CFUSE), such as its diameter, the amount of fuselage shielding decreases proportionally to the sound frequency.

Wing shielding approximations apply only in the case of over-the-wing engine installation configurations. Over-the-wing shielding (IUOTW = 1) (fig. 12) varies with the product of two factors dependent on THETAF and PHI as shown in figure 12(b); the user supplies the maximum shielding (SWING) and direction of maximum shielding (SMX). When the sound wavelength exceeds the

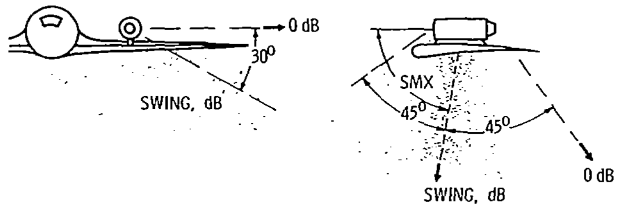


Figure 12. - Regions of wing shielding component for approximate shielding calculations, for over-the-wing configuration only.

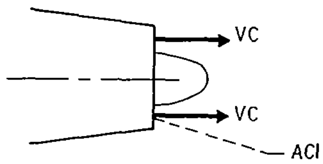
user-supplied wing dimension (CWING), such as its chord, the wing shielding decreases proportionally to the frequency.

Subroutine FLAP

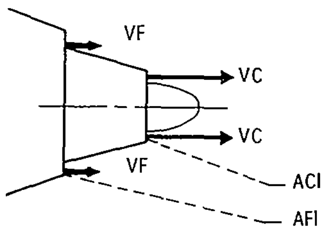
Under-the-wing (UTW) or over-the-wing (OTW) powered-lift noise is calculated by subroutine FLAP, which is based on reference 5 (Dorsch, et al.). This source is sometimes called "jet/flap" noise and includes the noise contribution of the free jet as well as any scrubbing and edge noises. Therefore, when subroutine FLAP is called (IFLAP = 1), subroutine JET should not be used, as the jet noise is already included in the flap noise prediction. The flap noise produced is not axisymmetric and requires angles THETA, THETAF, and PHI from FOOTPR (or RADIUS), where THETAF is the projection of THETA on the plane of PHI = 0° (fig. 4(b)).

This subroutine requires values of core flow exhaust velocity (AVC) in the &PARAM input and, if there is a fan flow, values of the fan nozzle exhaust velocity (AVF).

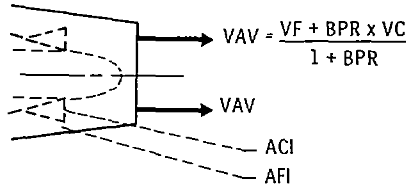
For both UTW (IUOTW = 0) and OTW (IUOTW = 1) cases the overall levels are predicted in the reference direction (THETAF = 90°, PHI = 0°), based on the type of nozzle, the flap angle, and the exhaust velocity. The levels are then modified by appropriate directivity terms. The exhaust velocity used in the calculations depends on the nozzle configuration. For a simple conical nozzle (INOZ = 0)(fig. 13(a)) the exhaust velocity is the average velocity at the nozzle exit; the nozzle area (AC1) is required in the &FLAPDA input. For the unmixed coaxial nozzle (INOZ = 1)(fig. 13(b)) the procedure uses an area-weighted, sixth-power average of the velocities; areas AC1 and AF1 are required input in &FLAPDA. For a mixed-flow exhaust (INOZ = 2)(fig. 13(c)) a bypass-ratio-weighted average velocity is used; in this case the velocities AVC and AVF in &PARAM should be for each stream ideally expanded individually to ambient conditions; AC1, AF1, and the bypass ratio (BPR) are required in &FLAPDA.



(a) Simple conical nozzle.



(b) Coaxial nozzle.



(c) Mixer nozzle.

Figure 13. - Nozzle geometries for flap noise. (BPR = bypass ratio.)

The flap angle (PSYI) is the angle between the wing chord and the trailing flap chord. This angle is entered either as an array PSY in the &TRAJ input when using FOOTPR or as a single input PSYI to the &OPER input when using RADIUS.

The prediction of UTW noise in reference 5 distinguishes between configurations sensitive to the flap angle (PSYI) and those relatively insensitive. The two-flap model configuration of figure 10(a) of reference 5 can be taken as an example of a "sensitive" configuration (INSENS = 0), where the area impinged by the high-velocity exhaust decreases appreciably when the flap angle is reduced from the large value typical of a landing condition to a low value that might represent a typical takeoff condition. In this case the flap angle dependence is given by equation (11) of reference 5. When the impingement area is relatively insensitive to flap angle, as with the three-flap model of figure 10(a) of reference 5, INSENS = 1 in the &FLAPDA input and equation (16) is used for the flap angle dependence.

In the UTW configurations of reference 5 the ratio of wing chord to overall nozzle diameter (WINGD) is roughly 3. For engines with very large bypass ratios, this ratio may be considerably less than 3 so that the wing and flap area impinged by the exhaust flow scales better with nozzle diameter than with nozzle area. An approximate correction for this case can be made by entering a value of WINGD less than 3; a value of WINGD = 2, for example, causes a 1.76-decibel reduction in the predicted levels.

The coefficient BETA for the PHI-angle dependence of the directivity for the UTW configuration (eq. (14) and fig. 14 of ref. 5) changes rapidly near the wingtip direction as originally defined. This programmed prediction uses THETA instead of THETAF for the abscissa of figure 14, because of the anomalies that would be produced by rapid changes in THETAF as THETA and PHI approach 90°. Although this involves a reinterpreting of the directivity data, the changes are not large, and disturbing fluctuations in level in the sideline direction are avoided.

The OTW directivity term with PHI-dependence is modified from that of reference 5 to include data for PHI > 90°. In addition, this term is multiplied by sin(THETA) to eliminate PHI-directivity changes as THETA approaches 0° or 180°.

For the UTW configurations, relative airspeed effects on the source noise level can be obtained by setting IFWD = 1. The coefficient CAY for this effect depends on the flap angle (PSYI) and THETAF and is given by figure 18 of reference 5. No relative airspeed effect is made for the OTW configuration.

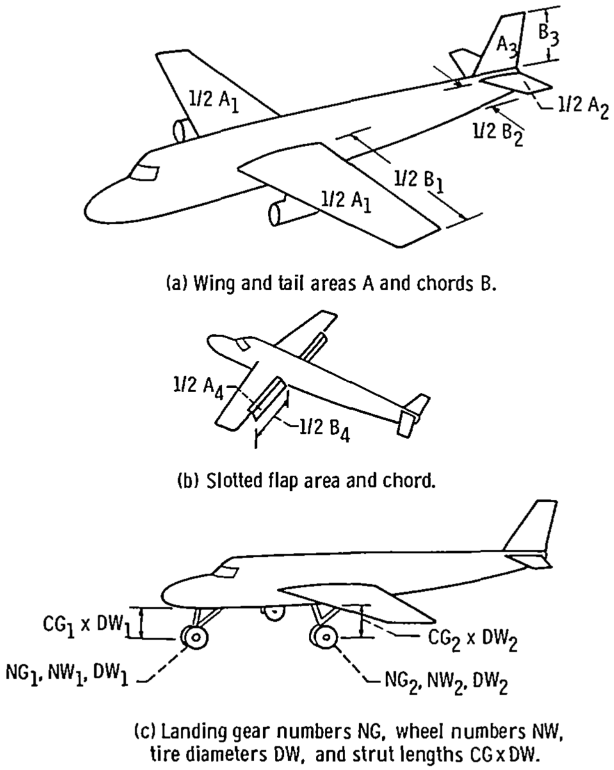


Figure 14. - Airframe noise geometry.

Doppler frequency shift and source motion amplification are made when IDOP = 1. The exponent EDOP for the amplification factor can be modified by the user from the default value of 4.

A suppression spectrum can be applied to the predicted flap noise spectrum by setting ISUPP = 1 or ISUPPR = 1 and supplying the suppression spectrum (FLSUPP).

Subroutine AIRFR

Subroutine AIRFR calculates the airframe noise resulting from airflow over the wing and tail surfaces, over slotted flaps when deflected, over landing gear when deployed, and from leading-edge slats when present (fig. 14). The prediction method is basically that of reference 11 (Fink), but slight modifications are made in constants and slopes as in the ANOP program, Langley Research Center. This subroutine is only a reprogramming of the ANOP program. For input in &AIRFDA the areas and total spans of the wing, horizontal tail, vertical tail, and deflected flaps are grouped as areas A and spans B, each with four dimensions. The span of the vertical tail is simply its height. The landing gear characteristics of number of landing gear (NG), number of wheels per gear (NW), tire diameter of the wheels (DW), and ratio of strut length to tire diameter (CG) are each two-dimensional, with the value of each for the nose gear to be given first, followed by the value of each for the main gear. Inputs of ICLEAN and ITYPW allow for the adjustments for a "clean" configured aircraft and for a delta or conventional type of wing.

Choices of the type of sources to be included can be indicated by inputs of IWING, IFL, ISLAT, and ILG. Rather than a single choice for landing gear noise (ILG), values of ILGR can be entered in the &TRAJ input to FOOTPR, so that the gear can be lowered or raised during the flight. For the slotted-flap aerodynamic noise, values of the flap angle (FLAPA) must also be entered in &TRAJ. All source frequencies will be Doppler shifted if IDOP = 1; source motion amplification is part of the prediction, so no additional FDOP factor is provided for.

Function Subroutine AIRATT

Function subroutine AIRATT calculates atmospheric attenuation of noise according to reference 12 (ARP 866). The program is an adaptation of one written by Dr. Frank Montegani of Lewis Research Center (ref. 13). It assumes that the attenuation of noise in a frequency band is the same as the attenuation of a pure tone at the center frequency of that band. It is called by NOIS or RADIUS when IATM = 1.

Subroutine ATMB

Subroutine ATMB calculates the atmospheric attenuation of a pure tone by using the method of reference 14 (Bass and Shields). It is called by the subroutine BASAT for band attenuation. Results from this attenuation prediction procedure are more accurate at high frequencies and long distances than those from reference 12. The programming of reference 15 is modified for use here.

Subroutine BASAT

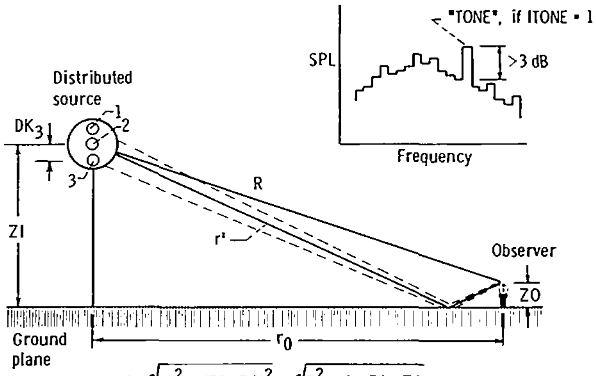
Subroutine BASAT is a general procedure for adding or removing the effect of atmospheric attenuation on a fractional-octave-band spectrum. Approximations are made for the effect of the spectrum gradient in the region of the band being considered. This procedure, rather than ARP 866 (ref. 12), is used for calculating atmospheric attenuation in each band when IATM = 2. This subroutine is called by either NOIS or RADIUS. Programming is an adaptation of that detailed in reference 15.

Subroutine EGAC

Subroutine EGAC is adapted from reference 16 (Boeing), which includes a procedure for extra ground attenuation calculation based on the prediction by SAE AIR 923 (ref. 17) for turbulent scattering of noise (downwind direction). The program interpolates for two factors based on the distance R and elevation angle (VIEW) (fig. 4(a)). The predicted attenuation diminishes to zero at VIEW = 45°. This subroutine is called by NOIS or RADIUS when IEGA = 1.

Subroutine GNDRFL

Subroutine GNDRFL, which calculates the modifications to the spectrum due to ground reflection (fig. 15), is based on reference 18 (Putnam). Broadband noise is treated as white noise, and tone effects will be included if ITONE = 1; an individual spectrum band is then treated as a tone if it protrudes above the surrounding bands by 3 decibels or more. A distributed noise source can be approximated as (NS) discrete sources at several heights (DK) relative to the source center. The ground characteristics are given in terms of its reflectivity (QABS) and the phase shift (FSHIFT) of the reflected sound waves, both as a function of frequency. This subroutine is called by NOIS or RADIUS when IGND = 2.



$$r' = \sqrt{r_0^2 + (ZI + ZO)^2} = \sqrt{R^2 + 4 * ZI * ZO}$$
$$Z' = r'/R = \sqrt{1 + 4 * ZI * ZO/R^2}$$
$$\Delta r = r' - R = R\,(z' - 1)$$

Figure 15. - Geometry of ground reflections.

Function Subroutine PERNOY

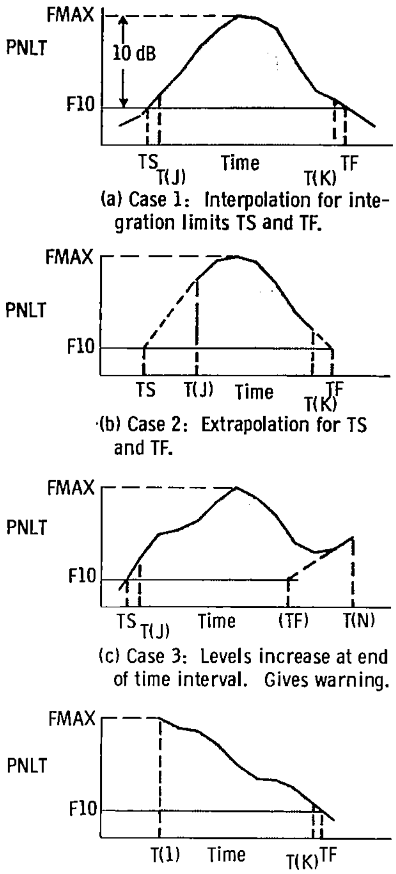
Function subroutine PERNOY calculates the perceived noise levels (PNL) from the individual spectra and the total noise spectrum by ARP 865A (ref. 19). It contains a warning if any of the spectrum band levels exceed 150 decibels, which is the upper limit of the procedure. This subroutine is called by each individual noise source subroutine and by NOIS or RADIUS for the total noise.

Function Subroutine TONE

Function subroutine TONE calculates the tone correction to PNL to give PNLT. This is a programmed version of the procedure of FAR 36 (ref. 20). Note that this March 1978 version omits the cutoff at F = 3 of the 1969 version. This subroutine is called by each individual noise source subroutine and by NOIS or RADIUS for the total noise. Pseudotones may be introduced into the spectrum when ground reflections (IGND = 2) are included; no provision is made for eliminating these as contributors to the tone correction.

Function Subroutine EPNL

Function subroutine EPNL integrates the time history of PNLT for effective perceived noise level, as defined by FAR 36 (ref. 20). It assumes that PNLT varies linearly between calculated points (fig. 16). The procedure integrates by Simpson's rule over observer times TAU (resulting from the user's choice of time increment (TD) in &GEOM), rather than summing ½-second contributions. It should be noted that TD must be chosen small enough to adequately describe the noise time history near the peak. The



(a) Case 1: Interpolation for integration limits TS and TF.

(b) Case 2: Extrapolation for TS and TF.

(c) Case 3: Levels increase at end of time interval. Gives warning.

(d) Case 4: Maximum level occurs at start, inadequate time history. Gives warning and doubles integral.

Figure 16. - Time history integrations for EPNL (effective perceived noise levels).

integration is made between the interpolated times TS and TF, between which the level is 10 decibels or less below the maximum (fig. 16(a)). When the first or last point is less than 10 decibels below the maximum PNLT, a straight-line extrapolation is made to the 10-decibels-down point for purposes of integration (fig. 16(b)). Occasionally the time history levels show an upturn at the start or end of the time interval, so that the extrapolated starting or final time (TS or TF) would be erroneous (fig. 16(c)); in this case the extrapolated time is ignored and a warning is issued. If the user has chosen an insufficient time span, so that either the first or last calculated point results in the maximum PNLT, the program gives a warning message and makes an approximation by doubling the area of the integrated history (fig. 16(d)). This function subroutine is called by FOOTPR when either IOUT(2) or IOUT(3) equals 3.

Subroutine TERP

Subroutine TERP is a general linear interpolation routine devised for this program. It extrapolates linearly outside its range; it can handle interpolation for F as a function of three independent variables (F = f(A,B,C)), where A is an array of abscissa values common to each of the curves in B and C and B is a set of curves for each value of C, with the same number of B curves for each C (fig. 17). Values of A, B, and C must each be in ascending order. This procedure first calls SERCH to find the coordinates of the nearest lower values of A, B, and C.

Subroutine SERCH

Subroutine SERCH finds the interval in which an independent variable falls within a given set of values and calculates the position within that interval for interpolation purposes. It is called repeatedly for the independent variables used in TERP. The search procedure assumes that the independent variable array is in ascending order.

Outline of Programs

The main programs and their subroutines are outlined in this section. General flow diagrams for main programs FOOTPR and RADIUS are given in figure 1. A checklist of input requirements and a complete list and description of the input variables are given in tables II and III.

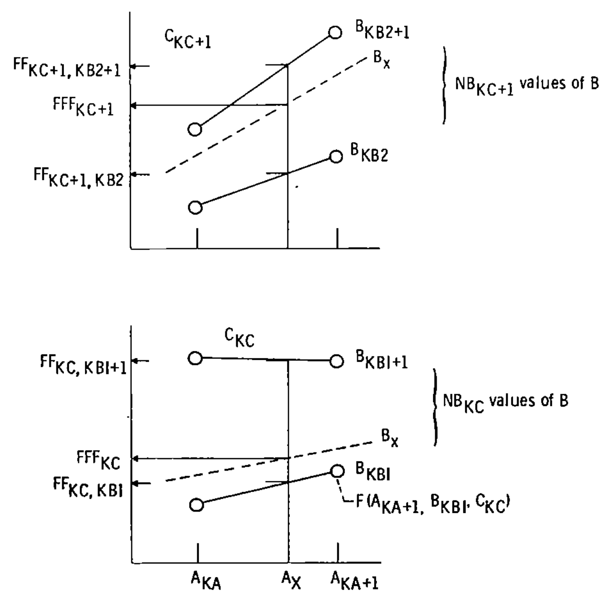


Figure 17. - Scheme for linear interpolation routines TERP and SERCH to find $F(A_X, B_X, C_X)$, where $F = F(A, B, C)$. Symbols correspond to variables in program listing.

Main Program FOOTPR

Trajectories: up to 50 points each allowed for aircraft path and status description; coordinates XA, YA, ZA; engine attack angles ALF1; bank angles GAM; velocities VA; flap angles PSY (for powered lift) and FLAPA (for airframe noise); engine performance (thrust or speed) levels EPP; and ILGR and IREVR for landing gear down or reverser deployed. When ICPA = 1, the first trajectory point (XA(1),YA(1),ZA(1)) must occur prior to the closest point of approach to any observer points (XO,YO,ZO).

Observers: up to 20 points each for observer ground coordinates XO and YO; one value of observer altitude ZO.

Noise sources: fan (inlet and exhaust), jet, core (combustion), turbine, flap (under or over the wing), airframe (wing, tail, flaps, landing gear, and leading-edge slats). Simple suppression spectra may be applied to each engine source level.

Frequency bands: one-tenth decade (approx one-third octave), 50 to 10 000 hertz for all calculations.

Propagation effects: atmospheric attenuation (by ARP 866 or Bass and Shields), extra ground attenuation (in simplified symmetric form used in Boeing program), ground reflection (+3 dB or Putnam prediction), simple shielding (of fan, jet, core, and turbine). These propagation effects are applied only to total noise values, not to individual sources.

Time history: specified by NT and TD for the number of time increments desired and the time interval between them, starting with TSTART. These points are interpolated along a flight path defined by XA, YA, and ZA. WHEN ICPA = 1 the middle point occurs at the closest point of approach of the aircraft to the observer. When ICPA = 0 the first point coincides with the first trajectory point.

Outputs available: controlled by IOUT for individual and total spectra and/or OASPL, PNL, and PNLT at each point in time; PNL-max, PNLT-max, or EPNL at each observer point; and coordinates of chosen contours. The output is preceded by a "COMENT" of the user's choice, and (optionally) by a summary of the observer grid and aircraft trajectory inputs.

Subroutines to FOOTPR

NOIS: called by FOOTPR; interpolates on engine performance level for noise parameters; calls noise source programs; applies atmospheric absorption, extra ground attenuation, ground reflection, and shielding corrections to totals.

FAN: called by NOIS; calculates inlet and exhaust fan noise levels, as spectra, OASPL, PNL, and PNLT; all are free-field values at the specified distance R with no atmospheric attenuation.

JET: called by NOIS; calculates jet noise levels (omit if calling FLAP).

CORE: called by NOIS; calculates low-frequency combustion noise levels.

TURB: called by NOIS; calculates turbine noise levels.

FLAP: called by NOIS; calculates OTW or UTW powered-lift noise levels (includes noise from jet).

AIRFR: called by NOIS; calculates airframe noise (by Fink and ANOP-Langley).

Function PERNOY: called by NOIS and source subroutines; for perceived noise.

Function TONE: called by NOIS and source subroutines; for tone correction.

Function EPNL: called by FOOTPR; for EPNL from time history of PNLT.

Function AIRATT: called by NOIS; for atmospheric absorption correction (by ARP 866).

BASAT and ATMB: called by NOIS; for atmospheric attenuation by Bass and Shields and by Montegani.

EGAC: called by NOIS; for extra ground attenuation correction as function of elevation angle (Boeing).

GNDRFL: called by NOIS; for ground reflection as white noise or tone (by Putnam).

SHLD: called by NOIS; for approximate shielding of total of fan, jet, core, and turbine noise.

TERP: called by most subroutines; a linear interpolation routine.

SERCH: called by TERP; routine to find nearest points in interpolation.

Main Program RADIUS

Up to 20 values of THETA and 10 of PHI to specify microphone or observer locations at constant radius R.

Aerodynamic parameters that vary with engine speed are interpolated from an array of values as a function of engine performance setting EPP.

For each source, the output consists of arrays of free-field, one-third-octave SPL values as a function of frequency and angle in the usual format, with OASPL, PNL, and PNLT given for each angle. Each page is titled by a "COMENT" of the users choice and the variables input to each source prediction. The final output is the SPL array for the total of the sources, modified for atmospheric attenuation, extra ground attenuation, and ground reflection as specified by the user. (This final output may be rejected by setting ITOT = 0 in the &SOURCE input).

Programs for subroutines to RADIUS: FAN, JET, CORE, TURB, FLAP, AIRFR, GNDRFL, SHLD, function PERNOY, function TONE, function AIRATT, BASAT and ATMB, EGAC, TERP, and SERCH. Note that subroutines NOIS and EPNL are not used.

Inputs to Main Programs and Subroutines

All data read in for program variables is in namelisted form, except for the first title line, so that order within each set is arbitrary and omissions can be made. Each main and subroutine program for noise sources (and for shielding and ground reflection) has one or more namelist block under which input variable values for that program can be read. A checklist of these input data blocks is given in table II. In table III each main program and subroutine requiring inputs is listed, including the names of the input dataset blocks, and followed by all the variables that can be entered in each block. The maximum number of values that can be entered for each variable is given as its "dimension"; each variable is briefly defined and the prescribed SI and U.S. customary units are listed. Many variables are preassigned default values for the convenience of the user; no input is necessary if the default value is acceptable. These default values correspond to typical values in U.S. customary units. If the user has specified input in SI units (UNITS = 2HSI), the default values may be in error or inappropriate. For some inputs the condition or subroutine for which the input variable is required is also given.

Example One

To illustrate the format of the inputs, several examples are shown in table IV. The order of inputs within any block is immaterial, but the blocks must occur in the order in which they are read, as shown. The first case is for calculation of the noise exposure at six observer stations on the ground (defaults are NYO = 2, YO = 500 and 1000). The aircraft flies an approach path defined by three points in XA, YA, and ZA. Angle of attack, velocity, engine operating level, and flap settings are defined at each point. Note that the engine and flap settings change at the moment of touchdown. The aircraft comes to a stop at XA = 1500 feet. The user wishes the calculations to span 11 seconds, at 1-second intervals, and asks for a geometry printout (IGEOM = 1) at each point. The ambient conditions are nonstandard as shown. The aircraft has four engines and is assumed to generate fan, core, turbine, and flap noise. For this particular calculation, no Doppler frequency shift or source motion amplification is requested (by default). The user wishes to make corrections to the totals of the source noises by a constant 3-decibel addition for ground reflection and for atmospheric attenuation by the method of ARP 866. The printout option IOUT is triggered to print out each source and the total spectra at each point, followed by the maximum PNL at each observer point.

The needed engine-related parameters are supplied at seven engine operating conditions. Note that values of fan exhaust temperature (ATF) are included in this engine map although required only for jet noise calculations, which are omitted here; the extra variable that will be read in will do no harm here. Because the user has set ICORR = 1, this engine map will be treated as values for a standard operating day (288.17 K or 518.7° R and 101.29 kN/m^2 or 2116 lb/ft^2 pressure) and will be corrected to the non-standard-day conditions by the usual pressure and temperature factors. Correction of the core temperatures after combustion is not straightforward, and the user has chosen to correct these (T4 and TC) by the ambient air temperature ratio to the 1.022 power.

With the default values the user accepts in the fan data input, the fan is single stage with no inlet guide vanes. Flight conditions are such that there is negligible inlet flow distortion to the fan. Although the user might have chosen for the over-the-wing aircraft to reject the noise from the fan exhaust duct by setting IEXH = 0, he accepts the default of IEXH = 2 and includes the fan exhaust contribution. Since fan pressure ratio (AFPR) rather than fan temperature rise (ADELT) was supplied in the engine map, a value of FANEFF is necessary in the fan data for calculating DELT.

Note that data are supplied for calculating jet noise, although they are not used in this particular calculation. The program ignores this line of data in reading inputs.

The core noise prediction input calls for the modified level prediction of reference 10. Hence, a value of DTEMD, the design temperature drop across the complete turbine, must be included. The turbine noise input includes the stator-chord-to-stator-rotor axial spacing of 700 percent. The turbine rpm is derived from the fan RPM and the gear ratio (GEAR) of 2.302. The indicator ITYPTB = 1 informs the program that a 10-decibel decrease in turbine noise level is called for since the core exhaust from the turbine is upstream of the fan nozzle (see the section Subroutine TURB).

Data are supplied for making a shielding correction, although no correction has been called for. The program ignores this line of input. The shielding input calls for an over-the-wing case, with a maximum fuselage shielding of 3 decibels in the direction of the wingtip, a shadow zone approximately 60° wide, and a maximum of 5 decibels wing shielding at 80° from the inlet in the plane below the aircraft. The default values for fuselage and wing dimensions affecting shielding are both 10 feet so that wavelengths greater than 10 feet would be shielded less.

The flap noise prediction calls for an over-the-wing case with a mixed nozzle exhaust flow from a bypass ratio of 6:1. Forward-velocity effects on the levels at the source are to be included.

The printout for this example is shown in table V and is discussed later. Other printout options are available by choice of IOUT; these are illustrated in succeeding examples and in table XI.

Example Two

The inputs for this example are abbreviated, assuming that the calculations for this example follow the calculations of Example One without unloading the program. Hence, any parameters omitted in this example will remain the same as in Example One. Six observer stations are defined alongside the takeoff path of the aircraft. The aircraft ground roll commences at XA = 0, with liftoff at XA = 1500 feet at a velocity of 148.6 feet per second. Engine power and flap settings remain constant throughout the takeoff. The number of time increments is increased to 21. Geometric information is requested at each point, but only overall levels (rather than spectra) are desired for each source. Following this history, the maximum PNLT at each observer point will be given. Note that each namelist input block must be supplied, but no input variables are given where no change is made from Example One. Program output from this example is shown in table VI and is discussed later.

Example Three

The landing and takeoff calculations of Examples One and Two are combined here for one observer point at XO = −2000 feet and YO = 500 feet. The inputs again assume that the program has not been unloaded since the calculations of Example One. The aircraft is assumed to go from landing settings and velocity to full takeoff power at touchdown, accelerating to the takeoff velocity at XA = 1500 feet. Figure 18 is a graph of the aircraft geometry and power settings. By choice of IOUT the output will give only the total corrected noise at each calculation point. This example is included to illustrate a caution to the user. Note that the number of time intervals has been increased to 41; the need for this longer time history is discussed later. Program output is shown in table VII.

Example Four

In this example engine noise levels are predicted for comparison with acoustic test stand measurements using the program RADIUS. The program-supplied default values for observer positions happen to correspond to all the microphone locations for the test data, so that &GEOMT requires no input. The experimental data were corrected to "lossless" (no atmospheric attenuation) values, so that &AMB requires no input. No powered-lift flaps were used in this series of tests, so a jet noise prediction is called for (IJET = 1) rather than flap noise as in Example One. By using the default value for IATM, no atmospheric attenuation is applied. The engine characteristics for &PARAM are the same as those for Example One.

Program RADIUS requires &OPER input for each engine condition desired. Note that the first &OPER input is read before the source input data are read. The second operating condition (and any subsequent conditions) is read after the source inputs. Values of VI and PSYI are read in but are not used.

The fan source input (&FANDA) is the same as for Example One, except that, because inlet flow distortion occurs in these ground tests, IFD = 1. Fan

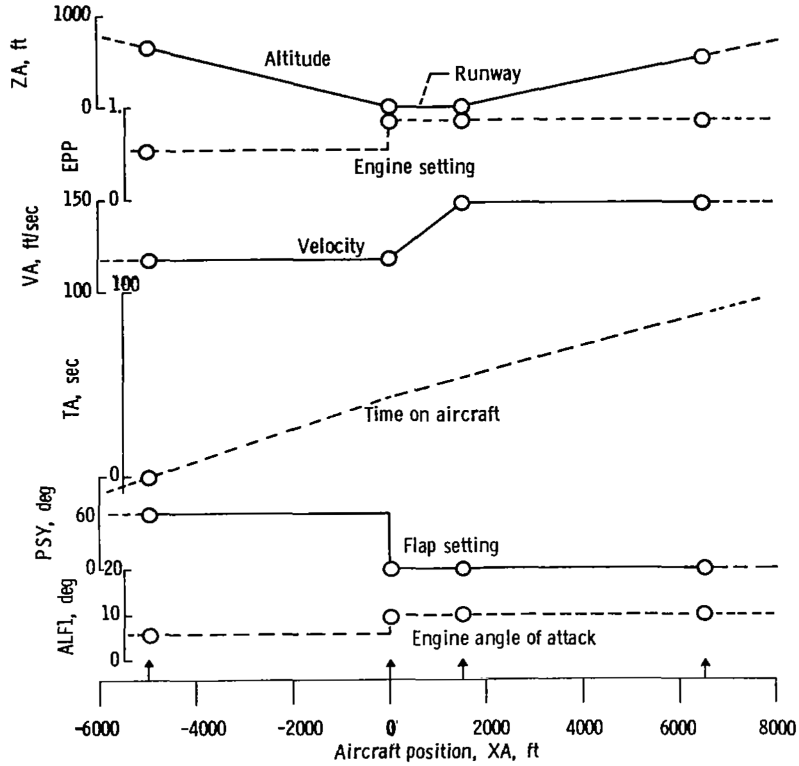


Figure 18. - Flight geometry of example three.

inlet and exhaust suppression spectra are supplied here, but are not used, since ISUPPR = 0. The input of ISUPPR here is unnecessary since the &SOURCE input accepts the default value of ISUPP = 0.

The jet noise input (&JETDA) calls for a coaxial nozzle calculation (INOZ = 1), with values supplied for the core gas parameters GAMMAC and GASRC. If values of the fuel flow rate (AFUEL) had been supplied in &PARAM, GAMMAC and GASRC could have been omitted here and would have been calculated in the jet noise subroutine.

The inputs for core, turbine, and flap noise subroutines are the same as those in Example One, although the flap noise inputs (&FLAPDA) are ignored in this example.

Example Five

In this example the aircraft noise is calculated for a single observer during an aircraft approach to the landing point. The aircraft is at 394 feet altitude as it flies over the observer at 7518 feet before touchdown. The aircraft angle of attack (ALF1) is 8.83° above its flight path, or 5.83° above horizontal, since the flight path represents a 3° glide slope. Slotted flaps and landing gear are deployed throughout the approach, and engine power and aircraft velocity are constant. Noise levels will be calculated 21 times (default value) at 0.5-second intervals. The input value for UNITS could have been omitted here but is included for illustration. The value is alphanumeric and is read in the Hollerith convention (as 3HENG or 2HSI).

The aircraft has three engines generating fan, jet, core, and turbine noise. Airframe noise is also expected to be a contributor. Doppler frequency shift and source motion amplification will be applied as well as a simple ground reflection correction of 3 decibels. Atmospheric attenuation will be calculated by the methods of references 14 and 15. Suppression will be applied when suppression spectra are given (fan inlet and exhaust and turbine). Source spectra will be printed at each time, and EPNL will be calculated for the single observer point.

Engine characteristics are given at approach and takeoff power settings. In this case no interpolation is required. Note that no values are given for the fan stream exhaust velocity or temperature. The exhaust nozzle is assumed to fully mix fan and core streams, and AVC and ATC represent the mixed values. This requires that separate values be supplied for the turbine exhaust temperatures (ATCTUR) for the prediction of turbine noise. Values of AFUEL are given, although they are not used since AT4 values are included and GAMMAC and GASRC are given later.

The jet noise input accepts the default value of INOZ = 0 for a simple nozzle. This is chosen to be compatible with the mixed values used for AVC and ATC. GAMMAC and GASRC are also mixed-flow values. The total mixed flow exhaust area is given for AC.

The aircraft has a total wing area of 4007.6 square feet and a wing span of 200.19 feet. The total horizontal tail area is 927.82 square feet with a total span of 68.11 feet; the vertical tail area is 577 square feet with a height (span) of 29.45 feet. There are two slotted flaps (default NF = 2) with a total area of 880.5 square feet and total span of 108.4 feet (fig. 14). There is a single nose landing gear with two wheels 2.925 feet in diameter. The two main landing gear each have four wheels 4.17 feet in diameter. The ratios of strut length to wheel diameter are 3.93 for the nose gear and 3.46 for the main gear (i.e., the nose strut is 11.5 ft long and the main gear struts are 14.4 ft long). The calculation is for an aerodynamically clean aircraft; so ICLEAN = 0. Setting IWING = 1 causes the wing and the horizontal and vertical tail trailing-edge noise to be included, and IFL = 1 adds the slotted-flap noise for flaps at the angles specified during the flight in &TRAJ. There are no leading-edge slats.

Example Six

This example shows the additional inputs required for a footprint contour calculation for the aircraft landing of Example One. A single contour of 90 EPNL is called for, in the form of Y coordinates at 11 values of XO. The extremes of these XO values were selected from preliminary calculations of EPNL at various points under the flight path (at YO = 0) to find the approximate terminations of the footprint contour. To give an adequate time history for each EPNL calculation, NT was set at 21.

When the aircraft has decelerated to a stop at XA = 1500 feet, the calculated EPNL will go to infinity unless the engine operating level is reduced to such a point that the PNLT is more than 10 decibels below the maximum. To enable extrapolation to such low settings, engine performance is defined artificially at EPP = 0. At the XA = 1500 foot point, the operating level is set to a somewhat arbitrary low level of 3 percent.

Samples of Output

The complete calculated outputs from input Examples One through Six are given in tables V through X, respectively. Brief portions of the output derived from these same examples modified as to requested output (IOUT) are given in table XI. Detailed discussion of these output examples follows.

Example One

This output (table V) has the one-line title chosen by the user. A summary of the observer coordinates and of the aircraft trajectory points and flight conditions then follows. This summary of inputs can be turned on or off by choice of ITITLE (default ITITLE = 1). The next three lines are the titling and values for the first point in response to IGEOM = 1. Subsequent points only include numerical values as on the third line. The values given represent the interval number (KI), the aircraft position (XI, YI, ZI), the aircraft-observer geometry (R, THETA, THETAF, PHI), the time at the aircraft and corresponding arrival time at the observer (TI and TAU), the engine power setting (EPPI), and the aircraft velocity (VI). Although this line of information is redundant or peripheral to the noise calculations, these values can be of help in tracing the flight history, especially with a complicated geometry or in troubleshooting. The following line prepares the reader for the individual spectra at the frequencies listed on the next two lines.

At each time interval a summary of the observer location, observer time (TAU), and aircraft location in terms of radius (R) and angle (THETA) is given in a single line. Each source spectrum then follows in a two-line format corresponding to the previously listed frequencies. Values of OASPL, PNL, and PNLT for each individual source are also given. Remember that each individual spectrum is unmodified for any propagation losses specified. The total noise spectrum (on the last two lines following the source spectra) represents the sum of the individual sources, with all the appropriate corrections included—in this case, atmospheric attenuation and simple ground reflection. If shielding had been called for, the total spectrum would include the effects of shielding the fan, core, and turbine sources.

Succeeding time interval outputs include the new geometric output line for IGEOM = 1, the line for the general location description at the new time, and lines for the individual and total spectra. For the first observer point the aircraft proceeds from an initial point at TAU = 21.6 seconds, where R = 817.0 feet and THETA = 46.7°, to the closest point of approach at 26.4 seconds, where R = 564.1 feet and THETA = 92.8°, and ends at 31.6 seconds with R = 817.0 feet and THETA = 138.8°. A longer history and a greater range in THETA could be obtained by increasing either the number (NT) or size (TD) of the time intervals. Similar time histories are generated for each position of the observer.

It is apparent for the first observer point and first time interval that fan noise is the primary contributor to the total PNLT, although flap noise is predominant at the low frequencies and is the stronger contributor to OASPL. The total OASPL is 3.6 decibels above the flap noise OASPL, 3 decibels of which is due to the ground reflection. Total PNLT is only 0.8 decibel above that from the fan alone, although 3 decibels are also added here by the ground reflection. Although the unattenuated high-frequency harmonics from the fan are strong, atmospheric attenuation causes the total spectrum to fall off rapidly as the frequency approaches 10 kilohertz. The user is cautioned that simply comparing individual source PNLT may lead to incorrect conclusions in determining the controlling source at large distances, since the individual source levels include no atmospheric attenuation. Low-frequency sources, such as flap noise in this case, will assume increasing importance as distance and atmospheric attenuation increase.

The combined effects of source directivity and changing distance can be observed for each source as the aircraft flies past the observer points. In this particular example, changes in R with time produce changes in source levels of 3.2 decibels at the most, so that the prevailing influence on the source histories is their own directivity.

After the output of the spectra at each time and observer location, the program prints the maximum level of PNL for the total noise source at each XO,YO location of the observer points. Maximum PNLT or EPNL would have been given if the input specified other values for IOUT(2). Identification of the maxima is helped by also printing out the angles (THETA) and times (TAU) when the maxima occurred for each observer point. For the first two observer points at a sideline distance (YO) of 1000 feet, these maxima occur near the end of the time history, indicating that a longer time history is desirable. For the first two 500-foot sideline locations also, the last point is only 3 to 4 decibels below the maximum PNL. For calculation of a valid EPNL at these locations a longer history would be recommended.

The noise histories at the last two observer locations (XO = 0 and YO = 500 and 1000) show the effect of the engine power cutback at touchdown. The fan and flap noise levels drop dramatically, but the turbine noise drops only slightly. Regarding the turbine noise, it is interesting that there are no tones in the spectra and no tone corrections (PNL = PNLT) before cutback; but, when the turbine speed drops, tones appear in the spectra at 3162 and 6309 hertz that are sufficient to give a tone correction of about 3.5 decibels.

Example Two

The output from Example Two is shown in table VI. It is for an aircraft takeoff after a 1500-foot accelerating roll on the runway. The initial portion of this output is in the same form as the output from Example One, except for the summary. The engine power is constant before and after liftoff, and the aircraft velocity increases at constant acceleration until the specified VA of 148.6 feet per second at liftoff. This acceleration can be seen in the VI values listed in the geometry information.

Since IOUT(1) = 2 for this case, overall levels are given for the individual sources instead of spectra. Titles above the source noise levels are modified from those of the previous case. Here the observer coordinates and time (XO, YO, and TAU) are identified along with the noise level quantities. The reader is reminded that the individual levels do not include ground reflections or atmospheric attenuation. Hence the levels for fan noise alone can exceed the total levels, as in the first three time increments shown.

Because of the angle of climb and angle of attack of the aircraft, when the aircraft has passed the observer, the observer is able to "see" the upper surface of the wing and flaps (THETAF > 180°). Although the first part of each time history is dominated by fan noise, the last few points are dominated by the flap noise, which increases dramatically in directions above the wing for an over-the-wing configuration.

Specification of IOUT(2) = 2 causes the summary information with the values of maximum PNLT to be given at the end. By comparing these maxima with the individual source histories, it can be seen that for this case the flap noise component is the primary noise contributor at all the maxima except at XO = 3500, YO = 500, where the fan noise dominates.

Even though NT was increased from 11 for Example One to 21 for this example, at some observer points the last level given in the history is only a few decibels below the maximum. Calculation of EPNL from the time histories in these cases might be quite inaccurate because of the long extrapolation involved in approximating the 10-decibel-down point.

Example Three

The output for Example Three (table VII) is for a combined landing and takeoff similar to Examples One and Two. The flight history is described in detail in the discussion of the sample inputs. This example is included to illustrate the care that must be exercised when a large power-level change occurs at some point in the aircraft flight. By referring to figure 18, it is evident that the increase in power setting does not occur until 42.7 seconds into the flight (landing and takeoff). The resultant increase in noise level will be sensed later at the observer point, depending on the distance from the aircraft when the change occurs. The printout shows that by the 38th point in the time history the power level has changed and that the specified observer will hear it almost 2 seconds later. The total noise PNLT jumps by over 17 decibels and exceeds the previous maximum PNLT by 3.5 decibels. If the number of specified time increments (NT) had been 33 or less, the time history for this observer would have omitted this loudest portion, and the calculated maximum and time weighting factor (if used for EPNL) would have been in serious error.

This example also illustrates the output when IOUT(1) = 3. Only the noise totals, modified by specified propagation effects, are listed at each time increment.

Example Four

The output in table VIII shows the use of RADIUS, in place of FOOTPR and NOIS, to calculate predicted noise levels at a constant radius from the source at angles chosen by the user. As can be seen from the format, this output is similar to typical printouts for the acoustic measurements from static ground tests. A page is devoted to each source component, given as free-field unattenuated values, followed by a page for the total of the sources, including any propagation corrections. This sequence of pages is repeated for each engine operating condition (EPPI) requested.

For sources that are not axisymmetric (powered-lift flap noise and airframe noise), these source levels will be calculated and printed out on separate pages for each azimuthal angle (PHI) requested.

Each page begins with four heading lines for the title, engine operating condition, source identity, and number of engines, radius, and azimuthal angle. When ITITLE = 1, several lines then give the important parameters used in the prediction. These values have been either entered by the user (in &PARAM or individual source input) or are default or calculated values. For example, in the fan noise input, values of fan pressure ratio (AFPR) rather than temperature rise (ADELT) were supplied in &PARAM. From the interpolated value of FPR = 1.054 (at EPPI = 37.78) and the fan efficiency (FANEFF = 0.84), a temperature rise DELT of 9.4° R is calculated in the fan noise subroutine and is shown in the list of input parameters. It is well for the user to check these input values to insure that no unintended omissions or defaults are entered in the calculation.

In addition to the spectrum at each THETA, the OASPL, PNL, and PNLT for each spectrum are calculated and printed near the bottom of each page. The OASPL values represent only the summation of the SPL values for the frequencies given (50 Hz to 10 kHz). Hence, in cases where the spectral energy maximizes near the high or low end of the frequency spectrum, there may be an appreciable difference between these listed OASPL values and the overall levels calculated within each source subroutine prior to generating a spectrum.

The power spectrum is calculated by assuming an axisymmetrical source and is shown in the last column of printout. The total acoustic power appears in the same column at the end of the OASPL line. The total acoustic power predicted from the fan at EPPI = 37.78 in this example is 132.9 decibels (ref. 0.1 pW).

Example Five

The output in table IX illustrates the use of FOOTPR with airframe noise included as a source. There is only one observer point; it is located under the path of the aircraft as it makes an approach. A total of 10 seconds of time history is used for calculating the EPNL. For this example, airframe noise is shown to be a minor contributor compared with the suppressed fan noise for most of the history. The total noise levels in PNLT go from 91.5 decibels to a maximum of 103.9 decibels and back down to 80.1 decibels, giving adequate range for a good EPNL calculation. The summary shows an EPNL of 97.6 decibels at the observer, with the maximum levels occurring at TAU = 0.96 second (rounded to 1.0 sec in the history) and THETA = 115°.

Example Six

In table X the results of the contour calculation using the Example Six inputs are shown. For illustration of the convergence to the Y coordinate of the contour, IOUT(1) was set to 3 for those portions of the calculations when XO was −7000 and 1000 feet. Notice that at −7000 feet, two iterations were required to obtain a calculated EPNL of 90 decibels (±0.1 dB) at a Y coordinate of about 366 feet. At XO = 1000, only one iteration was required to arrive at the contour coordinate of about 447 feet.

The normal output for IOUT = 0,3,3 is shown beginning with the repeat of the title line. The EPNL values at the two (by default) sideline distances are then given at each XO position. Also included are the angles (THETA) and observer times (TAU) when the maximum PNLT occurred.

The 90-EPNL-contour coordinates are then listed and the approximate area in square feet, acres, and square miles. Because of the reduced power when the aircraft touches down and the near shutdown of the engines at XA = 1500 feet, the footprint closes just shortly beyond the end of the aircraft roll. The first and last XO points (at −7500 and 1600 ft) for this contour calculation were selected after trial calculations for the EPNL at YO = 0 and XO = −8000, −7500, 1550, 1600, and 1700 feet. If coordinates had been requested at XO values less than about −7500 feet or greater than about 1600 feet, the program would not have been able to obtain a successful convergence.

Illustrations of Printout Options

Some of the output choices available to the user are shown in table XI; the basic inputs from Examples One and Six are used and the IOUT output controls are varied. Table III specifies the input values of IOUT, IGEOM, and ITOT to exercise various output options. For the examples discussed in this section, IGEOM = 0 and ITOT = 1.

The output resulting from IOUT(1) = 1 is also demonstrated in the Output from Example One (table V). Detailed spectra are given from each source and for the total at each time increment. The program equates JOUT in each noise source subroutine with IOUT(1). Various selections of source outputs can be made by using IOUT(1) and ITOT and giving JOUT inputs to each source. For example, by setting IOUT(1) = 0 and then inputting JOUT = 1 in a particular source input, the spectrum of only that source will be given at each time increment. By setting IOUT(1) = 1, but JOUT = 0 for all individual noise source inputs, only the spectra for the total noise will be given.

The effects of setting IGEOM = 0 (or omitting IGEOM) and ITITLE = 0 are shown by comparing table XI to table V; the lines of geometric information are omitted, and there is no initial printout of the observer and trajectory coordinates. When IOUT(1) = 2, only the summary information of OASPL, PNL, and PNLT is shown for each source and the total at each time increment. Notice that these values are the same as those in the more detailed printout in table V. This level of output is useful when there are no problems concerning the spectra or when the user has already satisfied himself concerning the spectra in previous calculations.

When IOUT(1) = 3, the next sample in table XI shows just the OASPL, PNL, and PNLT histories for the total of the noise sources, modified for the propagation losses specified. This total history may be adequate when an EPNL calculation is being made and the user wishes to check the time history being integrated into EPNL.

When IOUT(1) = 0, all time history information is omitted in the printout, and only the maximum levels are given for each observer, along with the angle and time when each maximum occurred.

Corresponding outputs when IOUT(2) equals 1, 2, or 3 are shown next in table XI. The values of PNL-max and PNLT-max are the maxima of those shown in table V. The angles THETA and the times indicate where the maxima occurred. When IOUT(2) = 0, these printouts of maxima or EPNL are omitted.

To calculate PNL, PNLT, or EPNL contours, set IOUT(3) equal to 1, 2, or 3, respectively. The results are shown for the inputs of Example Six. The first two values of YO are taken as the default values of 500 and 1000. To define contours for these examples, NXO is increased to 11, and XO values are added between −7500 and 1600 feet. The number of time increments (NT) is increased to 21 to improve the EPNL calculation. The contour area is that integrated between the first and last value of XO. Large errors in area can occur if the program fails to converge to a Y coordinate at some XO, or if it somehow converges to a negative value of Y. Where the user can anticipate that at some XO points the requested contour level will be very near the X axis, the solution for the Y coordinate will be expedited by setting one of the initial YO values to zero.

On the IBM 360 computer the solution for the Y coordinates for a contour level of 90 EPNdB at four XO distances required approximately 100 seconds of CPU time. The calculations are for four independent noise sources, with a 3-decibel ground reflection and atmospheric attenuation applied to the total, evaluated 21 times along the aircraft trajectory.

Program Listings

A complete listing of the main programs FOOTPR and RADIUS and all subroutines used by them are shown in appendix B. Punched cards or tapes for these listings can be obtained by suitable request from COSMIC, 112 Barrow Hall, University of Georgia, Athens, Georgia, 30602 (telephone 404-542-3265).

Concluding Remarks

Programs have been demonstrated that enable the user to make single- and multiple-point and contour noise calculations by using the procedures recommended in the ANOP noise source documentation. Various common corrections can be made to account for propagation and shielding effects.

Each of the main programs and subroutines have been discussed to aid the user in relating the program features to the noise source predictions and to his particular problem. Sample inputs and outputs have been described at length, with tables for illustration. Generally, the programs are simple enough that the user should be able to make any modifications that might better suit his application.

There are several present limitations to this program. Some of these are listed here. However, the program will be found useful in a wide variety of noise prediction situations.

(1) No provision is made for a layered atmosphere in the calculation of atmospheric attenuation. This would require an additional subroutine to break the propagation path into several segments having distinct properties and then to apply the existing attenuation predictions to each segment.

(2) Suppression spectra can be applied to individual sources, but only as a function of frequency. Source directivity is also modified by suppression treatment, but no provision is made for this in the present version. Additional subroutines to predict the suppression of each source, based on the physical characteristics of the suppressor, would also be highly desirable.

(3) No provision is made for the calculation of jet noise with a multiple-tube or chute type of suppressor.

(4) Provision has not yet been made for predicting the noise for inverted velocity profiles of coaxial jet nozzles.

(5) Eventually, it may be desirable to predict the propagation of each source individually to the far field. Shielding and ground reflection effects, and perhaps others, depend to some degree on the characteristics of the source. In addition, there are possible interference effects between similar noise sources on separate engines. The specific locations of the engines on the aircraft, as well as the wing and fuselage shielding will affect any interferences.

(6) Some provisions for a thrust reverser noise prediction have already been incorporated in these programs, but no subroutine for this noise source has been provided as yet. The user may wish to develop and incorporate a subroutine for reverser noise.

Lewis Research Center
National Aeronautics and Space Administration
Cleveland, Ohio, April 2, 1981

Appendix A
Symbols

Symbols used in the text of this report are listed here. Other symbols for input parameters are listed in table III. Where appropriate, the noise module in which the variable appears, or is input, is identified by the module name. Variable names in capital letters correspond to the names in the Fortran coding.

A	array of variables in interpolation routine
A	array of areas, AIRFR, m^2 (ft^2)
$\hat{a}$	unit direction vector on aircraft (fig. 3)
AC	core nozzle area, JET, m^2 (ft^2)
AC1	core nozzle area, FLAP, m^2 (ft^2)
ADELT	array of fan temperature rises, engine map, K (°R)
AF1	fan nozzle area, FLAP, m^2 (ft^2)
AFPR	array of fan pressure ratios, engine map
AFUEL	array of fuel flow rates, engine map, kg/s (lb/s)
AIRM	Mach number of air approaching fan face, FAN
ALF	angle between engine axis and ground plane, ALF = ALF1 + ALF2, deg
ALF1	engine angle of attack, deg
ALF2	angle of climb of aircraft, deg
ANNHT	primary nozzle annulus height JET, m (ft)
ANNHTF	fan nozzle annulus height JET, m (ft)
AP3	array of combustor inlet pressures, engine map, N/m^2 (lb/ft^2)
APHI	array of angles to sideline (fig. 4(b)), for RADIUS, deg
ARPM	array of fan speeds, engine map, rpm
AT3	array of combustor inlet temperatures, engine map, K (°R)
AT4	array of combustor exit temperatures, engine map, K (°R)
ATC	array of core nozzle exit temperatures, engine map, K (°R)
ATCTUR	array of turbine exit temperatures, engine map, K (°R)
ATF	array of fan nozzle exit temperatures, engine map, K (°R)
ATHETA	array of angles from engine inlet (fig. 4(b)), for RADIUS, deg
ATIPM	array of fan blade tip relative Mach numbers, engine map
ATIPM2	array of second fan stage relative Mach numbers, engine map
ATURTS	array of turbine rotor tip speeds, engine map, m/s (ft/s)
AVC	array of core nozzle exit velocities, engine map, m/s (ft/s)
AVF	array of fan nozzle exit velocities, engine map, m/s (ft/s)
AWAFAN	array of fan total airflows, engine map, kg/s (lb/s)
AWCORE	array of core total (air + fuel) flows, engine map, kg/s (lb/s)
B	array of variables in interpolation routine
B	array of span lengths, AIRFR, m (ft)
b	aircraft position with respect to observer (fig. 4(a)), XA − XO
BETA	coefficient in PHI-angle dependence, FLAP
BPD	intermediate variable in defining aircraft position
BPDPH	intermediate variable in defining aircraft position
BPR	bypass ratio of engine, FLAP
C	array of variables in interpolation routine
C	ambient speed of sound, m/s (ft/s)
CAY	coefficient in forward speed effect on source, FLAP
CFUSE	characteristic dimension of fuselage (i.e., diam), SHLD, m (ft)
CG	ratio of strut length to wheel diameter, AIRFR
COMENT	array of initial title in FOOTPR or RADIUS
CS	ratio of stator chord to rotor spacing, TURB, percent
CSUPP	suppression spectrum, CORE, dB
CWING	characteristic dimension of wing (i.e., chord), SHLD, m (ft)
CX	speed of sound at fan face, FAN, ft/s
d	aircraft position with respect to observer (fig. 4(a)), YA − YO

DECMPT decrement to combination tone levels, FAN, dB

DELF fuselage shielding factor, SHLD, dB

DELT fan temperature rise, FAN, °R

DELW wing shielding factor, SHLD, dB

DHC hydraulic diameter of core nozzle, JET, m (ft)

DHF hydraulic diameter of fan nozzle, JET, m (ft)

DK array of source heights, GNDRFL, m (ft)

DMB intermediate variable in defining aircraft position

DTEMD design temperature drop across turbine, CORE, K (°R)

DW tire diameters of nose and main gear wheels, AIRFR, m (ft)

EDOP exponent on FDOP for source motion amplification

EDOP2 same as EDOP, specific for second fan stage, FAN

EPNL effective perceived noise level, time and tone weighted, dB

EPP array of engine performance parameters in FOOTPR

EPPI engine performance parameter, FOOTPR, or input to RADIUS

F array of dependent variables in interpolation routine

FANEFF fan aerodynamic efficiency (<1), FAN

FDOP Doppler factor for frequency shift and motion amplification

FILBW fraction of filter bandwidth having gain of 1

FLAPA array of angles of slotted flaps, in FOOTPR, deg

FLAPI slotted flap angle, AIRFR, deg

FLSUPP suppression spectrum, FLAP, dB

FPR fan pressure ratio, FAN

FR gain factor of filter, FAN and TURB

FSHIFT array of phase shifts of reflected signal, GNDRFL, deg

GAM array of banking angles of aircraft, deg

GAMMA specific heat ratio of core flow, CORE

GAMMAC specific heat ratio of core nozzle exhaust, JET

GAMMAF specific heat ratio of fan nozzle exhaust, JET

GASRC gas constant of core exhaust, JET, j/kg/K (ft-lb/lbm/°R)

GEAR gear ratio, last stage turbine to fan, TURB

h aircraft position with respect to observer (fig. 4(a)), ZA – ZO

HEAD angle between aircraft track and X axis, deg

$\hat{i}$ unit vector along X axis

IATM key to effect atmospheric attenuation corrections

ICLEAN key for clean aerodynamic configuration, AIRFR

ICORR key to correct engine parameters to ambient conditions

ICPA key to center time history or start time at first point

IDOP key for Doppler shifts and source motion corrections

IEGA key to effect extra ground attenuation corrections

IEXH key for including inlet or exhaust noise, FAN

IFD key to indicate inlet flow distortion, FAN

IFL key to include slotted-flap noise, AIRFR

IFLAP key to calculate powered-lift (flap) noise, NOIS

IFWD key to correct sources for forward velocity, JET and FLAP

IGEOM key to obtain extra geometry information in printout

IGND key to effect ground reflection corrections

IGV key for inlet guide vanes, FAN

IJET key to include jet noise, NOIS

ILG key to include landing gear noise, AIRFR

ILGR array of keys for landing gear noise, in FOOTPR

IMOD key to use modified prediction procedure, CORE

INOZ key to indicate nozzle type, JET and FLAP

INSENS key for flap angle sensitivity, FLAP

IOUT key for various levels of detail in calculated output

IREVR array of keys to calculate reverser noise, in FOOTPR

ISKIP key to skip unnecessary steps in NOIS and JET

ISLAT key to include slatted-leading-edge noise, AIRFR

ISUPP key to apply suppression spectra to all sources

ISUPPR override key to ISUPP in each source module

ITITLE key for printing preliminary inputs to noise calculations

ITONE key to treat spectrum protrusions as tones, GNDRFL

ITOT key to include or reject total of source spectra in printout

ITYPTB key for turbine nozzle exhaust position, TURB

ITYPW key for aircraft wing type, AIRFR

IUOTW key for engine location under or over wing, FLAP and SHLD

IWING key to include wing and tail noise, AIRFR

$\hat{j}$ unit vector along Y axis

JOUT key for control of individual source outputs

$\hat{k}$ unit vector along Z axis

KI counting parameter, number of time increments, FOOTPR

MTRD design tip relative Mach number in ref. 1

NF number of trailing-flap slots, AIRFR

NG number of nose and main landing gear, AIRFR

NPHI number of values of APHI supplied, in RADIUS

NS number of sources simulating distributed source, GNDRFL

NT number of time increments for noise calculations, in FOOTPR

NTHETA number of values of ATHETA supplied, in RADIUS

NW number of nose and main landing gear wheels, AIRFR

NXO number of XO coordinates supplied, in FOOTPR

NYO number of YO coordinates supplied, in FOOTPR

OASPL overall sound pressure level (broadband), dB

$\hat{p}$ unit vector along aircraft trajectory

PHI angle in sideline direction (fig. 4(b)), deg

PNL perceived noise level

PNLT perceived noise level, tone weighted

PSY array of powered-lift flap angles, in FOOTPR, deg

PSYI powered-lift flap angle, in RADIUS, deg

QABS array of ground reflectivities, GNDRFL

R distance from aircraft to observer, m (ft)

$\bar{R}$ radius vector from aircraft to observer

RPM fan speed, FAN, rpm

RSS rotor-stator spacing, FAN, percent

RTSM fan rotor blade tip Mach number, FAN, ft/sec

SFUSE maximum fuselage shielding at THETA = 90°, SHLD, dB

SMX angle in flyover plane of maximum wing shielding, SHLD, deg

SPL sound pressure level, roughly one-third octave, dB

SUPPEX suppression spectrum for fan exhaust, FAN, dB

SUPPIN suppression spectrum for fan inlet, FAN, dB

SWIDE angle span of fuselage shielding, SHLD, deg

SWING maximum wing shielding, SHLD, deg

T3 combustor inlet temperature, CORE, °R

T4 combustor exit temperature, CORE, °R

TAU retarded time at observer position, s

TC core nozzle exit temperature, JET, °R

TCTUR turbine exit temperature, TURB, °R

TD size of time increment for noise calculations, s

TF time at end of EPNL integration (fig. 15), EPNL, s

THETA angle between engine inlet and observer direction, deg

THETAF projection of THETA in plane of $\hat{a}$ and $\hat{u}$ (fig. 4(b)), deg

THETAH projection of THETA in plane of $\hat{a}$ and $\hat{w}$ (fig. 4(b)), deg

TI time on aircraft at noise calculation, FOOTPR, s

TIPM relative fan tip Mach number, FAN

TIPM2 relative second-stage fan tip Mach number, FAN

TIPMD design relative fan tip Mach number, FAN

TIPMD2 second-stage design relative fan tip Mach number, FAN

TS time at start of EPNL integration (fig. 15), EPNL, s

TSTART reference time at first trajectory point, FOOTPR, s

TSUPP suppression spectrum, TURB, dB

TURTS last-stage rotor relative tip speed, TURB, ft/s

$\hat{u}$ unit direction vector on aircraft (fig. 3)

UNITS variable designating SI or U.S. customary units

VA array of aircraft velocities, FOOTPR, m/s (ft/s)

VI aircraft velocity, in FOOTPR, or input to RADIUS, m/s (ft/s)

VIEW elevation angle of aircraft from observer, FOOTPR, deg

$\hat{w}$ unit direction vector on aircraft (fig. 3)

WINGD ratio of wing chord to nozzle diameter, FLAP

X coordinate (fig. 2)

XA array of aircraft coordinates (fig. 2), m (ft)

XI aircraft coordinate at time TI, m (ft)

XO array of observer coordinates (fig. 2), m (ft)

Y coordinate (fig. 2)

YA array of aircraft coordinates (fig. 2), m (ft)

YI aircraft coordinate at time TI, m (ft)

YO array of observer coordinates (fig. 2), m (ft)

Z coordinate (fig. 2)

ZA array of aircraft coordinates (fig. 2), m (ft)

ZETA angle between aircraft motion and observer direction, deg

ZI aircraft coordinate at time TI, m (ft)

ZO array of observer coordinates (fig. 2), m (ft)

Appendix B
Listings of Main Programs and Subroutines

Main Program FOOTPR

```
C              MAIN PROGRAM FOR FOOTPRINT CALCULATION
C                FROM AIRCRAFT NOISE SOURCE SUBROUTINES
C         WRITTEN AT LERC AS PART OF ANOP SUPPORT EFFORT.
C     PROGRAM CALCULATES GEOMETRY FOR FLIGHT PAST SELECTED GRID POINTS,
C                 OR POINTS ON SPECIFIED NOISE CONTOUR LINES.
C
C      CALLS SUBROUTINES NOIS AND EPNL
C      OUTFLOW:  UNITS,ISKIP,IREV,ILG,FDOP,C,TAMB,PAMB,RH,
C          R,THETA,THETAF,THETAH,PHI,VIEW,HEAD,PSYI,FLAPI,EPPI,
C          VI,X,Y,TAU,IJ,KI,ZO,ZI
C      RETURN FLOW:  PNL,PNLT,EPNL,TIS,TIF
C
C     INPUTS ARE THROUGH NAMELIST BLOCKS "GRID", "AMB", AND "TRAJ"
C
       DIMENSION XO(20),YO(20),XOM(20),YCON(20),YCONM(20),XA(50),YA(50),-
     1 ZA(50),ALF(50),ALF1(50),GAM(50),EPP(50),VA(50),TA(50),PSY(50),-
     2 FLAPA(50),ILGR(50),IREVR(50),ALFCOS(50),ALFSIN(50),FPNL(100),-
     3 TIME(100),CONTR(5)
       DIMENSION FPNLMX(20,20),TAUMX(20,20),THETMX(20,20),COMENT(20)
       COMMON UNITS,ISKIP,IOUT(3),IREV,ILG,FDOP,C,TAMB,PAMB,RH,NENG
       COMMON/GEOM/R,THETA,THETAF,THETAH,PHI,VIEW,HEAD,PSYI,FLAPI,EPPI,-
     1 VI,X,Y,TAU,IJ,KI,ZO,ZI
       DATA SI,ENG/2HSI,3HENG/,AR/.0174533/
       NAMELIST/GRID/UNITS,NXO,NYO,XO,YO,ZO,NCONTR,CONTR
       NAMELIST/TRAJ/NP,XA,YA,ZA,ALF1,GAM,EPP,VA,PSY,FLAPA,ILGR,IREVR,-
     1    TSTART,TD,NT,ICPA,IGEOM,ITITLE
       NAMELIST/AMB/TAMB,PAMB,RH
C        UNITS=ENG/SI (FOR ENGLISH/INTERNAT. UNITS FOR INPUT & OUTPUT)
C        NXO,NYO = NO. OF X AND Y COORDS. FOR OBSERVERS
C        XO,YO,ZO = X, Y, & Z COORDS. OF OBSERVERS (ALL AT ZO)
C        NCONTR = NO. OF SOUND LEVEL CONTOURS DESIRED
C        CONTR = NCONTR VALUES OF CONTOUR LEVELS (PNL,PNLT,EPNL)
C        NP  =  NO. OF POINTS NEEDED TO SPECIFY AIRCRAFT PATH
C        XA,YA,ZA = NP VALUES OF X, Y, & Z ON AIRCRAFT PATH
C        VA = NP VALUES OF AIRCRAFT VELOCITY
C        EPP = NP VALUES OF AIRCRAFT POWER SETTING
C        ALF1= NP VALUES OF A/C ANGLE OF ATTACK
C        GAM = NP VALUES OF A/C BANK ANGLE
C        PSY = NP VALUES OF A/C FLAP ANGLE (FLAP NOISE)
C        FLAPA = NP VALUES OF FLAP ANGLES FOR AIRFRAME NOISE
C        ILGR = 1/0 (FOR LANDING GEAR DOWN/UP)
C        IREVR = 1/0 (Y/N FOR REVERSERS OPERATING), NP VALUES
C        TSTART=TIME ON AIRCRAFT AT FIRST PATH POINT GIVEN
C        TD = SIZE OF TIME INCREMENTS IN SEC.
C        NT = NO. OF TIME INCREMENTS (INDEP. OF NP), UP TO 100
C        ICPA = 1/0 (Y/N TO CENTER TIME HISTORY ON CLOSEST POINT OF
C            APPROACH; OTHERWISE START HISTORY AT FIRST TRAJECTORY POINT)
C        ITITLE = 1/0 (Y/N FOR TITLING OUTPUT WITH INPUT GEOMETRY)
C        IGEOM = 1/0 (Y/N FOR PRINTING EXTRA GEOMTRY INFO)
C        TAMB,PAMB,RH = AMBIENT TEMP, PRESSURE AND REL. HUM.
C            (UNIFORM ATMOSPHERE)
C            NOTE THAT THE FOLLOWING DATA ARE ASSIGNED AS DEFAULT VALUES
      DATA ICPA,NXO,XO,TSTART,TD,NT,IGEOM/2*1,20*500.,0.,1.,21,0/
      DATA NYO,YO,NCONTR,CONTR/2,500.,19*1000.,1,90.,95.,3*100./
C       FOR TAKEOFF WITH 6 DEG CLIMB STARTING FROM
C           XA=0., ZA=ENG HT=8 FT, TO ZA=5000., WITH VA=150., EPP=100.
      DATA NP,XA,ZA,YA,GAM,VA/2,0.,49*47496.,8.,49*5000.,100*0.,50*150./
      DATA EPP,PSY,FLAPA,ILGR,IREVR/50*100.,100*0.,100*0/
      UNITS=ENG
      ZO=4.
      GAMMAF=1.4
      TAMB=-1.
      PAMB=-1.
```

```
C        THESE NEG. VALUES TO DETECT IF DATA READ IN.  FINAL DEFAULTS
C             GIVEN AT STATEMENT 6.
      RH=70.
      NENG=1
      ITITLE=1
C
      READ(5,91) (COMENT(I),I=1,20)
      READ(5,GRID)
      READ(5,TRAJ)
      READ(5,AMB)
      WRITE(6,92) (COMENT(I),I=1,20)
      IF(ITITLE.EQ.0) GO TO 2
      IF(UNITS.EQ.ENG) WRITE(6,97) (XO(I),I=1,NXO)
      IF(UNITS.EQ.SI) WRITE(6,98) (XO(I),I=1,NXO)
      WRITE(6,99) (YO(I),I=1,NYO)
      WRITE(6,101) ZO
      WRITE(6,102) (XA(I),I=1,NP)
      WRITE(6,103) (YA(I),I=1,NP)
      WRITE(6,104) (ZA(I),I=1,NP)
      WRITE(6,105) (EPP(I),I=1,NP)
      WRITE(6,106) (VA(I),I=1,NP)
      WRITE(6,107) (ALF1(I),I=1,NP)
      WRITE(6,108) (GAM(I),I=1,NP)
      WRITE(6,109) (PSY(I),I=1,NP)
      WRITE(6,139) (FLAPA(I),I=1,NP)
      WRITE(6,140) (ILGR(I),I=1,NP)
      WRITE(6,141) (IREVR(I),I=1,NP)
      WRITE(6,90)
    2 IF(UNITS.EQ.ENG) GO TO 6
      ZO=ZO*3.28
      DO 3 I=1,NP
      XA(I)=XA(I)*3.28
      YA(I)=YA(I)*3.28
      ZA(I)=ZA(I)*3.28
    3 VA(I)=VA(I)*3.28
      DO 4 I=1,NXO
    4 XO(I)=XO(I)*3.28
      DO 5 I=1,NYO
    5 YO(I)=YO(I)*3.28
      TAMB=TAMB*1.8
      PAMB=PAMB*.02089
    6 IF(TAMB.LT.0.) TAMB=518.7
      IF(PAMB.LT.0.) PAMB=2116.
C
      NTI=NT/2
      C=41.447*SQRT(GAMMAF*TAMB)
C    ******  CONVERT TO RADIANS, CALC TIMES AND ANGLES ALONG FLIGHT PATH
      TA(1)=TSTART
      DO 8 K=1,NP
      ALF1(K)=ALF1(K)*AR
      GAM(K)=GAM(K)*AR
      ALFCOS(K)=COS(ALF1(K))
      ALFSIN(K)=SIN(ALF1(K))
    7 IF(K.EQ.1) GO TO 8
      DG=SQRT((XA(K)-XA(K-1))**2+(YA(K)-YA(K-1))**2)
      DZ=ZA(K)-ZA(K-1)
      DS=SQRT(DG**2+DZ**2)
      TA(K)=TA(K-1)+2.*DS/(VA(K)+VA(K-1))
      ALF(K-1)=ALF1(K-1)+ATAN(DZ/DG)
    8 CONTINUE
      ALF(NP)=ALF(NP-1)+ALF1(NP)-ALF1(NP-1)
C
    9 DO 49 M=1,NCONTR
      DO 40 I=1,NXO
      X=XO(I)
      ICON=0
      FACT=1.
      DELST=1.E5
      DELBST=1.E5
```

```
      DO 39 J=1,NYO
      Y=YO(J)
      ITER=0
      IJ=I*J*M
      IF(ICPA.EQ.1) GO TO 10
      TI=TSTART
      KST=1
      GO TO 19
C   ******  FIND THE CLOSEST POINT OF APPROACH TO OBSERVER AT (I,J)
   10 DO 13 K=1,NP
      B=X-XA(K)
      D=Y-YA(K)
      H=ZA(K)-ZO
      IF(K.EQ.NP) GO TO 11
      DX=XA(K+1)-XA(K)
      DY=YA(K+1)-YA(K)
      DZ=ZA(K+1)-ZA(K)
   11 TEST=B*DX+D*DY-H*DZ
      IF(TEST) 15,14,12
   12 TESTST=TEST
      DXS=DX
      DYS=DY
      DZS=DZ
   13 CONTINUE
      DR=TEST/SQRT(DX**2+DY**2+DZ**2)
      TCP=TA(NP)
      IF(VA(NP).GT.0.) TCP=TCP+DR/VA(NP)
      GO TO 17
   14 TCP=TA(K)
      GO TO 17
   15 IF(K.GT.1) GO TO 16
      DR=TEST/SQRT(DX**2+DY**2+DZ**2)
      TCP=TA(1)
      IF(VA(1).GT.0.) TCP=TCP+DR/VA(1)
      GO TO 17
   16 DR=TESTST/SQRT(DXS**2+DYS**2+DZS**2)
      VCP=SQRT(VA(K-1)**2+2.*DR*(VA(K)-VA(K-1))/(TA(K)-TA(K-1)))
      TCP=TA(K-1)+2.*DR/(VCP+VA(K-1))
   17 FNTI=NTI
      TI=TCP-FNTI*TD
      DO 18 K=1,NP
      IF(TI.GT.TA(K)) GO TO 18
      KST=K-1
      IF(K.EQ.1) KST=1
      GO TO 19
   18 CONTINUE
      KST=NP
C
   19 FPMAX=0.
      DO 32 KI=1,NT
      IF(TI.GE.TA(KST+1)) KST=KST+1
      KT=KST
      IF(KST.GT.NP) KST=NP
      IF(KT.GT.NP-1) KT=NP-1
      TFR=(TI-TA(KST))/(TA(KT+1)-TA(KT))
      EPPST=EPPI
      EPPI=EPP(KST)
      IREV=IREVR(KST)
      ILG=ILGR(KST)
      FLAPI=FLAPA(KST)
      PSYI=PSY(KST)
C   ***** VI IS INTERPOLATED VALUE WHEN VA CHANGE OCCURS
      VST=VI
      VI=VA(KST)+(VA(KT+1)-VA(KT))*TFR
      IF(TI.LT.TA(1)) VI=VA(1)
      IF(TI.GT.TA(NP)) VI=VA(NP)
      VMR=(VI+VA(KST))/(VA(KT+1)+VA(KT))
      DX=XA(KT+1)-XA(KT)
      DY=YA(KT+1)-YA(KT)
```

```
      DZ=ZA(KT+1)-ZA(KT)
      DGSQ=DX**2+DY**2
      DG=SQRT(DGSQ)
      DS=SQRT(DGSQ+DZ**2)
   20 ALFCS=(ALFCOS(KST)*DG-ALFSIN(KST)*DZ)/DS
      ALFSN=(ALFSIN(KST)*DG+ALFCOS(KST)*DZ)/DS
C         ALFCS AND ALFSN BY COS & SIN OF SUM OF 2 ANGLES, ALF=ALF1+ALF2
      XI=XA(KST)+DX*TFR*VMR
      YI=YA(KST)+DY*TFR*VMR
      ZI=ZA(KST)+DZ*TFR*VMR
C
   21 B=X-XI
      D=Y-YI
      H=ZI-ZO
      R=SQRT(B**2+D**2+H**2)
      TAU=TI+R/C
   22 IF(R.LT..01) GO TO 31
C         SOLVE FOR DOT PRODUCTS, AIRCRAFT UNIT VECTORS
      BPD=(B*DX+D*DY)/DG
      DMB=(D*DX-B*DY)/DG
      BPDPH=BPD*ALFSN+H*ALFCS
      RDOTA=BPD*ALFCS-H*ALFSN
      IF(RDOTA.EQ.0.) RDOTA=.1E-60
      GAMSN=SIN(GAM(KST))
      GAMCS=COS(GAM(KST))
      RDOTW=DMB*GAMCS+BPDPH*GAMSN
      RDOTU=DMB*GAMSN-BPDPH*GAMCS
      IF(RDOTU.EQ.0.) RDOTU=-.1E-50
C         SOLVE FOR SOURCE-RELATED ANGLES
   23 COSTH=RDOTA/R
      IF(COSTH.GT.1.) COSTH=1.
      IF(COSTH.LT.-1.) COSTH=-1.
      THETA=ARCOS(COSTH)/AR
      THETAF=ATAN2(-RDOTU,RDOTA)/AR
      IF(RDOTU.GT.0..AND.RDOTA.LT.0.) THETAF=THETAF+360.
      THETAH=ATAN2(RDOTW,RDOTA)/AR
      PHI=ATAN2(RDOTW,-RDOTU)/AR
C       DOPPLER SHIFT CORR. BASED ON COSINE OF DIRECTION OF MOTION
   27 COSDOP=(B*DX+D*DY-H*DZ)/DS/R
      FDOP=1.-VI*COSDOP/C
      VIEW=ARSIN(H/R)/AR
      HEAD=ARSIN(DY/DG)/AR
      IF(IGEOM.EQ.0) GO TO 29
      IF(KI.EQ.1.AND.IJ.EQ.1) WRITE(6,93)
      IF(KI.EQ.NTI+1.AND.ICPA.EQ.1) WRITE(6,95)
      IF(UNITS.EQ.SI) GO TO 28
      WRITE(6,94) KI,XI,YI,ZI,R,THETA,THETAF,THETAH,PHI,TI,TAU,EPPI,VI
      GO TO 29
   28 XIM=XI/3.28
      YIM=YI/3.28
      ZIM=ZI/3.28
      RM=R/3.28
      VIM=VI/3.28
      WRITE(6,94) KI,XIM,YIM,ZIM,RM,THETA,THETAF,THETAH,PHI,TI,TAU,-
     1  EPPI,VIM
   29 ISKIP=0
      IF(KI.EQ.1) GO TO 30
      IF(EPPI.EQ.EPPST.AND.VI.EQ.VST) ISKIP=1
C
   30 CALL NOIS(PNL,PNLT)
      IF(KI.EQ.NTI+1.AND.IGEOM.EQ.1.AND.ICPA.EQ.1) WRITE(6,96)
      IF(IOUT(2).EQ.0.AND.IOUT(3).EQ.0) GO TO 32
      IF(IOUT(2).EQ.1.OR.IOUT(3).EQ.1) FPNL(KI)=PNL
      IF(IOUT(2).GE.2.OR.IOUT(3).GE.2) FPNL(KI)=PNLT
      TIME(KI)=TAU
      IF(FPNL(KI).LT.FPMAX) GO TO 32
      FPMAX=FPNL(KI)
      IF(ITER.GT.0) GO TO 32
      FPNLMX(I,J)=FPMAX
```

```
      TAUMX(I,J)=TAU
      THETMX(I,J)=THETA
      GO TO 32
   31 WRITE(6,126) KI,TAU
   32 TI=TI+TD
C        END OF LOOP IN TIME INCREMENTS WITH KI
      IF(IOUT(2).NE.3.AND.IOUT(3).NE.3) GO TO 33
      FPMAX=EPNL(FPNL,FPMAX,TIME,NT,TIS,TIF)
      IF(ITER.EQ.0) FPNLMX(I,J)=FPMAX
   33 IF(IOUT(3).EQ.0.OR.J.GT.2.OR.ICON.EQ.1) GO TO 39
      DEL=ABS(CONTR(M)-FPMAX)
      IF(DEL.GT..1) GO TO 34
      YCON(I)=Y
      ICON=1
      GO TO 39
   34 IF(DEL.GE.DELBST) GO TO 35
C        STORE BEST AND NEXT-BEST VALUES OF DEL,FPMAX,AND Y
      DELST=DELBST
      DELBST=DEL
      FST=FBEST
      FBEST=FPMAX
      YST=YBEST
      YBEST=Y
      IF(FACT.LE..5) FACT=2.*FACT
      IF(J.EQ.1) GO TO 39
      GO TO 37
   35 IF(DEL.GE.DELST) GO TO 36
      DELST=DEL
      FST=FPMAX
      YST=Y
      IF(FACT.LE..5) FACT=2.*FACT
      GO TO 37
   36 FACT=0.5*FACT
   37 IF(ITER.LT.9) GO TO 38
C        ONE MORE TRY AT Y NEAR ZERO
      Y=1.
      ITER=ITER+1
      IF(ITER.LE.11) GO TO 10
      YCON(I)=YBEST
      WRITE(6,127) CONTR(M),X,YBEST,FBEST
      GO TO 39
   38 IF(ITER.GT.1) Y=YBEST+FACT*(YBEST-YST)*(CONTR(M)-FBEST)/(FBEST-FST)
      IF(ITER.LE.1) Y=YBEST*(YST/YBEST)**((FBEST-CONTR(M))/(FBEST-FST))
      ITER=ITER+1
      GO TO 10
   39 CONTINUE
   40 CONTINUE
      IF(IOUT(2).EQ.0) GO TO 45
      IF(IOUT(2).EQ.1) WRITE(6,115)
      IF(IOUT(2).EQ.2) WRITE(6,116)
      IF(IOUT(2).EQ.3) WRITE(6,117)
      WRITE(6,110)
      IF(UNITS.EQ.SI) GO TO 41
      WRITE(6,111) (YO(J),J=1,NYO)
      GO TO 43
   41 DO 42 J=1,NYO
   42 XOM(J)=YO(J)/3.28
      WRITE(6,111) (XOM(J),J=1,NYO)
   43 DO 44 I=1,NXO
      IF(UNITS.EQ.ENG) WRITE(6,112) XO(I),(FPNLMX(I,J),J=1,NYO)
      XOMM=XO(I)/3.28
      IF(UNITS.EQ.SI) WRITE(6,112) XOMM,(FPNLMX(I,J),J=1,NYO)
      WRITE(6,113) (THETMX(I,J),J=1,NYO)
      WRITE(6,114) (TAUMX(I,J),J=1,NYO)
   44 CONTINUE
   45 IF(IOUT(3).EQ.0) STOP
      IF(IOUT(3).EQ.1.AND.M.EQ.1) WRITE(6,118)
      IF(IOUT(3).EQ.2.AND.M.EQ.1) WRITE(6,119)
      IF(IOUT(3).EQ.3.AND.M.EQ.1) WRITE(6,120)
```

```
      WRITE(6,121) CONTR(M)
      NXM=NXO-1
      AREA=0.
      DO 46 I=1,NXM
   46 AREA=AREA+(XO(I+1)-XO(I))*(YCON(I+1)+YCON(I))/2.
      IF(UNITS.EQ.SI) GO TO 47
      WRITE(6,122) (XO(I),I=1,NXO)
      WRITE(6,123) (YCON(I),I=1,NXO)
      AREA1=AREA/43560.
      AREA2=AREA/27878400.
      WRITE(6,128) AREA,AREA1,AREA2
      GO TO 49
   47 DO 48 I=1,NXO
      XOM(I)=XO(I)/3.28
   48 YCONM(I)=YCON(I)/3.28
      WRITE(6,124) (XOM(I),I=1,NXO)
      WRITE(6,125) (YCONM(I),I=1,NXO)
      AREA=AREA/10.764
      AREA1=AREA/1.E6
      WRITE(6,129) AREA,AREA1
   49 CONTINUE
      STOP
   90 FORMAT(1H4)
   91 FORMAT(8X,20A4)
   92 FORMAT(1H1,20X,20A4)
   93 FORMAT(///,'  GEOMETRIC RELATIONS OF AIRCRAFT/OBSERVER'/-
     1   8X,' KI      XI        YI        ZI        R        THETA  THETAF THETAH-
     2   PHI        TI        TAU      EPPI      VI')
   94 FORMAT(2X,6H GEOM:,I3,4F8.1,2X,4F7.1,1X,2F8.2,2X,2F8.1)
   95 FORMAT('******  CLOSEST POINT OF APPROACH')
   96 FORMAT('******')
   97 FORMAT('   OBSERVER COORDINATES (IN FEET).'/8H     XO:,15F8.1/-
     1  8X,5F8.1)
   98 FORMAT('   OBSERVER COORDINATES (IN METERS).'/8H     XO:,15F8.1/-
     1   8X,5F8.1)
   99 FORMAT(8H     YO:,15F8.1/8X,5F8.1)
  101 FORMAT(8H     ZO:,F8.1)
  102 FORMAT('   AIRCRAFT TRAJECTORY POINTS AND OPERATING CONDITIONS.'/-
     1  8H     XA:,15F8.1/8X,15F8.1/8X,15F8.1/8X,5F8.1)
  103 FORMAT(8H     YA:,15F8.1/8X,15F8.1/8X,15F8.1/8X,5F8.1)
  104 FORMAT(8H     ZA:,15F8.1/8X,15F8.1/8X,15F8.1/8X,5F8.1)
  105 FORMAT(8H    EPP:,15F8.1/8X,15F8.1/8X,15F8.1/8X,5F8.1)
  106 FORMAT(8H     VA:,15F8.1/8X,15F8.1/8X,15F8.1/8X,5F8.1)
  107 FORMAT(8H   ALF1:,15F8.1/8X,15F8.1/8X,15F8.1/8X,5F8.1)
  108 FORMAT(8H    GAM:,15F8.1/8X,15F8.1/8X,15F8.1/8X,5F8.1)
  109 FORMAT(8H    PSY:,15F8.1/8X,15F8.1/8X,15F8.1/8X,5F8.1)
  139 FORMAT(8H  FLAPA:,15F8.1/8X,15F8.1/8X,15F8.1/8X,5F8.1)
  140 FORMAT(8H   ILGR:,15I8/8X,15I8/8X,15I8/8X,5I8)
  141 FORMAT(8H  IREVR:,15I8/8X,15I8/8X,15I8/8X,5I8)
  110 FORMAT(7H   XO ,20X,12H YO POSITION)
  111 FORMAT(7H  POS  ,7X,16F7.0)
  112 FORMAT(F7.0,7H LEVEL ,16F7.1)
  113 FORMAT(8X,7H THETA ,16F7.1)
  114 FORMAT(9X,7H TIME  ,16F7.2)
  115 FORMAT(///20X,'VALUES OF PNL-MAX')
  116 FORMAT(///20X,'VALUES OF PNLT-MAX')
  117 FORMAT(///20X,'VALUES OF EPNL')
  118 FORMAT(///10X,' CORRDINATES FOR  "PNL"  CONTOUR')
  119 FORMAT(///10X,' COORDINATES FOR  "PNLT"  CONTOUR')
  120 FORMAT(///10X,' COORDINATES FOR  "EPNL"  CONTOUR')
  121 FORMAT(/'   CONTOUR LEVEL =',F8.1,' DB')
  122 FORMAT(16H X - COORD (FT):,14F8.1)
  123 FORMAT(16H Y - COORD (FT):,14F8.1)
  124 FORMAT(16H X - COORD ( M):,14F8.1)
  125 FORMAT(16H Y - COORD ( M):,14F8.1)
  126 FORMAT(' R GOES TO ZERO AT KI =',I3,', TAU =',F4.1,' .  POINT-
     1 OMITTED IN NOISE SUMMATION')
  127 FORMAT(/' Y-COORD. FOR',F6.1,' DB CONTOUR DID NOT CONVERGE IN 10-
     1 ITERATIONS AT XO =',F7.1/5X,'BEST VALUE OF Y =',F7.1,', BEST-
```

```
     2 LEVEL =',F6.1)
  128 FORMAT(25H   APPROX. CONTOUR AREA =,E11.3,7H SQ FT,,F9.2,-
     1 7H ACRES,,F7.2,9H SQ MILES)
  129 FORMAT(25H   APPROX. CONTOUR AREA =,E11.3,6H SQ M,,F9.2,6H SQ KM)
      END
```

Subroutine NOIS

```
C          NOISE SUBROUTINE FOR USE IN FOOTPRINT PROGRAM
C           INTERPOLATES FOR ENGINE MAP PARAMETERS, CALLS
C           SPECIFIED NOISE SOURCE SUBROUTINES, AND MAKES
C           PROPAGATION CORRECTIONS.  INPUTS ARE IN NAMELIST
C           BLOCKS "PARAM" AND "SOURCE".  "PARAM" CONSISTS OF
C           ARRAYS OF ENGINE VARIABLES AS A FUNCTION OF "EPP",
C           FOR EACH VARIABLE REQUIRED FOR SPECIFIED SOURCES.
C           "SOURCE" CONTAINS INDICATORS FOR NO. OF ENGINES,
C           AND NOISE SOURCES AND CORRECTIONS DESIRED, AND FOR
C           TYPE OF OUTPUT DESIRED.
C     CALLED BY FOOTPR
C     CALLS SUBROUTINES AIRATT,TERP,FAN,JET,CORE,TURB,SHLD,FLAP,AIRFR,
C                 BASAT,EGAC,GNDRF,PERNOY,TONE
C     INFLOW:  R,THETA,EPPI,X,Y,TAU,IJ,KI,UNITS,ISKIP,TAMB,PAMB,FDOP
C     OUTFLOW:  TP,F,IOUT,FDOP,VC,VF,TC,TF,FUEL,WAFAN,RPM,TIPM,TIPM2,
C          DELT,FPR,WCORE,P3,T3,T4,TURTS,TCTUR,F1,F2,F3,F4
C     RETURN FLOW:  TP,SSPL,AIRATT,PERNOY,TONE
C
      SUBROUTINE NOIS(PNL,PNLT)
      DIMENSION AEPP(10),AVC(10),AVF(10),ATC(10),ATF(10),ATIPM(10),-
     1 AWAFAN(10),ARPM(10),ADELT(10),AFPR(10),AWCORE(10),AP3(10),-
     2  AT3(10),AT4(10),ATURTS(10),AFUEL(10),ATIPM2(10),ATCTUR(10)
      DIMENSION ATM(24),SSPL(24),IFREQ(24)
      COMMON/GEOM/R,THETA,THETAF,THETAH,PHI,VIEW,HEAD,PSYI,FLAPI,EPPI,-
     1   VI,X,Y,TAU,IJ,KI
      COMMON/SPECT/TP(24),SPL(24),F(24),DUMY1,DUMY2,DUMY3,F1,F2,F3,F4
      COMMON/PARAM/VC,VF,TC,TF,FUEL,WAFAN,RPM,TIPM,TIPM2,DELT,FPR,-
     1   WCORE,P3,T3,T4,TURTS,TCTUR
      COMMON UNITS,ISKIP,IOUT(3),IREV,ILG,FDOP,C,TAMB,PAMB,RH,NENG,ISUPP
      NAMELIST/SOURCE/NENG,ITOT,IFAN,IJET,IFLAP,ICORE,ITURB,IAIRF,-
     1  IDOP,IATM,IEGA,IGND,ISUPP,ISHLD,IOUT,FILBW
      NAMELIST/PARAM/NPARAM,AVC,AVF,ATC,ATF,AFUEL,ATIPM,ATIPM2,AWAFAN,-
     1ARPM,ADELT,AFPR,AWCORE,AP3,AT3,AT4,ATURTS,ATCTUR,AEPP,ICORR,TCORXP
C       NOTE: PARAM VARIABLES MUST BE ENTERED IN ORDER OF INCREASING EPP
C         NENG=NUMBER OF ENGINES
C         ISUPP=1/0 (Y/N ON SUPPRESSION SPECTRA APPLIED TO EACH SOURCE
C           FOR WHICH SUPRESSION SPECTRA ARE SUPPLIED:  MAY BE
C           OVERRIDDEN BY ISUPPR IN INDIVIDUAL SOURCE INPUT)
C         IDOP=1/0 (Y/N ON DOPPLER FREQ AND INTENSITY CORRECTION);
C         IATM=0 :  NO CORRECTION FOR ATMOSPHERIC ATTENUATION
C              1 :  CORRECT TOTAL NOISE FOR ATMOS. ATTEN. BY ARP 866
C              2 :  CORRECT TOTAL FOR ATMOS. ATTEN. BY BASS & SHIELDS
C         IEGA=1/0 (Y/N ON EXTRA GROUND ATTEN - ON TOTAL NOISE ONLY)
C         ISHLD=1/0 (Y/N FOR SHIELDING OF FAN,JET,CORE & TURBINE SOURCES)
C         IGND=0 : NO GROUND REFLECTIONS - FREE FIELD
C              1 : FLAT 3 DB GROUND REFLECTION CORRECTION
C              2 : CALC GROUND REFLECTION FOR GROUND IMPEDANCE SPECIFIED
C         ICORR=1/0 (Y/N FOR ENGINE PARAMS TO BE CORR. TO AMBIENT)
C         TCORXP = EXPONENT FOR CORE TEMP. CORRECTIONS IN ENGINE PARAMS
C         FILBW = FRACTION OF FILTER BANDWIDTH WITH GAIN=1
C       IOUT( ) SELECTS LEVEL OF NOISE PRINTOUT; I.E.,
C         IOUT(1) = 0:  NO INDIVIDUAL SOURCE PRINTOUT
C                   1:  SOURCE SPECTRA, INCLUDING OASPL,PNL,PNLT
C                   2:  PRINTS ONLY OASPL, PNL, PNLT OF EACH SOURCE
C                   3:  PRINTS ONLY OASPL, PNL, PNLT OF TOTAL NOISE
C         IOUT(2) = 0:  NO PRINTOUT AT GRID POINTS SPECIFIED
C                   1:  PRINTS PNL-MAX AT GRID POINTS
C                   2:  PRINTS PNLT-MAX AT GRID POINTS
C                   3:  PRINTS EPNL AT GRID POINTS
C         IOUT(3) = 0:  NO CONTOUR FOLLOWING
```

```
C                     1:   PRINTS COORDS. OF PNL-MAX CONTOURS
C                     2:   PRINTS COORDS. OF PNLT-MAX CONTOURS
C                     3:   PRINTS COORDS. OF EPNL CONTOURS
C              NOTE THAT IOUT(1) CAN BE OVER-RIDDEN IN INDIVIDUAL SOURCE
C              PROGRAM BY SPECIFYING JOUT=1 IN INPUT DATA TO THAT SOURCE
C   THIS DATA INPUT IS FOR DEFAULT VALUES
      DATA ITOT,IFAN,IJET,IFLAP,ICORE,ITURB,IAIRF,IATM,IEGA,IGND,ISHLD,-
     1   FILBW/1,10*0,1./
      DATA SI,ENG/2HSI,3HENG/
C
      IF(IJ.NE.1.OR.KI.NE.1) GO TO 4
      ISUPP=0
      IDOP=0
      ITOT=1
      ICORR=0
      TCORXP=1.
      FUEL=0.
C
      READ(5,SOURCE)
      READ(5,PARAM)
      IF(AEPP(1).GT.AEPP(NPARAM)) WRITE(6,99)
C
      IF(UNITS.EQ.ENG) GO TO 2
      DO 1 I=1,NPARAM
      AVC(I)=AVC(I)*3.28
      AVF(I)=AVF(I)*3.28
      ATC(I)=ATC(I)*1.8
      ATF(I)=ATF(I)*1.8
      AFUEL(I)=AFUEL(I)*2.205
      AWAFAN(I)=AWAFAN(I)*2.205
      ADELT(I)=ADELT(I)*1.8
      AWCORE(I)=AWCORE(I)*2.205
      AP3(I)=AP3(I)*.02089
      AT3(I)=AT3(I)*1.8
      AT4(I)=AT4(I)*1.8
      ATCTUR(I)=ATCTUR(I)*1.8
    1 ATURTS(I)=ATURTS(I)*3.28
C
    2 DO 3 L=1,24
      F(L)=10.**(.1*FLOAT(L+16))
      IF(IATM.EQ.1) ATM(L)=AIRATT(TAMB,RH,F(L))
    3 IFREQ(L)=F(L)
      F1=.78250188+.10874906*FILBW
      F2=1.-.10874906*FILBW
      F3=1.+.12201845*FILBW
      F4=1.2440369-.12201845*FILBW
C
      IF(IOUT(1).EQ.1) WRITE(6,91) (IFREQ(L),L=1,24)
      IF(IOUT(1).EQ.2) WRITE(6,92)
      IF(IOUT(1).EQ.3) WRITE(6,93)
      IF(IOUT(1).GE.2) WRITE(6,94)
C            ENTER HERE FOR SUBSEQUENT OBSERVER POINTS
    4 TTOT=TAMB+VI*VI/12025.1
      PTOT=PAMB*(TTOT/TAMB)**3.5
      TCORR=TTOT/518.7
      TCORR1=SQRT(TCORR)
      TCORR2=TCORR**TCORXP
      PCORR=PTOT/2116.
      WCORR=PCORR/TCORR1
      IF(IDOP.EQ.0) FDOP=1.
      IF(IOUT(1).EQ.1.AND.UNITS.EQ.ENG) WRITE(6,95) X,Y,TAU,R,THETA
      XM=X/3.28
      YM=Y/3.28
      RM=R/3.28
      IF(IOUT(1).EQ.1.AND.UNITS.EQ.SI) WRITE(6,96) XM,YM,TAU,RM,THETA
      DO 5 L=1,24
    5 TP(L)=1.E-50
C
      IF(IFAN.EQ.0) GO TO 7
```

```
      IF(ISKIP.EQ.1) GO TO 6
      CALL TERP(ATIPM,EPPI,1.,1.,AEPP,1.,1.,NPARAM,1,1,TIPM)
      CALL TERP(AWAFAN,EPPI,1.,1.,AEPP,1.,1.,NPARAM,1,1,WAFAN)
      CALL TERP(ARPM,EPPI,1.,1.,AEPP,1.,1.,NPARAM,1,1,RPM)
      CALL TERP(ADELT,EPPI,1.,1.,AEPP,1.,1.,NPARAM,1,1,DELT)
      CALL TERP(AFPR,EPPI,1.,1.,AEPP,1.,1.,NPARAM,1,1,FPR)
      CALL TERP(ATIPM2,EPPI,1.,1.,AEPP,1.,1.,NPARAM,1,1,TIPM2)
      IF(ICORR.EQ.0) GO TO 6
      WAFAN=WAFAN*WCORR
      RPM=RPM*TCORR1
      DELT=DELT*TCORR
    6 CALL FAN
    7 IF(IJET.EQ.0) GO TO 9
      IF(ISKIP.EQ.1) GO TO 8
      CALL TERP(AVC,EPPI,1.,1.,AEPP,1.,1.,NPARAM,1,1,VC)
      CALL TERP(AVF,EPPI,1.,1.,AEPP,1.,1.,NPARAM,1,1,VF)
      CALL TERP(ATC,EPPI,1.,1.,AEPP,1.,1.,NPARAM,1,1,TC)
      CALL TERP(ATF,EPPI,1.,1.,AEPP,1.,1.,NPARAM,1,1,TF)
      CALL TERP(AFUEL,EPPI,1.,1.,AEPP,1.,1.,NPARAM,1,1,FUEL)
      CALL TERP(AWCORE,EPPI,1.,1.,AEPP,1.,1.,NPARAM,1,1,WCORE)
      IF(ICORR.EQ.0) GO TO 8
      VC=VC*TCORR1
      VF=VF*TCORR1
      TC=TC*TCORR2
      TF=TF*TCORR
      FUEL=FUEL*PCORR*TCORR1
      WCORE=WCORE*WCORR
    8 CALL JET
    9 IF(ICORE.EQ.0) GO TO 11
      IF(ISKIP.EQ.1) GO TO 10
      IF(IJET.EQ.0) CALL TERP(AWCORE,EPPI,1.,1.,AEPP,1.,1.,NPARAM,1,1,-
     1   WCORE)
      CALL TERP(AP3,EPPI,1.,1.,AEPP,1.,1.,NPARAM,1,1,P3)
      CALL TERP(AT3,EPPI,1.,1.,AEPP,1.,1.,NPARAM,1,1,T3)
      CALL TERP(AT4,EPPI,1.,1.,AEPP,1.,1.,NPARAM,1,1,T4)
      IF(IJET.EQ.0) CALL TERP(AFUEL,EPPI,1.,1.,AEPP,1.,1.,NPARAM,1,1,-
     1   FUEL)
      IF(ICORR.EQ.0) GO TO 10
      IF(IJET.EQ.0) WCORE=WCORE*WCORR
      P3=P3*PCORR
      T3=T3*TCORR
      T4=T4*TCORR2
      IF(IJET.EQ.0) FUEL=FUEL*PCORR*TCORR1
   10 CALL CORE
   11 IF(ITURB.EQ.0) GO TO 13
      IF(ISKIP.EQ.1) GO TO 12
      IF(IJET.EQ.0) CALL TERP(ATC,EPPI,1.,1.,AEPP,1.,1.,NPARAM,1,1,TC)
      IF(IFAN.EQ.0) CALL TERP(ARPM,EPPI,1.,1.,AEPP,1.,1.,NPARAM,1,1,RPM)
      IF(IJET.EQ.0.AND.ICORE.EQ.0) CALL TERP(AWCORE,EPPI,1.,1.,AEPP,1.,-
     1   1.,NPARAM,1,1,WCORE)
      IF(IJET.EQ.0.AND.ICORE.EQ.0) CALL TERP(AFUEL,EPPI,1.,1.,AEPP,1.,-
     1   1.,NPARAM,1,1,FUEL)
      CALL TERP(ATURTS,EPPI,1.,1.,AEPP,1.,1.,NPARAM,1,1,TURTS)
      CALL TERP(ATCTUR,EPPI,1.,1.,AEPP,1.,1.,NPARAM,1,1,TCTUR)
      IF(TCTUR.LT.1.) CALL TERP(ATC,EPPI,1.,1.,AEPP,1.,1.,NPARAM,1,1,-
     1 TCTUR)
      IF(ICORR.EQ.0) GO TO 12
      TCTUR=TCTUR*TCORR2
      IF(IFAN.EQ.0) RPM=RPM*TCORR1
      IF(IJET.EQ.0.AND.ICORE.EQ.0) WCORE=WCORE*WCORR
      IF(IJET.EQ.0.AND.ICORE.EQ.0) FUEL=FUEL*PCORR*TCORR1
      TURTS=TURTS*TCORR1
   12 CALL TURB
   13 IF(ISHLD.EQ.1) CALL SHLD
C            SHIELDING APPLIED TO ONLY SOURCES ABOVE THIS POINT
      IF(IFLAP.EQ.0) GO TO 15
      IF(ISKIP.EQ.1) GO TO 14
      IF(IJET.EQ.1) GO TO 14
      CALL TERP(AVC,EPPI,1.,1.,AEPP,1.,1.,NPARAM,1,1,VC)
```

```
      CALL TERP(AVF,EPPI,1.,1.,AEPP,1.,1.,NPARAM,1,1,VF)
      IF(ICORR.EQ.0) GO TO 14
      VC=VC*TCORR1
      VF=VF*TCORR1
   14 CALL FLAP
   15 IF(IAIRF.EQ.1) CALL AIRFR
C
      DO 16 L=1,24
      IF(IGND.EQ.1) TP(L)=TP(L)*2.
      SSPL(L)=10.*ALOG10(TP(L))
      IF(IATM.EQ.1) SSPL(L)=SSPL(L)-ATM(L)*R/1000.
   16 CONTINUE
      IF(IATM.EQ.2) CALL BASAT(R,TAMB,PAMB,RH,SSPL)
   17 IF(IEGA.EQ.1) CALL EGAC(SSPL)
   18 IF(IGND.EQ.2) CALL GNDRF(SSPL)
      TSUM=0.
      DO 19 L=1,24
   19 TSUM=TSUM+10.**(.1*SSPL(L))
      OASPL=10.*ALOG10(TSUM)
      PNL=PERNOY(SSPL)
      PNLT=PNL+TONE(SSPL)
      IF(ITOT.EQ.0) RETURN
      IF(IOUT(1).EQ.1) WRITE(6,97) (SSPL(L),L=1,24),OASPL,PNL,PNLT
      IF(IOUT(1).GE.2) WRITE(6,98) X,Y,TAU,OASPL,PNL,PNLT
      RETURN
   91 FORMAT(//,20X,'SPECTRA FOR EACH NOISE SOURCE'/2X,6H FREQ ,17I7/-
     1 8X,7I7)
   92 FORMAT(20X,'NOISE CONTRIBUTIONS FOR EACH NOISE SOURCE')
   93 FORMAT(20X,'TOTAL NOISE HISTORY AT EACH POINT')
   94 FORMAT(57H  SOURCE    XO        YO        TAU     OASPL     PNL      PN-
     1LT)
   95 FORMAT(10X,19H SOURCES WHEN   XO=,F7.1,9H FT,  YO=,F7.1,11H FT,-
     1  TAU =,F7.1,10H SEC,  R =,F7.1,13H FT,  THETA =,F6.1,4H DEG)
   96 FORMAT(10X,19H SOURCES WHEN   XO=,F7.1,8H M,  YO=,F7.1,10H M,-
     1  TAU =,F7.1,10H SEC,  R =,F7.1,12H M,  THETA =,F6.1,4H DEG)
   97 FORMAT(8H TOTALS:,17F7.1/8X,7F7.1,21X,8H OASPL =,F7.1,6H PNL =,-
     1   F7.1,7H PNLT =,F7.1/)
   98 FORMAT(9H TOTAL  :,2F8.1,F8.3,3F8.1)
   99 FORMAT(2X,'WARNING: ENGINE PARAMETER INPUTS ARE NOT IN ORDER OF-
     1 ASCENDING EPP')
      END
```

Main Program RADIUS

```
C       MAIN PROGRAM FOR CALCULATING NOISE SOURCES AT A CONSTANT RADIUS
C       USING NOISE SOURCE PROGRAMS FROM ANOP PREDICTION REPORTS.
C       THIS VERSION CALCULATES ALL NOISE QUANTITIES FOR EACH SEPARATELY.
C
C       CALLS SUBROUTINES TERP,AIRATT,FAN,JET,CORE,TURB,SHLD,FLAP,AIRFR,
C                 BASAT,EGAC,GNDRF,PERNOY,TONE
C       OUTFLOW:  TP,F,UNITS,ISKIP,IOUT,ILG,FDOP,C,TAMB,PAMB,NENG,ISUPP,
C            R,THETA,THETAF,THETAH,PHI,PSYI,FLAPI,VI,IJ,KI,ZO,ZI,
C            VC,VF,TC,TF,FUEL,WAFAN,RPM,TIPM,TIPM2,DELT,FPR,WCORE,P3,T3,
C            T4,TURTS,TCTUR,F1,F2,F3,F4
C       RETURN FLOW:  TP,SPL,OASPL,PNL,PNLT,SSPL,AIRATT,PERNOY,TONE
C
      DIMENSION FSPL(24,20),TSP(24,20),TOTPWL(24),PWL(24),ATM(24),-
     1  IFREQ(24),FOASPL(20),FPNL(20),FPNLT(20),-
     2  SSPL(24),AREA(20),ATHETA(20),APHI(10),COMENT(20)
      DIMENSION AEPP(10),AVC(10),AVF(10),ATC(10),ATF(10),ATIPM(10),-
     1  ATIPM2(10),AWAFAN(10),ARPM(10),ADELT(10),AFPR(10),AWCORE(10),-
     2   AP3(10),AT3(10),AT4(10),ATURTS(10),AFUEL(10),ATCTUR(10)
      COMMON/GEOM/R,THETA,THETAF,THETAH,PHI,VIEW,HEAD,PSYI,FLAPI,EPPI,-
     1  VI,X,Y,TAU,IJ,KI,ZO,ZI
      COMMON/SPECT/TP(24),SPL(24),F(24),OASPL,PNL,PNLT,F1,F2,F3,F4
      COMMON/PARAM/VC,VF,TC,TF,FUEL,WAFAN,RPM,TIPM,TIPM2,DELT,FPR,-
     1   WCORE,P3,T3,T4,TURTS,TCTUR
      COMMON UNITS,ISKIP,IOUT(3),IREV,ILG,FDOP,C,TAMB,PAMB,RH,NENG,ISUPP
```

```
      DATA SI,ENG/2HSI,3HENG/,AR/.0174533/
      NAMELIST/GEOMT/UNITS,R,ATHETA,APHI,NTHETA,NPHI,VIEW,HEAD,ZO,ZI
C         IF USING GROUND REFLECTION SUBROUTINE (IGND=2), ZO (OBSERVER
C         HEIGHT IN M(FT)) AND ZI (SOURCE HEIGHT IN M(FT)) ARE REQUIRED.
      NAMELIST/AMB/TAMB,PAMB,RH
      NAMELIST/PARAM/NPARAM,AVC,AVF,ATC,ATF,AFUEL,ATIPM,ATIPM2,AWAFAN,-
     1ARPM,ADELT,AFPR,AWCORE,AP3,AT3,AT4,ATURTS,ATCTUR,AEPP,ICORR,TCORXP
C       NOTE: PARAM VARIABLES MUST BE ENTERED IN ORDER OF INCREASING EPP
      NAMELIST/SOURCE/NENG,ITOT,IFAN,IJET,IFLAP,ICORE,ITURB,IAIRF,-
     1   IDOP,IATM,IEGA,IGND,ISUPP,ISHLD,FILBW
      NAMELIST/OPER/EPPI,VI,PSYI,FLAPI,ILG
C       NOTE: IN FLAP NOISE NOISE PREDICTIONS - THETAF VALUES AT VARIOUS
C         ANGLES OF PHI ARE SET EQUAL TO THE THETA VALUES SPECIFIED FOR
C         THE FLYOVER PLANE.  ONLY A ROUGH APPROXIMATION OF NOISE POWER
C         IS USED - FLAP NOISE IN FLYOVER PLANE IS ASSUMED TO HAVE POLAR
C         SYMMETRY AS DO OTHER SOURCES, AND THIS "NOISE POWER" IS PRINTED
C          OUT AND ADDED TO THE TOTAL NOISE POWER.
C           NENG=NUMBER OF ENGINES
C           ISUPP=1/0 (Y/N ON SUPPRESSION SPECTRA APPLIED TO EACH SOURCE
C             FOR WHICH SUPRESSION SPECTRA ARE SUPPLIED:  MAY BE
C             OVERRIDDEN BY ISUPPR IN INDIVIDUAL SOURCE INPUT)
C           ITOT=1/0 (Y/N FOR PRINTING TOTAL OF SPECTRA)
C           IDOP=1/0 (Y/N ON DOPPLER FREQ AND INTENSITY CORRECTION);
C           IATM=0 :  NO CORRECTION FOR ATMOSPHERIC ATTENUATION
C                1 :  CORRECT TOTAL NOISE FOR ATMOS. ATTEN. BY ARP 866
C                2 :  CORRECT TOTAL FOR ATMOS. ATTEN. BY BASS & SHIELDS
C           IEGA=1/0 (Y/N ON EXTRA GROUND ATTEN - ON TOTAL NOISE ONLY)
C           ISHLD=1/0 (Y/N FOR SHIELDING OF FAN,JET,CORE & TURBINE)
C           IGND=0 : NO GROUND REFLECTIONS - FREE FIELD
C                1 : FLAT 3 DB GROUND REFLECTION CORRECTION
C                2 : CALC GROUND REFLECTION FOR GROUND IMPEDANCE SPECIFIED
C           ICORR=1/0 (Y/N FOR ENGINE PARAMS TO BE CORR. TO AMBIENT)
C           TCORXP = EXPONENT FOR CORE TEMP. CORR. IN ENGINE PARAMETERS
C           FILBW = FRACTION OF FILTER BANDWIDTH WITH GAIN=1
C    THIS DATA INPUT IS FOR DEFAULT VALUES
      DATA IFAN,IJET,IFLAP,ICORE,ITURB,IAIRF,IATM,IEGA,IGND,ICORR,-
     1   ISHLD,FILBW/11*0,1./
      DATA NTHETA,ATHETA/19,0.,10.,20.,30.,40.,50.,60.,70.,80.,90.,-
     1      100.,110.,120.,130.,140.,150.,160.,170.,180.,190./
      DATA NPHI,APHI/3,0.,45.,90.,7*0./
      UNITS=ENG
      GAMMAF=1.4
      R=-1.
      TAMB=-1.
      PAMB=-1.
C       THESE NEG. VALUES TO DETECT IF DATA READ IN.  FINAL DEFAULTS
C           GIVEN AT STATEMENT 4.
      RH=70.
      NENG=1
      ISUPP=0
      IDOP=0
      FDOP=1.
      KI=1
      ISKIP=0
      IOUT(1)=4
      ITOT=1
      FUEL=0.
      TCORXP=1.
C
    1 READ(5,96) (COMENT(I),I=1,20)
      READ(5,GEOMT)
      READ(5,AMB)
      READ(5,SOURCE)
      READ(5,PARAM)
      IF(AEPP(1).GT.AEPP(NPARAM)) WRITE(6,95)
C
    2 IF(UNITS.EQ.ENG) GO TO 4
      TAMB=TAMB*1.8
      PAMB=PAMB*.02089
```

```
      R=R*3.28
      ZO=ZO*3.28
      ZI=ZI*3.28
      DO 3 I=1,NPARAM
      AVC(I)=AVC(I)*3.28
      AVF(I)=AVF(I)*3.28
      ATC(I)=ATC(I)*1.8
      ATF(I)=ATF(I)*1.8
      AFUEL(I)=AFUEL(I)*2.205
      AWAFAN(I)=AWAFAN(I)*2.205
      ADELT(I)=ADELT(I)*1.8
      AWCORE(I)=AWCORE(I)*2.205
      AP3(I)=AP3(I)*.02089
      AT3(I)=AT3(I)*1.8
      AT4(I)=AT4(I)*1.8
      ATCTUR(I)=ATCTUR(I)*1.8
    3 ATURTS(I)=ATURTS(I)*3.28
    4 IF(R.LT.0.) R=100.
      RM=R/3.28
      IF(TAMB.LT.0.) TAMB=518.7
      IF(PAMB.LT.0.) PAMB=2116.
C
      IOUT(1)=4
      C=41.447*SQRT(GAMMAF*TAMB)
      DO 5 L=1,24
      F(L)=10.**(.1*FLOAT(L+16))
      ATM(L)=AIRATT(TAMB,RH,F(L))
    5 IFREQ(L)=F(L)
      F1=.78250188+.10874906*FILBW
      F2=1.-.10874906*FILBW
      F3=1.+.12201845*FILBW
      F4=1.2440369-.12201845*FILBW
C
      DO 6 I=1,NTHETA
      ANGF=.008727*(ATHETA(I)+ATHETA(I+1))
      IF(I.EQ.NTHETA) ANGF=3.1416
      AREA(I)=6.2832*R**2*(COS(ANGIN)-COS(ANGF))
    6 ANGIN=ANGF
C
    7 ANGIN=0.
      TOTPW=0.
      VSTORE=VI
      DO 8 L=1,24
      TP(L)=1.E-50
      PWL(L)=0.
      TOTPWL(L)=0.
      DO 8 I=1,20
    8 TSP(L,I)=0.
C
      READ(5,OPER)
      IF(UNITS.EQ.SI.AND.VI.NE.VSTORE) VI=VI*3.28
      TTOT=TAMB+VI*VI/12025.1
      PTOT=PAMB*(TTOT/TAMB)**3.5
      TCORR=TTOT/518.7
      TCORR1=SQRT(TCORR)
      TCORR2=TCORR**TCORXP
      PCORR=PTOT/2116.
      WCORR=PCORR/TCORR1
C
      PHI=APHI(1)
      TPW=0.
      VIM=VI/3.28
   10 IF(IFAN.EQ.0) GO TO 20
      CALL TERP(ATIPM,EPPI,1.,1.,AEPP,1.,1.,NPARAM,1,1,TIPM)
      CALL TERP(AWAFAN,EPPI,1.,1.,AEPP,1.,1.,NPARAM,1,1,WAFAN)
      CALL TERP(ARPM,EPPI,1.,1.,AEPP,1.,1.,NPARAM,1,1,RPM)
      CALL TERP(ADELT,EPPI,1.,1.,AEPP,1.,1.,NPARAM,1,1,DELT)
      CALL TERP(AFPR,EPPI,1.,1.,AEPP,1.,1.,NPARAM,1,1,FPR)
      CALL TERP(ATIPM2,EPPI,1.,1.,AEPP,1.,1.,NPARAM,1,1,TIPM2)
```

```
      IF(ICORR.EQ.0) GO TO 11
      WAFAN=WAFAN*WCORR
      RPM=RPM*TCORR1
      DELT=DELT*TCORR
   11 WRITE(6,97) (COMENT(I),I=1,20)
      WRITE(6,106) EPPI
      WRITE(6,107)
      IF(UNITS.EQ.ENG) WRITE(6,99) NENG,R,PHI
      IF(UNITS.EQ.SI) WRITE(6,98) NENG,RM,PHI
      DO 13 I=1,NTHETA
      IJ=I
      THETA=ATHETA(I)
      IF(IDOP.EQ.1) FDOP=1.-VI*COS(THETA*AR)/C
      CALL FAN
      DO 12 L=1,24
      FSPL(L,I)=SPL(L)
      PW=TP(L)*AREA(I)
      TPW=TPW+PW
      PWL(L)=PWL(L)+PW
      TSP(L,I)=TSP(L,I)+TP(L)
   12 TP(L)=1.E-50
      FOASPL(I)=OASPL
      FPNL(I)=PNL
   13 FPNLT(I)=PNLT
      WRITE(6,101) (ATHETA(I),I=1,NTHETA)
      TPW=10.*ALOG10(TPW)
      DO 14 L=1,24
      PW=10.*ALOG10(PWL(L))
      WRITE(6,102) IFREQ(L),(FSPL(L,I),I=1,NTHETA),PW
      TOTPWL(L)=TOTPWL(L)+PWL(L)
   14 PWL(L)=0.
      WRITE(6,103) (FOASPL(I),I=1,NTHETA),TPW
      WRITE(6,104) (FPNL(I),I=1,NTHETA)
      WRITE(6,105) (FPNLT(I),I=1,NTHETA)
C
   20 IF(IJET.EQ.0) GO TO 30
      CALL TERP(AVC,EPPI,1.,1.,AEPP,1.,1.,NPARAM,1,1,VC)
      CALL TERP(AVF,EPPI,1.,1.,AEPP,1.,1.,NPARAM,1,1,VF)
      CALL TERP(ATC,EPPI,1.,1.,AEPP,1.,1.,NPARAM,1,1,TC)
      CALL TERP(ATF,EPPI,1.,1.,AEPP,1.,1.,NPARAM,1,1,TF)
      CALL TERP(AFUEL,EPPI,1.,1.,AEPP,1.,1.,NPARAM,1,1,FUEL)
      CALL TERP(AWCORE,EPPI,1.,1.,AEPP,1.,1.,NPARAM,1,1,WCORE)
      IF(ICORR.EQ.0) GO TO 21
      VC=VC*TCORR1
      VF=VF*TCORR1
      TC=TC*TCORR2
      TF=TF*TCORR
      FUEL=FUEL*PCORR*TCORR1
      WCORE=WCORE*WCORR
   21 TPW=0.
      WRITE(6,97) (COMENT(I),I=1,20)
      WRITE(6,106) EPPI
      WRITE(6,108)
      IF(UNITS.EQ.ENG) WRITE(6,99) NENG,R,PHI
      IF(UNITS.EQ.SI) WRITE(6,98) NENG,RM,PHI
      DO 23 I=1,NTHETA
      IJ=I
      THETA=ATHETA(I)
      IF(IDOP.EQ.1) FDOP=1.-VI*COS(THETA*AR)/C
      CALL JET
      DO 22 L=1,24
      FSPL(L,I)=SPL(L)
      PW=TP(L)*AREA(I)
      TPW=TPW+PW
      PWL(L)=PWL(L)+PW
      TSP(L,I)=TSP(L,I)+TP(L)
   22 TP(L)=1.E-50
      FOASPL(I)=OASPL
      FPNL(I)=PNL
```

```
   23 FPNLT(I)=PNLT
      WRITE(6,101) (ATHETA(I),I=1,NTHETA)
      TPW=10.*ALOG10(TPW)
      DO 24 L=1,24
      PW=10.*ALOG10(PWL(L))
      WRITE(6,102) IFREQ(L),(FSPL(L,I),I=1,NTHETA),PW
      TOTPWL(L)=TOTPWL(L)+PWL(L)
   24 PWL(L)=0.
      WRITE(6,103) (FOASPL(I),I=1,NTHETA),TPW
      WRITE(6,104) (FPNL(I),I=1,NTHETA)
      WRITE(6,105) (FPNLT(I),I=1,NTHETA)
C
   30 IF(ICORE.EQ.0) GO TO 40
      IF(IJET.EQ.0) CALL TERP(AWCORE,EPPI,1.,1.,AEPP,1.,1.,NPARAM,1,1,-
     1    WCORE)
      CALL TERP(AP3,EPPI,1.,1.,AEPP,1.,1.,NPARAM,1,1,P3)
      CALL TERP(AT3,EPPI,1.,1.,AEPP,1.,1.,NPARAM,1,1,T3)
      CALL TERP(AT4,EPPI,1.,1.,AEPP,1.,1.,NPARAM,1,1,T4)
      IF(IJET.EQ.0) CALL TERP(AFUEL,EPPI,1.,1.,AEPP,1.,1.,NPARAM,1,1,-
     1    FUEL)
      IF(ICORR.EQ.0) GO TO 31
      IF(IJET.EQ.0) WCORE=WCORE*WCORR
      P3=P3*PCORR
      T3=T3*TCORR
      T4=T4*TCORR2
      IF(IJET.EQ.0) FUEL=FUEL*PCORR*TCORR1
   31 TPW=0.
      WRITE(6,97) (COMENT(I),I=1,20)
      WRITE(6,106) EPPI
      WRITE(6,109)
      IF(UNITS.EQ.ENG) WRITE(6,99) NENG,R,PHI
      IF(UNITS.EQ.SI) WRITE(6,98) NENG,RM,PHI
      DO 33 I=1,NTHETA
      IJ=I
      THETA=ATHETA(I)
      IF(IDOP.EQ.1) FDOP=1.-VI*COS(THETA*AR)/C
      CALL CORE
      DO 32 L=1,24
      FSPL(L,I)=SPL(L)
      PW=TP(L)*AREA(I)
      TPW=TPW+PW
      PWL(L)=PWL(L)+PW
      TSP(L,I)=TSP(L,I)+TP(L)
   32 TP(L)=1.E-50
      FOASPL(I)=OASPL
      FPNL(I)=PNL
   33 FPNLT(I)=PNLT
      WRITE(6,101) (ATHETA(I),I=1,NTHETA)
      TPW=10.*ALOG10(TPW)
      DO 34 L=1,24
      PW=10.*ALOG10(PWL(L))
      WRITE(6,102) IFREQ(L),(FSPL(L,I),I=1,NTHETA),PW
      TOTPWL(L)=TOTPWL(L)+PWL(L)
   34 PWL(L)=0.
      WRITE(6,103) (FOASPL(I),I=1,NTHETA),TPW
      WRITE(6,104) (FPNL(I),I=1,NTHETA)
      WRITE(6,105) (FPNLT(I),I=1,NTHETA)
C
   40 IF(ITURB.EQ.0) GO TO 50
      IF(IJET.EQ.0) CALL TERP(ATC,EPPI,1.,1.,AEPP,1.,1.,NPARAM,1,1,TC)
      IF(IFAN.EQ.0) CALL TERP(ARPM,EPPI,1.,1.,AEPP,1.,1.,NPARAM,1,1,RPM)
      IF(IJET.EQ.0.AND.ICORE.EQ.0) CALL TERP(AWCORE,EPPI,1.,1.,AEPP,1.,-
     1   1.,NPARAM,1,1,WCORE)
      IF(IJET.EQ.0.AND.ICORE.EQ.0) CALL TERP(AFUEL,EPPI,1.,1.,AEPP,1.,-
     1  1.,NPARAM,1,1,FUEL)
      CALL TERP(ATURTS,EPPI,1.,1.,AEPP,1.,1.,NPARAM,1,1,TURTS)
      CALL TERP(ATCTUR,EPPI,1.,1.,AEPP,1.,1.,NPARAM,1,1,TCTUR)
      IF(TCTUR.LT.1.) CALL TERP(ATC,EPPI,1.,1.,AEPP,1.,1.,NPARAM,1,1,-
     1  TCTUR)
```

```
      IF(ICORR.EQ.0) GO TO 41
      TCTUR=TCTUR*TCORR2
      IF(IFAN.EQ.0) RPM=RPM*TCORR1
      IF(IJET.EQ.0.AND.ICORE.EQ.0) WCORE=WCORE*WCORR
      IF(IJET.EQ.0.AND.ICORE.EQ.0) FUEL=FUEL*PCORR*TCORR1
      TURTS=TURTS*TCORR1
   41 TPW=0.
      WRITE(6,97) (COMENT(I),I=1,20)
      WRITE(6,106) EPPI
      WRITE(6,110)
      IF(UNITS.EQ.ENG) WRITE(6,99) NENG,R,PHI
      IF(UNITS.EQ.SI) WRITE(6,98) NENG,RM,PHI
      DO 43 I=1,NTHETA
      IJ=I
      THETA=ATHETA(I)
      IF(IDOP.EQ.1) FDOP=1.-VI*COS(THETA*AR)/C
      CALL TURB
      DO 42 L=1,24
      FSPL(L,I)=SPL(L)
      PW=TP(L)*AREA(I)
      TPW=TPW+PW
      PWL(L)=PWL(L)+PW
      TSP(L,I)=TSP(L,I)+TP(L)
   42 TP(L)=1.E-50
      FOASPL(I)=OASPL
      FPNL(I)=PNL
   43 FPNLT(I)=PNLT
      WRITE(6,101) (ATHETA(I),I=1,NTHETA)
      TPW=10.*ALOG10(TPW)
      DO 44 L=1,24
      PW=10.*ALOG10(PWL(L))
      WRITE(6,102) IFREQ(L),(FSPL(L,I),I=1,NTHETA),PW
      TOTPWL(L)=TOTPWL(L)+PWL(L)
   44 PWL(L)=0.
      WRITE(6,103) (FOASPL(I),I=1,NTHETA),TPW
      WRITE(6,104) (FPNL(I),I=1,NTHETA)
      WRITE(6,105) (FPNLT(I),I=1,NTHETA)
C
   50 IF(ISHLD.NE.1) GO TO 60
C        ASSUMES NO SHIELDING EFFECT ON TOTAL ACOUSTIC POWER
      DO 57 J=1,NPHI
      PHI=APHI(J)
      COSPHI=COS(PHI*AR)
      SINPHI=SIN(PHI*AR)
      WRITE(6,97) (COMENT(I),I=1,20)
      WRITE(6,106) EPPI
      IF(UNITS.EQ.ENG) WRITE(6,99) NENG,R,PHI
      IF(UNITS.EQ.SI) WRITE(6,98) NENG,RM,PHI
      WRITE(6,117)
      DO 55 I=1,NTHETA
      IJ=I*J
      ADD=0.
      THETA=ATHETA(I)
      IF(ABS(THETA-90.).LT.1.E-10) GO TO 51
      IF(THETA.GT.90.) ADD=180.
      TANTH=TAN(THETA*AR)
      THETAF=ATAN(COSPHI*TANTH)/AR + ADD
      THETAH=ATAN(SINPHI*TANTH)/AR + ADD
      GO TO 52
   51 THETAF=90.
      THETAH=90.
   52 DO 53 L=1,24
   53 TP(L)=TSP(L,I)
      CALL SHLD
      DO 54 L=1,24
      FSPL(L,I)=SPL(L)
      IF(J.EQ.1) TSP(L,I)=TP(L)
   54 TP(L)=1.E-50
      FOASPL(I)=OASPL
```

```
      FPNL(I)=PNL
   55 FPNLT(I)=PNLT
      WRITE(6,101) (ATHETA(I),I=1,NTHETA)
      DO 56 L=1,24
   56 WRITE(6,102) IFREQ(L),(FSPL(L,I),I=1,NTHETA)
      WRITE(6,118)
      WRITE(6,103) (FOASPL(I),I=1,NTHETA)
      WRITE(6,104) (FPNL(I),I=1,NTHETA)
   57 WRITE(6,105) (FPNLT(I),I=1,NTHETA)
C
   60 IF(IFLAP.EQ.0) GO TO 70
      IF(IJET.EQ.1) GO TO 61
      CALL TERP(AVC,EPPI,1.,1.,AEPP,1.,1.,NPARAM,1,1,VC)
      CALL TERP(AVF,EPPI,1.,1.,AEPP,1.,1.,NPARAM,1,1,VF)
      IF(ITURB.EQ.0) CALL TERP(ATC,EPPI,1.,1.,AEPP,1.,1.,NPARAM,1,1,TC)
      IF(ICORR.EQ.0) GO TO 61
      IF(ITURB.EQ.0) TC=TC*TCORR2
      VC=VC*TCORR1
      VF=VF*TCORR1
   61 DO 68 J=1,NPHI
      PHI=APHI(J)
      COSPHI=COS(PHI*AR)
      TPW=0.
      WRITE(6,97) (COMENT(I),I=1,20)
      WRITE(6,106) EPPI
      WRITE(6,111)
      IF(UNITS.EQ.ENG) WRITE(6,99) NENG,R,PHI
      IF(UNITS.EQ.SI) WRITE(6,98) NENG,RM,PHI
      DO 65 I=1,NTHETA
      IJ=I*J
      ADD=0.
      THETA=ATHETA(I)
      IF(ABS(THETA-90.).LT.1.E-10) GO TO 62
      IF(THETA.GT.90.) ADD=180.
      TANTH=TAN(THETA*AR)
      THETAF=ATAN(COSPHI*TANTH)/AR + ADD
      GO TO 63
   62 THETAF=90.
   63 IF(IDOP.EQ.1) FDOP=1.-VI*COS(THETA*AR)/C
      CALL FLAP
      DO 64 L=1,24
      FSPL(L,I)=SPL(L)
      IF(J.GT.1) GO TO 64
      PW=TP(L)*AREA(I)
      TPW=TPW+PW
      PWL(L)=PWL(L)+PW
      TSP(L,I)=TSP(L,I)+TP(L)
   64 TP(L)=1.E-50
      FOASPL(I)=OASPL
      FPNL(I)=PNL
   65 FPNLT(I)=PNLT
      WRITE(6,101) (ATHETA(I),I=1,NTHETA)
      IF(J.EQ.1) TPW=10.*ALOG10(TPW)
      DO 67 L=1,24
      IF(J.GT.1) GO TO 66
      PW=10.*ALOG10(PWL(L))
      WRITE(6,102) IFREQ(L),(FSPL(L,I),I=1,NTHETA),PW
      TOTPWL(L)=TOTPWL(L)+PWL(L)
      GO TO 67
   66 WRITE(6,102) IFREQ(L),(FSPL(L,I),I=1,NTHETA)
   67 PWL(L)=0.
      WRITE(6,103) (FOASPL(I),I=1,NTHETA),TPW
      WRITE(6,104) (FPNL(I),I=1,NTHETA)
   68 WRITE(6,105) (FPNLT(I),I=1,NTHETA)
C
   70 IF(IAIRF.EQ.0) GO TO 80
      DO 75 J=1,NPHI
      PHI=APHI(J)
      TPW=0.
```

```
      WRITE(6,97) (COMENT(I),I=1,20)
      IF(UNITS.EQ.ENG) WRITE(6,115) VI
      IF(UNITS.EQ.SI) WRITE(6,116) VIM
      WRITE(6,112)
      IF(UNITS.EQ.ENG) WRITE(6,99) NENG,R,PHI
      IF(UNITS.EQ.SI) WRITE(6,98) NENG,RM,PHI
      DO 72 I=1,NTHETA
      IJ=I*J
      THETAF=ATHETA(I)
      IF(IDOP.EQ.1) FDOP=1.-VI*COS(THETA*AR)/C
      CALL AIRFR
      DO 71 L=1,24
      FSPL(L.I)=SPL(L)
      IF(J.GT.1) GO TO 71
      PW=TP(L)*AREA(I)
      TPW=TPW+PW
      PWL(L)=PWL(L)+PW
      TSP(L,I)=TSP(L,I)+TP(L)
   71 TP(L)=1.E-50
      FOASPL(I)=OASPL
      FPNL(I)=PNL
   72 FPNLT(I)=PNLT
      WRITE(6,101) (ATHETA(I),I=1,NTHETA)
      IF(J.EQ.1) TPW=10.*ALOG10(TPW)
      DO 74 L=1,24
      IF(J.GT.1) GO TO 73
      PW=10.*ALOG10(PWL(L))
      WRITE(6,102) IFREQ(L),(FSPL(L,I),I=1,NTHETA),PW
      TOTPWL(L)=TOTPWL(L)+PWL(L)
      GO TO 74
   73 WRITE(6,102) IFREQ(L),(FSPL(L,I),I=1,NTHETA)
   74 PWL(L)=0.
      WRITE(6,103) (FOASPL(I),I=1,NTHETA),TPW
      WRITE(6,104) (FPNL(I),I=1,NTHETA)
   75 WRITE(6,105) (FPNLT(I),I=1,NTHETA)
C
   80 KI=0
      IF(ITOT.EQ.0) GO TO 7
      WRITE(6,97) (COMENT(I),I=1,20)
      WRITE(6,106) EPPI
      WRITE(6,113)
      PHI=APHI(1)
      IF(UNITS.EQ.ENG) WRITE(6,99) NENG,R,PHI
      IF(UNITS.EQ.SI) WRITE(6,98) NENG,RM,PHI
      WRITE(6,114) IFAN,IJET,IFLAP,ICORE,ITURB,IAIRF,IREVR,IATM,IGND,-
     1    IEGA,IDOP,ISHLD,ICORR
      WRITE(6,101) (ATHETA(I),I=1,NTHETA)
      DO 83 I=1,NTHETA
      DO 81 L=1,24
      SSPL(L)=10.*ALOG10(TSP(L,I))
      IF(IATM.EQ.1) SSPL(L)=SSPL(L)-ATM(L)*R/1000.
      IF(IGND.EQ.1) SSPL(L)=SSPL(L)+3.01
   81 CONTINUE
      IF(IATM.EQ.2) CALL BASAT(R,TAMB,PAMB,RH,SSPL)
      IF(IEGA.EQ.1) CALL EGAC(SSPL)
      IJ=I
      IF(IGND.EQ.2) CALL GNDRF(SSPL)
      TSUM=0.
      DO 82 L=1,24
      TSUM=TSUM+10.**(SSPL(L)/10.)
   82 FSPL(L,I)=SSPL(L)
      FPNL(I)=PERNOY(SSPL)
      FPNLT(I)=FPNL(I)+TONE(SSPL)
      FOASPL(I)=10.*ALOG10(TSUM)
   83 CONTINUE
      DO 84 L=1,24
      PW=10.*ALOG10(TOTPWL(L))
      TOTPW=TOTPW+TOTPWL(L)
   84 WRITE(6,102) IFREQ(L),(FSPL(L,I),I=1,NTHETA),PW
```

```
      TOTPW=10.*ALOG10(TOTPW)
      WRITE(6,103) (FOASPL(I),I=1,NTHETA),TOTPW
      WRITE(6,104) (FPNL(I),I=1,NTHETA)
      WRITE(6,105) (FPNLT(I),I=1,NTHETA)
      GO TO 7
C
   95 FORMAT(2X,'WARNING: ENGINE PARAMETER INPUTS ARE NOT IN ORDER OF-
     1 ASCENDING EPP')
   96 FORMAT(8X,20A4)
   97 FORMAT(1H1,20X,20A4)
   98 FORMAT(15X,I2,' ENGINE(S) AT A CONSTANT RADIUS OF',F6.1,' METERS,-
     1 IN THE PLANE OF PHI =',F5.1,' DEGREES'//)
   99 FORMAT(15X,I2,' ENGINE(S) AT A CONSTANT RADIUS OF',F6.1,' FEET,-
     1 IN THE PLANE OF PHI =',F5.1,' DEGREES'//)
  101 FORMAT(/30X,' POLAR ANGLE, THETA, DEGREES',60X,'POWER LEVEL'/1X,-
     1    4HFREQ,1X,20F6.1)
  102 FORMAT(1X,I4,21F6.1)
  103 FORMAT(/1X,4HOSPL,21F6.1)
  104 FORMAT(/1X,3HPNL,1X,20F6.1)
  105 FORMAT(/1X,4HPNLT,20F6.1)
  106 FORMAT(/35X,'ENGINE PERFORMANCE PARAMETER =',F8.2)
  107 FORMAT(//40X,'FAN NOISE SPECTRA')
  108 FORMAT(//40X,'JET NOISE SPECTRA')
  109 FORMAT(//40X,'CORE NOISE SPECTRA')
  110 FORMAT(//40X,'TURBINE NOISE SPECTRA')
  111 FORMAT(//40X,'FLAP NOISE SPECTRA')
  112 FORMAT(//40X,'AIRFRAME NOISE SPECTRA')
  113 FORMAT(//30X,'NOISE SPECTRA OF TOTAL OF ALL SOURCES')
  114 FORMAT(1X,'SOURCES AND EFFECTS INCLUDED ARE DESIGNATED BY CODE-
     1 > OR =1. '/1X,'SOURCES:   IFAN =',I1,8H, IJET =,I1,9H, IFLAP =,-
     2 I1,9H, ICORE =,I1,9H, ITURB =,I1,9H, IAIRF =,I1,9H, IREVR =,-
     3 I1/1X,'PROPAGATION EFFECTS:   IATM =',I1,8H, IGND =,I1,-
     4 8H, IEGA =,I1,8H, IDOP =,I1,9H, ISHLD =,I1,9H, ICORR =,I1)
  115 FORMAT(/35X,'AIRCRAFT VELOCITY =',F8.2,4H FPS)
  116 FORMAT(/35X,'AIRCRAFT VELOCITY =',F8.2,4H M/S)
  117 FORMAT(//25X,'SHIELDING FACTORS APPLIED TO THE PREVIOUS SOURCES')
  118 FORMAT(/' THE FOLLOWING ARE LEVELS AFTER ABOVE SHIELDING')
      END
```

Subroutine FAN

```
C        SUBROUTINE TO CALCULATE INLET AND EXHAUST FAN NOISE
C                 (OR COMPRESSOR INLET NOISE)
C            BY HEIDMANN ANOP PREDICTION PROCEDURE  (NASA TMX-71763)
C
C        CALLED BY NOIS OR RADIUS
C        CALLS SUBROUTINES TERP, PERNOY, TONE
C        INFLOW:  TP,F,UNITS,IOUT,FDOP,C,TAMB,NENG,ISUPP,F1,F2,F3,F4
C                 R,THETA,X,Y,TAU,IJ,KI, WAFAN,RPM,TIPM,TIPM2,DELT,FPR
C        RETURNS:  TP,SPL,OASPL,PNL,PNLT
C
C          REQUIRES PARAM INPUT OF AWAFAN,ARPM,ADELT OR AFPR,
C              OPTIONAL ATIPM,ATIPM2(2ND STAGE)
C
      SUBROUTINE FAN
      DIMENSION FIG7A(11),THET7A(11),FIG7B(14),THET7B(14),FIG13A(10),-
     1  THT13A(10),FIG13B(14),FIG16(12),THT16(12),C1(3),-
     2  C2(3),C3(3),C4(3),DCP(24),DP(24),DPX(24),AWREF(26),ATR(26)
      DIMENSION SUPPIN(24),SUPPEX(24),SUPIN(24),SUPEX(24)
      COMMON/GEOM/R,THETA,THETAF,THETAH,PHI,VIEW,HEAD,PSYI,FLAPI,EPPI,-
     1  VI,X,Y,TAU,IJ,KI
      COMMON/SPECT/TP(24),SPL(24),F(24),OASPL,PNL,PNLT,F1,F2,F3,F4
      COMMON/PARAM/VC,VF,TC,TF,FUEL,WAFAN,RPM,TIPM,TIPM2,DELT,FPR
      COMMON UNITS,ISKIP,IOUT(3),IREV,ILG,FDOP,C,TAMB,PAMB,RH,NENG,ISUPP
      NAMELIST/FANDA/JOUT,IGV,IFD,IEXH,NH,NSTG,NBL,NVAN,FANDIA,-
     1 FANHUB,TIPMD,RSS,NBL2,NVAN2,FAND2,TIPMD2,RSS2,PRAT,TRAT,GAMMAF,-
     2 FANEFF,FANEF2,ISUPPR,SUPPIN,SUPPEX,EDOP,EDOP2,DECMPT
C          IGV=1/0 (Y/N INLET GUIDE VANES);
```

```
C           IFD=1/0 (Y/N INLET FLOW DISTORTION);
C           IEXH=0/1/2 (FAN INLET ONLY/EXHAUST ONLY/OR BOTH INCLUDED);
C           NSTG=NO. OF FAN STAGES;
C           NH= NO. OF HARMONICS TO BE CONSIDERED IN TONES;
C           NBL(NBL2)=NO. OF FAN BLADES (2ND STAGE); NVAN(NVAN2)=NO. VANES;
C           FANDIA(FAND2) = FAN DIAMETER IN M(FT);
C           FANHUB=DIAMETER OF FIRST STAGE FAN HUB, IN M(FT);
C           TIPMD(TIPMD2)=DESIGN TIP RELATIVE MACH NUMBER;
C           RSS(RSS2)=ROTOR-STATOR SPACING IN PERCENT;
C           GAMMAF= GAMMA OF FAN AIR; FANEFF(FANEF2)=FAN EFFICIENCY;
C             (GAMMAF AND FANEFF REQUIRED IF USING "AFPR" IN "PARAM" INPUT
C                  INSTEAD OF "ADELT")
C           DECMPT=DECREMENT TO APPLY TO COMBINATION TONES, DB
C           PRAT=RATIO OF SECOND STAGE FPR TO FIRST STAGE FPR
C           TRAT=  "    "     "      "  DELT "     "      "   DELT
C           ISUPPR=1/0 (Y/N SUPPRESSION TO BE APPLIED TO INLET AND EXHAUST)
C           SUPPIN/SUPPEX = INLET/EXHAUST SUPPRESSION SPECTRA
C           EDOP/EDOP2 = EXP. ON SOURCE MOTION AMPLIF. (DEFAULT=4.)
        DATA FIG7A/1.,0.,0.,0.,2.,4.5,7.5,11.,15.,19.5,25./
        DATA THET7A/10.,20.,30.,40.,50.,60.,70.,80.,90.,100.,110./
        DATA FIG7B/15.8,11.5,8.,5.,2.7,1.2,.3,0.,2.,6.,10.,15.,20.,15./
        DATA THET7B/60.,70.,80.,90.,100.,110.,120.,130.,140.,150.,160.,-
     1  170.,180.,190./
        DATA FIG13A/1.5,0.,0.,0.,1.2,3.5,6.8,10.5,14.5,19./
        DATA THT13A/10.,20.,30.,40.,50.,60.,70.,80.,90.,100./
        DATA FIG13B/15.,11.,8.,5.,3.,1.,0.,0.,2.,5.5,9.,13.,18.,13./
C           ABSCISSA OF FIG 7B USED FOR FIG 13B
        DATA FIG16/9.5,8.5,7.,5.,2.,0.,0.,3.5,7.5,9.,13.5,9./
        DATA THT16/0.,10.,20.,30.,40.,50.,60.,70.,80.,90.,180.,270./
        DATA C1/39.28,19.59,9.96/,C2/79.5,83.6,81.5/,C3/-3.,-5.,-5./,-
     1  C4/3.,5.,3./
C           DATA TABLES FOR USE IN CALC FAN TIP REL MACH NO.(FIRST STAGE
C                     ONLY, WITH GAMMAF=1.4)
        DATA AWREF/0.,8.495,11.9542,14.5675,16.7366,18.6179,22.515,25.67,-
     1  30.643,34.479,37.552,38.869,40.062,41.146,42.131,43.026,43.839,-
     1  44.576,45.245,45.849,46.393,47.317,48.044,48.995,49.386,49.41/
        DATA ATR/1.,.998,.996,.994,.992,.99,.985,.98,.97,.96,.95,.945,-
     1  .94,.935,.93,.925,.92,.915,.91,.905,.9,.89,.88,.86,.84,.8333333/
C           DEFAULT VALUES
        DATA GAMMAF,IEXH,NVAN2,NBL2,NH,IGV,IFD,NSTG/1.4,2,2,1,5,0,0,1/
        DATA SI,ENG/2HSI,3HENG/,EDOP,EDOP2/4.,4./
        DATA AR,DISTOR,DECMPT/.0174533,2*0./
C
        IF(IJ.NE.1.OR.KI.GT.1) GO TO 8
        IF(KI.EQ.0) GO TO 2
        ISUPPR=ISUPP
        JOUT=IOUT(1)
        READ(5,FANDA)
        IF(UNITS.EQ.ENG) GO TO 1
        FANDIA=FANDIA*3.28
        FANHUB=FANHUB*3.28
        FAND2=FAND2*3.28
C
      1 VBRAT=1.-FLOAT(NVAN)/FLOAT(NBL)
        IF(VBRAT.EQ.0) VBRAT=2.
        AFAN=.7854*(FANDIA*FANDIA-FANHUB*FANHUB)
        GAM1=GAMMAF-1.
        GAMRAT=GAM1/GAMMAF
        DRSS=5.*ALOG10(RSS/300.)
        IF(RSS.GT.100..AND.IFD.EQ.1) DRSS=-2.386
        FTIPMD=0.
        IF(TIPMD.GT.1.) FTIPMD=20.*ALOG10(TIPMD)
C
      2 IF(JOUT.NE.4) GO TO 6
        IF(TIPM.GT..1) GO TO 3
        WREF=WAFAN/AFAN
        CALL TERP(ATR,WREF,1.,1.,AWREF,1.,1.,26,1,1,TR)
        TIPM=SQRT((2./TR-2.)/GAM1+.0027416*(RPM*FANDIA/C)**2/TR)
      3 IF(DELT.LT..01) DELT=TAMB*(FPR**GAMRAT-1.)/FANEFF
```

```
      IF(UNITS.EQ.SI) GO TO 4
      WRITE(6,95)RPM,WAFAN,FANDIA,TIPM,TIPMD,DELT,FPR,NBL,NVAN,RSS,-
     1     NSTG,FANEFF,IGV,IFD,IEXH,NH,GAMMAF,FANHUB
      GO TO 5
    4 WAFANM=WAFAN/2.205
      DELTM=DELT/1.8
      FANDIM=FANDIA/3.28
      FANHUM=FANHUB/3.28
      WRITE(6,96)RPM,WAFANM,FANDIM,TIPM,TIPMD,DELTM,FPR,NBL,NVAN,RSS,-
     1     NSTG,FANEFF,IGV,IFD,IEXH,NH,GAMMAF,FANHUM
    5 IF(NSTG.EQ.1) GO TO 6
      IF(TIPM2.LT..01) TIPM2=TIPM*TIPMD2/TIPMD
      TRATX=TRAT
      IF(TRAT.EQ.0.) TRATX=(TAMB/DELT+1.)*((FPR*PRAT)**GAMRAT-1.)/FANEF2
      IF(UNITS.EQ.ENG) WRITE(6,97) FAND2,TIPM2,TIPMD2,TRATX,PRAT,NBL2,-
     1    NVAN2,RSS2,FANEF2
      FAND2M=FAND2/3.28
      IF(UNITS.EQ.SI) WRITE(6,98) FAND2M,TIPM2,TIPMD2,TRATX,PRAT,NBL2,-
     1    NVAN2,RSS2,FANEF2
    6 IF(ISUPPR.NE.1) GO TO 8
      IF(JOUT.EQ.4) WRITE(6,103) (SUPPIN(L),L=1,24),(SUPPEX(L),L=1,24)
      DO 7 L=1,24
      SUPIN(L)=10.**(.1*SUPPIN(L))
    7 SUPEX(L)=10.**(.1*SUPPEX(L))
C
    8 IF(DELT.LT..01) DELT=TAMB*(FPR**GAMRAT-1.)/FANEFF
      RLOG=20.*ALOG10(R/3.28)
      TSQEM=10.*ALOG10(DELT**2*WAFAN/FDOP**EDOP)
      BPF=RPM*FLOAT(NBL)/60./FDOP
      SPLPK=58.5+TSQEM-DRSS-RLOG+FTIPMD
      TONLV=SPLPK+2.-DRSS
      SPLPKX=SPLPK+1.5
C ******   CALCULATE FAN FACE SPEED OF SOUND, CX, ASSUMING AIR
      WREF=WAFAN/AFAN
      CALL TERP(ATR,WREF,1.,1.,AWREF,1.,1.,26,1,1,TR)
      TX = TR*(TAMB+VI*VI/12015.1)
      CX=C*SQRT(TX/TAMB)
      RTSM=.05236*RPM*FANDIA/CX
C ******   TO CALC TIPM IF NOT SUPPLIED
      IF(TIPM.LT..01) TIPM=SQRT((2./TR-2.)/GAM1+RTSM*RTSM)
    9 DTIPM=20.*ALOG10(TIPM)
      IF(TIPM.GT..9) SPLPK=SPLPK-DTIPM-.91515
      IF(TIPM.GT.1.) SPLPKX=SPLPKX-DTIPM
      IF(IGV.EQ.1) SPLPKX=SPLPKX+3.
      IF(TIPM.LE..72) GO TO 10
      DTIPM1=2.5*DTIPM+7.133
      DTIPM2=3.*FTIPMD-4.*DTIPM-1.
      TONLV=TONLV+AMIN1(DTIPM1,DTIPM2)
   10 TONLVX=SPLPKX+3.-DRSS
      IF(IGV.EQ.1) TONLVX=TONLVX+3.
      CALL TERP(FIG7A,THETA,1.,1.,THET7A,1.,1.,11,1,1,FIG7AX)
      SPLPK=SPLPK-FIG7AX
      CALL TERP(FIG7B,THETA,1.,1.,THET7B,1.,1.,14,1,1,FIG7BX)
      SPLPKX=SPLPKX-FIG7BX
      CALL TERP(FIG13A,THETA,1.,1.,THT13A,1.,1.,10,1,1,F13AX)
      TONLV=TONLV-F13AX
      CALL TERP(FIG13B,THETA,1.,1.,THET7B,1.,1.,14,1,1,F13BX)
      TONLVX=TONLVX-F13BX
      CUTOF=ABS(RTSM/VBRAT)
      ICUT=0
      IF(CUTOF.LT.1.05.AND.RTSM.LT.1.) ICUT=1
      DO 11 L=1,24
      DCP(L)=0.
      DP(L)=0.
   11 DPX(L)=0.
      IF(TIPM.LE.1.) GO TO 15
C  ******    COMBINATION TONES
      CALL TERP(FIG16,THETA,1.,1.,THT16,1.,1.,12,1,1,DIR)
      DO 14 K=1,3
```

```
      FK=2.**K
      CM=30.+C1(K)*DTIPM
      CN=C2(K)-2.5*DTIPM
      COMBL=AMIN1(CM,CN)+TSQEM-DIR-RLOG-DECMPT
      IF(IGV.EQ.1) COMBL=COMBL-5.
      COMB=10.**(.1*COMBL)
      DO 12 L=1,24
      FRAT=BPF/FK/F(L)
      IF(FRAT.GT.1.12201845.OR.FRAT.LT..89125094) GO TO 12
      CF=F(L)
      GO TO 13
   12 CONTINUE
   13 DO 14 L=1,24
      FREQ=F(L)/CF
      IF(FREQ.LE.1.) SPEC=FREQ**C3(K)
      IF(FREQ.GT.1.) SPEC=FREQ**C4(K)
   14 DCP(L)=DCP(L)+COMB/SPEC
C  ******    TONES AT BPF AND HARMONICS (SEE FIGURES 8 & 9)
   15 DO 16 IH=1,NH
      FIH=IH
      HARM=3.*(FIH-1.)
      IF(IGV.EQ.1.AND.IH.GT.1) HARM=HARM+6.
      IF(ICUT.EQ.1.AND.IH.EQ.1) HARM=8.
      IF(IFD.EQ.1) DISTOR=10.**(.1*TONLV-FIH+1.)
      TONPWR=10.**(.1*(TONLV-HARM))+DISTOR
      TONPWX=10.**(.1*(TONLVX-HARM))
      DO 16 L=1,24
      FRAT=BPF*FIH/F(L)
      FR=1.
      IF(FRAT.GT.F4.OR.FRAT.LT.F1) GO TO 16
      IF(FRAT.GT.F3) FR=(F4-FRAT)/(F4-F3)
      IF(FRAT.LT.F2) FR=(FRAT-F1)/(F2-F1)
      DP(L)=DP(L)+TONPWR*FR
      DPX(L)=DPX(L)+TONPWX*FR
   16 CONTINUE
      IF(NSTG.EQ.1) GO TO 20
C  ******   FOR FANS OR COMPRESSORS OF TWO STAGES (REQUIRES
C                TRAT OR PRAT IN FANDA)
      IF(IJ.NE.1.OR.KI.NE.1) GO TO 17
      VBRAT2=1.-FLOAT(NVAN2)/FLOAT(NBL2)
      IF(VBRAT2.EQ.0) VBRAT2=2.
      DRSS2=5.*ALOG10(RSS2/300.)
      IF(RSS2.GT.100.) DRSS2=-2.386
      ETIPMD=0.
      IF(TIPMD2.GT.1.) ETIPMD=20.*ALOG10(TIPMD2)
   17 CX=C*SQRT((TX+DELT)/TAMB)
      IF(TRAT.NE.0.) DELT2=DELT*TRAT
      IF(TRAT.EQ.0.) DELT2=(TAMB+DELT)*((FPR*PRAT)**GAMRAT-1.)/FANEF2
      IF(TIPM2.EQ.0.) TIPM2=TIPM*TIPMD2/TIPMD
      SPLP2=58.5+10.*ALOG10(DELT2**2*WAFAN/FDOP**EDOP2)-DRSS2-RLOG+ETIPMD
      BPF2=RPM*FLOAT(NBL2)/60./FDOP
   18 SPLP2X=SPLP2+4.5
      TONLV=SPLP2+2.-DRSS2-F13AX
      DTIPM=20.*ALOG10(TIPM2)
      IF(TIPM2.GT..9) SPLP2=SPLP2-DTIPM-.91515
      IF(TIPM2.GT.1.) SPLP2X=SPLP2X-DTIPM
      DTIPM1=2.5*DTIPM+7.133
      DTIPM2=3.*ETIPMD-4.*DTIPM-1.
      TONLV=TONLV+AMIN1(DTIPM1,DTIPM2)
      TONLVX=SPLP2X+6.-DRSS2-F13BX
      SPLP2=SPLP2-FIG7AX
      SPLP2X=SPLP2X-FIG7BX
      RTSM2=.05236*RPM*FAND2/CX
      CUTOF=ABS(RTSM2/VBRAT2)
      ICUT=0
      IF(CUTOF.LT.1.05.AND.RTSM2.LT.1.) ICUT=1
C  ******   TONES AT BPF2 AND HARMONICS (NO COMBINATION TONES)
      DO 19 IH=1,NH
      FIH=IH
```

```
      HARM=3.*(FIH-1.)
      IF(IH.GT.1) HARM=HARM+6.
      IF(ICUT.EQ.1.AND.IH.EQ.1) HARM=8.
      TONPWR=10.**(.1*(TONLV-HARM))
      TONPWX=10.**(.1*(TONLVX-HARM))
      DO 19 L=1,24
      FRAT=BPF2*FIH/F(L)
      FR=1.
      IF(FRAT.GT.F4.OR.FRAT.LT.F1) GO TO 19
      IF(FRAT.GT.F3) FR=(F4-FRAT)/(F4-F3)
      IF(FRAT.LT.F2) FR=(FRAT-F1)/(F2-F1)
      DP(L)=DP(L)+TONPWR*FR
      DPX(L)=DPX(L)+TONPWX*FR
   19 CONTINUE
C
   20 SUM=0.
      DO 23 L=1,24
      FLOG=3.491*(ALOG(F(L)/BPF/2.5))**2
      PLEV=DP(L)+10.**(.1*(SPLPK-FLOG))
      IF(TIPM.GT.1.) PLEV=PLEV+DCP(L)
      PLEVEX=DPX(L)+10.**(.1*(SPLPKX-FLOG))
      IF(NSTG.EQ.1) GO TO 21
      FLOG2=3.491*(ALOG(F(L)/BPF2/2.5))**2
      PLEV=PLEV+10.**(.1*(SPLP2-FLOG2))
      PLEVEX=PLEVEX+10.**(.1*(SPLP2X-FLOG2))
   21 IF(ISUPPR.NE.1) GO TO 22
      PLEV=PLEV/SUPIN(L)
      PLEVEX=PLEVEX/SUPEX(L)
   22 IF(IEXH.EQ.1) PLEV=PLEVEX
      IF(IEXH.EQ.2) PLEV=PLEV+PLEVEX
      PLEV=NENG*PLEV
      SUM=SUM+PLEV
      SPL(L)=10.*ALOG10(PLEV)
      TP(L)=TP(L)+PLEV
   23 CONTINUE
      IF(JOUT.EQ.0) RETURN
      OASPL=10.*ALOG10(SUM)
      PNL=PERNOY(SPL)
      PNLT=PNL+TONE(SPL)
      IF(JOUT.EQ.1) WRITE(6,93) (SPL(L),L=1,24),OASPL,PNL,PNLT
      IF(JOUT.NE.2) RETURN
      IF(UNITS.EQ.ENG) WRITE(6,94) X,Y,TAU,OASPL,PNL,PNLT
      XM=X/3.28
      YM=Y/3.28
      IF(UNITS.EQ.SI) WRITE(6,94) XM,YM,TAU,OASPL,PNL,PNLT
      RETURN
   93 FORMAT(8H FAN    :,17F7.1/8X,7F7.1,21X,8H OASPL =,F7.1,6H PNL =,-
     1    F7.1,7H PNLT =,F7.1)
   94 FORMAT(9H FAN     :,2F8.1,F8.3,3F8.1)
   95 FORMAT(' INPUT PARAMETERS:  FAN SPEED =',F6.0,' RPM;  FAN MASS-
     1 FLOW (WAFAN) =',F6.1,' LB/S;  FAN DIAMETER (FANDIA) =',F6.3,-
     2 4H FT;,/5X,'TIP REL MACH NO.(TIPM) =',F6.3,';  DESIGN REL TIP-
     3 MACH (TIPMD) =',F6.3,';  TEMP RISE (DELT) =',F6.1,7H DEG R;,/5X,-
     4 'PRESS RATIO(1 STAGE)(FPR) =',F6.3,';  NO. BLADES(NBL) =',I3,-
     5 ';  NO. VANES(NVAN) =',I3,';  ROTOR/STATOR SPACING (RSS) =',-
     6 F5.0,3H %;,/5X,'NO. STAGES(NSTG) =',I2,';  STAGE EFF (FANEFF)-
     7 =',F5.3,';  INLET GUIDE VANES (IGV) =',I1,';  INLET FLOW DISTOR-
     8 (IFD) =',I1,1H;,/5X,'EXHAUST NOISE OPTION (IEXH) =',I1,';  NO.-
     9  OF TONE HARM CALC (NH) =',I2,';  AIR GAMMAF =',F5.2,'; FAN-
     1 HUB DIAM(FANHUB) =',F6.3,4H FT.)
   96 FORMAT(' INPUT PARAMETERS:  FAN SPEED =',F6.0,' RPM;  FAN MASS-
     1 FLOW (WAFAN) =',F6.1,' KG/S;  FAN DIAMETER (FANDIA) =',F6.3,-
     2 3H M;,/5X,'TIP REL MACH NO.(TIPM) =',F6.3,';  DESIGN REL TIP-
     3 MACH (TIPMD) =',F6.3,';  TEMP RISE (DELT) =',F6.1,7H DEG K;,/5X,-
     4 'PRESS RATIO(1 STAGE)(FPR) =',F6.3,';  NO. BLADES(NBL) =',I3,-
     5 ';  NO. VANES(NVAN) =',I3,';  ROTOR/STATOR SPACING (RSS) =',-
     6 F5.0,3H %;,/5X,'NO. STAGES(NSTG) =',I2,';  STAGE EFF (FANEFF)-
     7 =',F5.3,';  INLET GUIDE VANES (IGV) =',I1,';  INLET FLOW DISTOR-
     8 (IFD) =',I1,1H;,/5X,'EXHAUST NOISE OPTION (IEXH) =',I1,';  NO.-
```

```
     9  OF TONE HARM CALC (NH) =',I2,';  AIR GAMMAF =',F5.2,'; FAN-
     1 HUB DIAM(FANHUB) =',F6.3,3H M.)
  97 FORMAT('  SECOND STAGE:  DIAMETER (FAND2) =',F6.3,' FT;  TIP REL-
     1 MACH(TIPM2) =',F6.3,';  DES REL MACH(TIPMD2) =',F6.3,1H,/5X,-
     2 'SECOND/FIRST TEMP RISE RATIO (TRAT) =',F5.3,';  SEC/FIRST PRESS-
     3 RISE (PRAT) =',F5.3,1H;,/5X,'NO. BLADES(NBL2) =',I3,';  NO.-
     4 VANES(NVAN2) =',I3,';  ROTOR/STATOR SPACE(RSS2) =',F5.0,' %;-
     5  SECOND STAGE EFF (FANEF2) =',F5.3)
  98 FORMAT('  SECOND STAGE:  DIAMETER (FAND2) =',F6.3,' M;  TIP REL-
     1 MACH(TIPM2) =',F6.3,';  DES REL MACH(TIPMD2) =',F6.3,1H,/5X,-
     2 'SECOND/FIRST TEMP RISE RATIO (TRAT) =',F5.3,';  SEC/FIRST PRESS-
     3 RISE (PRAT) =',F5.3,1H;,/5X,'NO. BLADES(NBL2) =',I3,';  NO.-
     4 VANES(NVAN2) =',I3,';  ROTOR/STATOR SPACE(RSS2) =',F5.0,' %;-
     5  SECOND STAGE EFF (FANEF2) =',F5.3)
 103 FORMAT(1X,'FAN SUPPRESSION SPECTRA -',/1X,'INLET:  ',24F5.1/1X,-
     1  'EXHAUST:',24F5.1)
      END
```

Subroutine JET

```
C                   SUBROUTINE FOR JET NOISE CALCULATION
C                      BASED ON STONE'S ANOP PREDICTION (TMX-71618)
C
C          CALLED BY NOIS OR RADIUS
C          CALLS SUBROUTINES TERP, PERNOY, TONE
C          INFLOW:  TP,F,UNITS,ISKIP,IOUT,FDOP,C,TAMB,PAMB,ISUPP
C                   R,THETA,VI,X,Y,TAU,IJ,KI, VC,VF,TC,TF,FUEL,WCORE
C          RETURNS:  TP,SPL,OASPL,PNL,PNLT
C
C             REQUIRES PARAM INPUT OF AVC,ATC, OPTIONAL AWCORE, AFUEL FOR
C               CORE STREAM;  AVF, ATF FOR FAN STREAM
C
      SUBROUTINE JET
      DIMENSION DSPL(27,8),SHIFT(17,5),DSHSPL(27),ASTRU(27),ATHET(8),-
     1   VRAT(5),ARAT(17),SPLSHC(24),SPLSHF(24)
      DIMENSION AGAM(8,3),AGASR(8,3),AFAR(3),ATEMP(8)
      COMMON/GEOM/R,THETA,THETAF,THETAH,PHI,VIEW,HEAD,PSYI,FLAPI,EPPI,-
     1  VI,X,Y,TAU,IJ,KI
      COMMON/SPECT/TP(24),SPL(24),F(24),OASPL,PNL,PNLT
      COMMON/PARAM/VC,VF,TC,TF,FUEL,WAFAN,RPM,TIPM,TIPM2,DELT,FPR,-
     1   WCORE,P3,T3,T4
      COMMON UNITS,ISKIP,IOUT(3),IREV,ILG,FDOP,C,TAMB,PAMB,RH,NENG,ISUPP
      REAL MC,MF,MDC,MDF
      NAMELIST/JETDA/JOUT,IFWD,INOZ,IPLUG,ISLOT,AC,MDC,GAMMAC,GASRC,-
     1      DHC,ANNHT,EDOP,       AF,MDF,GAMMAF,GASRF,DHF,ANNHTF
C        AC/AF = AREA OF CORE/FAN NOZZLE
C        MDC/MDF = DESIGN MACH NUMBER OF CORE/FAN NOZZLE (IF SUPERSONIC)
C        GAMMAC/GAMMAF = GAMMA OF CORE/FAN FLOW    *
C        GASRC/GASRF = GAS CONSTANT OF CORE/FAN FLOW IN J/KG/DEG K ,OR
C                   (FT LB/LBM/DEG R)   *
C              * GAMMAC AND GASRC VALUES CAN BE CALCULATED IF FUEL AND
C                WCORE FLOW DATA IN PARAM.  USES DEFAULT VALUES IF
C                      NOT SUPPLIED  AND FUEL=0.
C        DHC/DHF = HYDRAULIC DIAM OF CORE/FAN NOZZLE (REQD. FOR SLOT)
C        ANNHT/ANNHTF = ANNULAR HEIGHT OF CORE(PLUG)/FAN NOZZLE
C        INOZ = 1/0:  (COAXIAL/SIMPLE CIRCULAR NOZZLE)
C                FOR MIXED FLOW NOZZLE, USE INOZ=0 AND ENTER
C                GASRC, GAMMAC, AVC, AND ATC FOR MIXED FLOW PROPERTIES.
C        ISLOT = 1/0: (Y/N, SLOT NOZZLE ON PRIMARY)
C        IPLUG = 1/0:  (Y/N, PLUG NOZZLE ON PRIMARY)
C        IFWD = 1/0:  (Y/N, FORWARD VELOCITY EFFECTS ON SOURCE)
C        EDOP = EXP. ON SOURCE MOTION (DOPPLER)AMPLIF. ON SHOCK
C            NOISE ONLY (DEFAULT=1.)
C
C          ASTRU REPRESENTS ABSCISSA VALUES FOR FIGURES 5, 7, 17, AND 19
      DATA ASTRU/-1.8,-1.6,-1.4,-1.2,-1.1,-1.,-.9,-.8,-.7,-.6,-.5,-.4,-
     1   -.3,-.2,-.1,0.,.1,.2,.3,.4,.5,.6,.7,.8,1.,1.2,1.8/
C          FROM FIGURE 5
```

```
      DATA DSPL/38.7,34.2,29.7,25.,22.8,20.7,18.7,17.1,15.6,14.3,13.3,-
     112.5,11.8,11.3,11.,2*10.8,11.,11.4,11.9,12.6,13.3,14.3,15.3,17.5,-
     219.7,26.8,  43.8,38.2,32.5,26.8,24.,21.5,19.2,17.1,15.4,14.,12.8,-
     311.9,11.3,10.8,10.6,10.5,10.6,11.1,11.6,12.4,13.2,14.2,15.3,16.4,-
     418.8,21.1,28.2, 41.5,35.5,29.6,23.5,20.4,17.7,15.7,14.1,12.9,11.8-
     5,11.,10.4,10.1,10.,10.2,10.6,11.2,11.9,13.,14.1,15.4,16.6,17.9,-
     619.2,21.6,24.,31.4, 38.7,32.6,26.4,20.1,17.2,14.8,13.,11.5,10.4,-
     79.7,9.3,9.4,10.,10.8,11.7,12.8,14.2,15.6,16.9,18.3,19.8,21.1,22.5-
     8,23.9,26.7,29.6,37.8, 37.1,31.5,25.2,18.7,15.9,13.6,11.6,10.,8.8,-
     98.,8.3,9.2,10.7,12.1,13.7,15.3,17.,18.6,20.3,21.9,23.6,25.3,26.9,-
     128.7,31.9,35.3,45.1, 36.5,30.3,23.6,17.3,14.5,12.4,11.2,10.9,10.7-
     2,11.2,12.6,14.3,16.,17.9,19.,21.7,23.7,25.7,27.5,29.4,31.4,33.3,-
     335.2,37.2,40.9,44.7,56.2, 40.,33.6,27.4,21.2,17.9,15.7,14.2,14.,-
     414.8,15.8,16.9,18.3,20.,21.8,23.9,26.2,28.3,30.4,32.5,34.5,36.7,-
     538.8,40.9,42.9,47.2,51.2,63., 40.5,34.7,28.7,22.8,19.8,17.4,16.5,-
     616.4,17.5,18.7,20.4,22.1,24.2,26.4,28.9,31.2,33.8,36.2,38.5,40.9,-
     7 43.3,45.7,48.,50.3,55.2,60.,74./
      DATA ATHET/110.,120.,130.,140.,150.,160.,170.,180./
C          FROM FIGURE 7
      DATA DSHSPL/36.8,32.6,28.4,24.3,22.3,20.3,18.6,17.2,15.9,14.7,-
     1  13.5,12.6,11.9,11.4,11.,10.7,10.6,10.8,11.1,11.5,12.2,13.,-
     2  14.1,15.2,18.1,21.1,30.7/
C         FOR FIGURE 12
      DATA ARAT/0.,.1,.2,.3,.4,.5,.6,.7,.8,.9,1.,1.1,1.2,1.3,1.4,-
     1   1.5,1.6/
      DATA SHIFT/0.,.07,.136,.19,.234,.266,.285,.291,.297,.299,7*.3,-
     10.,.085,.17,.246,.315,.376,.433,.483,.53,.573,.611,.645,.676,.704-
     2,.73,.753,.778, 0.,.123,.23,.327,.41,.477,.534,.585,.63,.671,.708-
     3,.738,.767,.794,.818,.84,.86, 0.,.1,.2,.287,.365,.433,.491,.54,-
     4.586,.625,.66,.689,.713,.738,.761,.783,.805, 0.,.08,.157,.23,.293-
     5,.35,.404,.453,.5,.542,.58,.613,.645,.674,.7,.725,.75/
      DATA VRAT/.2,.4,.6,.8,1./
C         TABLES FOR CALC. GAMMAC AND GASRC, BASED ON A-1 FUEL (H/C=.16,
C            LHV=10335), FROM VALUES OF FUEL AND WCORE SUPPLIED TO RADIUS
C            OR NOISE.  IF FUEL=0., USES DEFAULTS FOR GAMMAC AND GASRC.
      DATA AFAR/0.,.02,.05/
      DATA ATEMP/540.,720.,1080.,1440.,1800.,2160.,2700.,3600./
      DATA AGAM/1.398,1.394,1.374,1.352,1.335,1.323,1.31,1.296,  1.389,-
     1 1.382,1.361,1.339,1.321,1.309,1.295,1.282,  1.377,1.367,1.343,-
     2 1.321,1.303,1.29,1.277,1.263/
      DATA AGASR/7*53.35,53.36,7*53.33,53.36,7*53.31,53.36/
      DATA AR,CISA,RHOISA/.0174533,1116.,.0765/
C         TABLE OF DEFAULT VALUES
      DATA GASRC,GAMMAC,GASRF,GAMMAF/2*-1.,53.35,1.4/
      DATA MDC,MDF/2*1./
      DATA ISLOT,IPLUG,IFWD,IGAM,IGASR/5*0/
      DATA SI,ENG/2HSI,3HENG/,EDOP/1./
C
      DO 1 L=1,24
      SPLSHC(L)=0.
    1 SPLSHF(L)=0.
C         SKIP MOST CALCS IF ENGINE PARAMS AND AIRCRAFT VELOCITY CONSTANT
      IF(ISKIP.EQ.1) GO TO 21
      IF(IJ.NE.1.OR.KI.GT.1) GO TO 7
      IF(KI.EQ.0) GO TO 3
      RHOAMB=PAMB/53.3/TAMB
      JOUT=IOUT(1)
      ISUPPR=ISUPP
C
      READ(5,JETDA)
      IF(GAMMAC.GT.0.) IGAM=1
      IF(GASRC.GT.0.) IGASR=1
      IF(UNITS.EQ.ENG) GO TO 2
      AC=AC*10.76
      AF=AF*10.76
      DHC=DHC*3.28
      DHF=DHF*3.28
      ANNHT=ANNHT*3.28
      ANNHTF=ANNHTF*3.28
```

```
      GASRC=GASRC*.1858
      GASRF=GASRF*.1858
C ****** FOR SIMPLE JETS, OR FOR CORE FLOW OF COAXIAL JETS
C
    2 ACRHO=AC*PAMB*PAMB/4478373.
      DC=SQRT(AC*1.27324)
      DPC=DC
      DDP=0.
      IF(IPLUG.NE.1) GO TO 3
      DPC=ANNHT+AC/3.1416/ANNHT
      DDP=DPC-2.*ANNHT
      IF(DHC.EQ.0.) DHC=2.*ANNHT
    3 IF(JOUT.NE.4) GO TO 7
C       FOR INPUT VALUES WHEN USING RADIUS
      IF(WCORE.GT.0.) FAR=FUEL/(WCORE-FUEL)
      IF(IGAM.EQ.1) GO TO 4
      GAMMAC=1.4
      IF(FUEL.GT.0.)CALL TERP(AGAM,TC,FAR,1.,ATEMP,AFAR,1.,8,3,1,GAMMAC)
    4 IF(IGASR.EQ.1) GO TO 5
      GASRC=53.35
      IF(FUEL.GT.0.)CALL TERP(AGASR,TC,FAR,1.,ATEMP,AFAR,1.,8,3,1,GASRC)
    5 IF(UNITS.EQ.SI) GO TO 6
      WRITE(6,95) INOZ,IPLUG,ISLOT,IFWD,AC,VC,TC,GAMMAC,GASRC,MDC,-
     1   DHC,ANNHT,FUEL
      GO TO 7
    6 ACM=AC/10.76
      VCM=VC/3.28
      TCM=TC/1.8
      GASRCM=GASRC/.1858
      DHCM=DHC/3.28
      ANNHTM=ANNHT/3.28
      FUELM=FUEL/2.205
      WRITE(6,96) INOZ,IPLUG,ISLOT,IFWD,ACM,VCM,TCM,GAMMAC,GASRCM,-
     1   MDC,DHCM,ANNHTM,FUELM
    7 VMC=VC/C
      IF(WCORE.GT.0.) FAR=FUEL/(WCORE-FUEL)
      IF(IGAM.EQ.1) GO TO 8
      GAMMAC=1.4
      IF(FUEL.GT.0.)CALL TERP(AGAM,TC,FAR,1.,ATEMP,AFAR,1.,8,3,1,GAMMAC)
    8 IF(IGASR.EQ.1) GO TO 9
      GASRC=53.35
      IF(FUEL.GT.0.)CALL TERP(AGASR,TC,FAR,1.,ATEMP,AFAR,1.,8,3,1,GASRC)
    9 TEC=TC-VC*VC*(1.-1./GAMMAC)/GASRC/64.4
      MC=VC/SQRT(32.2*GAMMAC*GASRC*TEC)
      RHOC=PAMB/GASRC/TEC
      EMMC=.62*VMC
      THETAP=THETA*VMC**.1
C       USE THET FOR INTERPOLATION, WHERE 110.LE.THET.LE.180
      THET=THETAP
      IF(THETAP.GT.180.) THET=180.
      IF(THETAP.LT.110.) THET=110.
      VM=VMC
      IF(IFWD.EQ.0) GO TO 10
      VM=VMC*(1.-VI/VC)**.75
      EMMC=EMMC*(1.-VI/VC)
   10 VM35=VM**3.5
      VCOR=VM**4.*VM35/(1.+.01*VM*VM35)
      SPLOR=141.+10.*ALOG10(ACRHO*VCOR)+(30.*VM35/(.6+VM35)-10.)*-
     1  ALOG10(RHOC/RHOAMB)
      CSTRUH=DC/VC*(TC/TAMB)**(.4*(1.+COS(THETAP*AR)))*FDOP
C ****** FOR PLUG OR SLOT NOZZLE
      IF(IPLUG.EQ.1)  SPLOR=SPLOR+3.*ALOG10(.1+2.*ANNHT/DPC)
      IF(IPLUG.EQ.1.OR.ISLOT.EQ.1) CSTRUH=CSTRUH*(DHC/DC)**.4
      IF(MC.LT.1..OR.ABS(MC-MDC).LT..01) GO TO 12
C ****** SHOCK NOISE OF CORE JET
      FM3=(MC-1.)**3
      VF8=VMC**8
      F3=MC**3
      DNUM=12.5*FM3*VF8
```

```
      DNOM=(.04+FM3)*(1.+2.*FM3*(MC-1.))*(1.+.05*VF8/F3)*(1.+   -
     1   .0086*VF8/F3)
      SPLOS=147.+10.*ALOG10(ACRHO*DNUM/DNOM)
      SPLOSH=SPLOS-10.*ALOG10(R*R*FDOP**EDOP)
      DO 11 L=1,24
      STRUX=ALOG10(CSTRUH*F(L))
      CALL TERP(DSHSPL,STRUX,1.,1.,ASTRU,1.,1.,27,1,1,DSPLX)
      SPLSHC(L)=SPLOSH-DSPLX
   11 CONTINUE
   12 IF(INOZ.EQ.0) GO TO 19
C  ******  FOR COAXIAL JETS
      IF(IJ.NE.1.OR.KI.GT.1) GO TO 15
      IF(ANNHTF.GT.0.) GO TO 13
      DDF=SQRT(1.27324*(AF+AC)+DDP**2)
      ANNHTF=(DDF-DPC)/2.
C        ASSUMES CIRCULAR FAN ANNULUS, THIN INNER WALL
   13 IF(DHF.EQ.0.) DHF=2.*ANNHTF
      IF(JOUT.NE.4) GO TO 15
      IF(UNITS.EQ.SI) GO TO 14
      WRITE(6,97) AF,VF,TF,GAMMAF,GASRF,MDF,DHF,ANNHTF
      GO TO 15
   14 AFM=AF/10.76
      VFM=VF/3.28
      TFM=TF/1.8
      GASRFM=GASRF/.1858
      DHFM=DHF/3.28
      ANNHTM=ANNHTF/3.28
      WRITE(6,97) AFM,VFM,TFM,GAMMAF,GASRFM,MDF,DHFM,ANNHTM
   15 TEF=TF-VF*VF*(1.-1./GAMMAF)/GASRF/64.4
      MF=VF/SQRT(32.2*GAMMAF*GASRF*TEF)
      RHOF=PAMB/GASRF/TEF
      IF(MF.LT.1..OR.ABS(MF-MDF).LT..01) GO TO 18
C ****** FOR SUPERSONIC FAN FLOW (UNDEREXPANDED) CALCULATE AS
C              SEPARATE JET PLUS SHOCK NOISE.
      VMF=VF/C
      DF=SQRT(AF*1.27324)
      EMMC=.62*VMF
      THETPF=THETA*VMF**.1
C        USE THETF FOR INTERPOLATION, WHERE 110.LE.THETF.LE.180
      THETF=THETPF
      IF(THETPF.GT.180.) THETF=180.
      IF(THETPF.LT.110.) THETF=110.
      VM=VMF
      IF(IFWD.EQ.0) GO TO 16
      VM=VMF*(1.-VI/VF)**.75
      EMMC=EMMC*(VF-VI)/VF
   16 AFRHO=ACRHO*AF/AC
      VM35=VM**3.5
      VCOR=VM**4*VM35/(1.+.01*VM*VM35)
      SPLOF=141.+10.*ALOG10(AFRHO*VCOR)+(30.*VM35/(.6+VM35)-10.)*-
     1   ALOG10(RHOF/RHOAMB)+3.*ALOG10(.1+2.*ANNHTF/DF)
      FSTRUH=DF/VF*(TF/TAMB)**(.4*(1.+COS(THETPF*AR)))*(DHF/DF)**.4*FDOP
      FMACH=EMMC/(1.+EMMC**5)**.2
      SPLOA=SPLOF-30.*ALOG10(1.+FMACH*COS(THETA*AR))-20.*ALOG10(R)
      FM3=(MF-1.)**3
      VF8=VMF**8
      F3=MF**3
      DNUM=12.5*FM3*VF8
      DNOM=(.04+FM3)*(1.+2.*FM3*(MF-1.))*(1.+.05*VF8/F3)*(1.+   -
     1   .0086*VF8/F3)
      SPLOS=147.+10.*ALOG10(AFRHO*DNUM/DNOM)
      SPLOSH=SPLOS-10.*ALOG10(R*R*FDOP**EDOP)
      DO 17 L=1,24
      STRUX=ALOG10(FSTRUH*F(L))
      CALL TERP(DSHSPL,STRUX,1.,1.,ASTRU,1.,1.,27,1,1,DSPSHX)
      CALL TERP(DSPL,STRUX,THETF,1.,ASTRU,ATHET,1.,27,8,1,DSPLX)
      SPLSHF(L)=10.*ALOG10(10.**(.1*(SPLOSH-DSPSHX))+10.**(.1*-
     1   (SPLOA-DSPLX)))
   17 CONTINUE
```

```
      GO TO 19
C ****** FOR SHOCKFREE FAN FLOW
   18 ARATX=AF/AC
      ARATL=ALOG10(1.+ARATX)
      VRATX=VF/VC
      VRATR=1.-VRATX
      EM=1.1*SQRT(ARATX)
      IF(ARATX.GE.29.7) EM=6.
      IF(VRATR.LT.0.) VRATR=0.
      SPLOR=SPLOR+5.*ALOG10(TC/TF)+10.*ALOG10(VRATR**EM+1.2*-
     1   (1.+ARATX*VRATX*VRATX)**4/(1.+ARATX)**3)
      CALL TERP(SHIFT,ARATL,VRATX,1.,ARAT,VRAT,1.,17,5,1,SHIFTX)
      CSTRUH=CSTRUH*TC/(TC-SHIFTX*TF)
   19 CMACH=EMMC/(1.+EMMC**5)**.2
      GO TO 25
C     ****************************************
C          CALCULATIONS SHORTENED HERE FOR CONSTANT POWER AND AIRSPEED
   21 THETAP=THETA*VMC**.1
      THET=THETAP
      IF(THETAP.GT.180.) THET=180.
      IF(THETAP.LT.110.) THET=110.
      CSTRUH=DC/VC*(TC/TAMB)**(.4*(1.+COS(THETAP*AR)))*FDOP
      IF(IPLUG.EQ.1.OR.ISLOT.EQ.1) CSTRUH=CSTRUH*(DHC/DC)**.4
      IF(MC.LT.1..OR.ABS(MC-MDC).LT..01) GO TO 23
      SPLOSH=SPLOS-10.*ALOG10(R*R*FDOP**EDOP)
      DO 22 L=1,24
      STRUX=ALOG10(CSTRUH*F(L))
      CALL TERP(DSHSPL,STRUX,1.,1.,ASTRU,1.,1.,27,1,1,DSPLX)
      SPLSHC(L)=SPLOSH-DSPLX
   22 CONTINUE
   23 IF(INOZ.EQ.0) GO TO 25
C          FOR COAXIAL JETS
      IF(MF.LT.1..OR.ABS(MF-MDF).LT..01) GO TO 25
      THETPF=THETA*VMF**.1
      THETF=THETPF
      IF(THETPF.GT.180.) THETF=180.
      IF(THETPF.LT.110.) THETF=110.
      FSTRUH=DF/VF*(TF/TAMB)**(.4*(1.+COS(THETPF*AR)))*(DHF/DF)**.4*FDOP
      SPLOA=SPLOF-30.*ALOG10(1.+FMACH*COS(THETA*AR))-20.*ALOG10(R)
      SPLOSH=SPLOS-10.*ALOG10(R*R*FDOP**EDOP)
      DO 24 L=1,24
      STRUX=ALOG10(FSTRUH*F(L))
      CALL TERP(DSHSPL,STRUX,1.,1.,ASTRU,1.,1.,27,1,1,DSPSHX)
      CALL TERP(DSPL,STRUX,THETF,1.,ASTRU,ATHET,1.,27,8,1,DSPLX)
      SPLSHF(L)=10.*ALOG10(10.**(.1*(SPLOSH-DSPSHX))+10.**(.1*-
     1   (SPLOA-DSPLX)))
   24 CONTINUE
C     ********* ALL CALCS RESUME HERE
   25 SPLOA=SPLOR-30.*ALOG10(1.+CMACH*COS(THETA*AR))-20.*ALOG10(R)
      DO 26 L=1,24
      STRUX=ALOG10(CSTRUH*F(L))
      CALL TERP(DSPL,STRUX,THET,1.,ASTRU,ATHET,1.,27,8,1,DSPLX)
   26 SPL(L)=SPLOA-DSPLX
      SUM=0.
      DO 28 L=1,24
      PLEV=10.**(.1*SPL(L))
      IF(MC.GE.1..AND.ABS(MC-MDC).GE..01) PLEV=PLEV+10.**(.1*SPLSHC(L))
      IF(MF.GE.1..AND.ABS(MF-MDF).GE..01) PLEV=PLEV+10.**(.1*SPLSHF(L))
      PLEV=NENG*PLEV
      SUM=SUM+PLEV
      SPL(L)=10.*ALOG10(PLEV)
      TP(L)=TP(L)+PLEV
   28 CONTINUE
      IF(JOUT.EQ.0) RETURN
      OASPL=10.*ALOG10(SUM)
      PNL=PERNOY(SPL)
      PNLT=PNL+TONE(SPL)
      IF(JOUT.EQ.1) WRITE(6,93) (SPL(L),L=1,24),OASPL,PNL,PNLT
      IF(JOUT.NE.2) RETURN
```

```
      IF(UNITS.EQ.ENG) WRITE(6,94) X,Y,TAU,OASPL,PNL,PNLT
      XM=X/3.28
      YM=Y/3.28
      IF(UNITS.EQ.SI) WRITE(6,94) XM,YM,TAU,OASPL,PNL,PNLT
      RETURN
   93 FORMAT(8H JET    :,17F7.1/8X,7F7.1,21X,8H OASPL =,F7.1,6H PNL =,-
     1    F7.1,7H PNLT =,F7.1)
   94 FORMAT(9H JET     :,2F8.1,F8.3,3F8.1)
   95 FORMAT(' INPUT PARAMETERS:  NOZZLE TYPE(SIMPLE=0,COAX=1)(INOZ) ='-
     1 ,I1,'; IPLUG=',I1,';  ISLOT=',I1,';  FWD VEL EFFECTS(IFWD)=',I1,-
     2 1H;,/20X,'AREA(SQ FT)   VEL(FPS)-
     3      TEMP(R)       GAMMA       GAS CONST    DES MACH # HYD DIA(FT) ANN-
     4UL HT(FT)  FUEL (#/S)',/10X,5HCORE:,7X,F6.3,2(6X,F6.1),6(5X,F7.3))
   96 FORMAT(' INPUT PARAMETERS:  NOZZLE TYPE(SIMPLE=0,COAX=1)(INOZ) ='-
     1 ,I1,'; IPLUG=',I1,';  ISLOT=',I1,';  FWD VEL EFFECTS(IFWD)=',I1,-
     2 1H;,/20X,'AREA(SQ M)    VEL(M/S)-
     3      TEMP(K)       GAMMA       GAS CONST    DES MACH # HYD DIA(M)  ANN-
     4UL HT(M)   FUEL(KG/S)',/10X,5HCORE:,7X,F6.3,2(6X,F6.1),6(5X,F7.3))
   97 FORMAT(10X,5HFAN :,7X,F6.3,2(6X,F6.1),6(5X,F7.3))
      END
```

Subroutine CORE

```
C             SUBROUTINE FOR LOW-FREQ CORE NOISE CALCULATION
C               BASED ON TMX-71627 OF HUFF, OR GE-FAA EQN OF FAA-RD-77-4
C
C           CALLED BY NOIS OR RADIUS
C           CALLS SUBROUTINES TERP,PERNOY, TONE
C           INFLOW: TP,F,UNITS,IOUT,FDOP,TAMB,PAMB,NENG,ISUPP
C                   R,THETA,X,Y,TAU,IJ,KI,FUEL,WCORE,P3,T3,T4
C           RETURNS:  TP,SPL,OASPL,PNL,PNLT
C
C            REQUIRES PARAM INPUT OF AWCORE,AP3,AT4 (OR AFUEL)
C                   OPTIONAL AT3, AT4 (IF FUEL SUPPLIED)
C
      SUBROUTINE CORE
      DIMENSION AFIG1(15),ATHET(15),AFIG2(12),AFREQ(12),CSUPP(24),-
     1  ATDEL(9,4),AFAR(9),AT3R(4)
      COMMON/GEOM/R,THETA,THETAF,THETAH,PHI,VIEW,HEAD,PSYI,FLAPI,EPPI,-
     1  VI,X,Y,TAU,IJ,KI
      COMMON/SPECT/TP(24),SPL(24),F(24),OASPL,PNL,PNLT
      COMMON/PARAM/VC,VF,TC,TF,FUEL,WAFAN,RPM,TIPM,TIPM2,DELT,FPR,-
     1 WCORE,P3,T3,T4
      COMMON UNITS,ISKIP,IOUT(3),IREV,ILG,FDOP,C,TAMB,PAMB,RH,NENG,ISUPP
      NAMELIST/COREDA/JOUT,ISUPPR,CSUPP,GAMMA,DTEMD,IMOD,EDOP
C        VALUES OF AT3, AP3, AT4, AND AWCORE (& AFUEL) ARE ENTERED AS
C          ARRAYS IN PARAM OF CALLING PROGRAM.
C        ISUPPR = 1/0:  (Y/N, SUPPRESSION TO BE APPLIED TO PREDICTION)
C        FLSUPP = SUPPRESSION SPECTRUM
C        EDOP = EXPONENT FOR SOURCE MOTION (DOPPLER) AMPLIF. (DEFAULT=2.)
C        GAMMA ASSUMED =1.4 UNLESS SUPPLIED IN COREDA - REQUIRED FOR
C          CALCULATION IF AT3 VALUES NOT SUPPLIED IN PARAM
C         ***FOR MODIFIED PREDICTION (1/18/77) (BASED ON GE-FAA
C            EQUATION), SET IMOD=1, AND SUPPLY VALUE OF
C            DESIGN TURBINE DELTA T, (DTEMD=T4(D)-TC(D)), IN COREDA
      DATA AFIG1/32.5,29.5,26.7,25.1,24.1,23.3,22.4,19.7,18.9,18.6,-
     1  18.6,18.7,19.,19.2,19./
      DATA ATHET/0.,20.,40.,50.,60.,70.,80.,100.,110.,120.,130.,140.,-
     1  160.,180.,200./
      DATA AFIG2/33.,26.5,18.7,12.8,10.9,10.2,10.,10.5,11.3,14.2,-
     1 19.8,30./
      DATA AFREQ/-1.222,-1.,-.699,-.398,-.222,-.097,0.,.176,.301,-
     1  .602,1.,1.602/
C          DATA FOR INTERPOLATING FOR T4
      DATA AT3R/460.,1060.,1660.,2260./
      DATA AFAR/.1,.2,.3,.4,.5,.6,.65,.7,.75/
      DATA ATDEL/740.,1390.,1970.,2490.,2980.,3420 ,3580.,3660.,3600.,-
     1  670.,1280.,1830.,2330.,2770.,3150.,3280.,3360.,3330.,-
```

```
     2  630.,1190.,1700.,2160.,2560.,2860.,2950.,3010.,3020.,-
     3  570.,1110.,1570.,1990.,2320.,2530.,2600.,2640.,2660./
      DATA SI,ENG/2HSI,3HENG/,AR,EDOP/.0174533,2./,IMOD/0/
C
      IF(IJ.NE.1.OR.KI.GT.1) GO TO 5
      IF(KI.EQ.0) GO TO 1
      GAMMA=1.4
      JOUT=IOUT(1)
      ISUPPR=ISUPP
      READ(5,COREDA)
      GAMRAT=1.-1./GAMMA
      IF(UNITS.EQ.SI) DTEMD=DTEMD*1.8
    1 IF(JOUT.NE.4) GO TO 5
      IF(IMOD.EQ.1) WRITE(6,92)
      IF(T3.LT..1) T3=TAMB*(P3/PAMB)**GAMRAT
      IF(T4.GT..1) GO TO 2
      FAR=FUEL/(WCORE-FUEL)
      CALL TERP(ATDEL,AFAR,AT3R,FAR,T3,1.,9,4,1,TDEL)
      T4=T3+TDEL
C       PRECEDING FOR CALC T3 & T4 INPUT VALUES FOR RADIUS
    2 IF(UNITS.EQ.SI) GO TO 3
      WRITE(6,95) T3,T4,P3,WCORE,DTEMD
      GO TO 4
    3 T3M=T3/1.8
      T4M=T4/1.8
      P3M=P3/.02089
      WCOREM=WCORE/2.205
      DTEMDM=DTEMD/1.8
      WRITE(6,96) T3M,T4M,P3M,WCOREM,DTEMDM
    4 IF(ISUPPR.EQ.1) WRITE(6,99) (CSUPP(L),L=1,24)
    5 CALL TERP(AFIG1,THETA,1.,1.,ATHET,1.,1.,15,1,1,FIG1)
      IF(T3.LT..1) T3=TAMB*(P3/PAMB)**GAMRAT
      IF(T4.GT.0.) GO TO 7
C        TO CALC T4 FROM FUEL/AIR
      IF(FUEL.GT.0.) GO TO 6
      WRITE(6,100)
      STOP
    6 FAR=FUEL/(WCORE-FUEL)
      CALL TERP(ATDEL,AFAR,AT3R,FAR,T3,1.,9,4,1,TDEL)
      T4=T3+TDEL
    7 SPLOA=56.5-FIG1+10.*ALOG10(NENG*WCORE*((T4-T3)*P3*TAMB/PAMB/T3/-
     1  R*3.28)**2/FDOP**EDOP)
      IF(IMOD.EQ.1) SPLOA=SPLOA+114.5-40.*ALOG10(DTEMD)
C          (LEVELS UNCHANGED IF DTEMD=728.62 DEG R)
      FREQP=740.*SQRT(P3/WCORE/2116.*SQRT(518.7/T4))
      IF(FREQP.LT.300..OR.FREQP.GT.1000.) FREQP=400.
      FREQP=FREQP/FDOP
    8 SUM=0.
      DO 9 L=1,24
      FREQ=ALOG10(F(L)/FREQP)
      CALL TERP(AFIG2,FREQ,1.,1.,AFREQ,1.,1.,12,1,1,FIG2)
      SPL(L)=SPLOA-FIG2
      IF(ISUPPR.EQ.1) SPL(L)=SPL(L)-CSUPP(L)
      PLEV=10.**(.1*SPL(L))
      SUM=SUM+PLEV
    9 TP(L)=TP(L)+PLEV
      IF(JOUT.EQ.0) RETURN
      OASPL=10.*ALOG10(SUM)
      PNL=PERNOY(SPL)
      PNLT=PNL+TONE(SPL)
      IF(JOUT.EQ.1) WRITE(6,93) (SPL(L),L=1,24),OASPL,PNL,PNLT
      IF(JOUT.NE.2) RETURN
      IF(UNITS.EQ.ENG) WRITE(6,94) X,Y,TAU,OASPL,PNL,PNLT
      XM=X/3.28
      YM=Y/3.28
      IF(UNITS.EQ.SI) WRITE(6,94) XM,YM,TAU,OASPL,PNL,PNLT
      RETURN
   92 FORMAT(22X,'MODIFIED NOISE LEVEL PREDICTION')
   93 FORMAT(8H CORE  :,17F7.1/8X,7F7.1,21X,8H OASPL =,F7.1,6H PNL =,-
```

```
     1   F7.1,7H PNLT =,F7.1)
  94 FORMAT(9H CORE   :,2F8.1,F8.3,3F8.1)
  95 FORMAT(1X,'INPUT PARAMETERS: COMBUSTOR INLET TEMP (T3) =',F6.1,-
     1  ' DEG R; EXHAUST TEMP (T4) =',F6.1,' DEG R;'/10X,'INLET PRESS-
     2 (P3) =',F7.1,' PSF; CORE MASS FLOW (WCORE) =',F6.1,' LB/S; -
     3 DESIGN TURBINE DELTA T (DTEMD) =',F6.1,' DEG R')
  96 FORMAT(1X,'INPUT PARAMETERS: COMBUSTOR INLET TEMP (T3) =',F6.1,-
     1 ' DEG K; EXHAUST TEMP (T4) =',F6.1,' DEG K;'/10X,'INLET PRESS-
     2 (P3) =',F9.1,' N/SQ M; CORE MASS FLOW (WCORE) =',F6.1,' KG/S; -
     3 DESIGN TURBINE DELTA T (DTEMD) =',F6.1,' DEG K')
  99 FORMAT(1X,'CORE SUPP:',24F5.1//)
 100 FORMAT(' INADEQUATE DATA IN PARAM INPUT - SUPPLY AT4 OR AFUEL-
     1 FOR COREN CALC.')
      END
```

Subroutine TURB

```
C                  SUBROUTINE TO CALCULATE THE TURBINE NOISE
C            BASED ON KREJSA'S (BOEING) ANOP PREDICTION (TMX-73566)
C
C         CALLED BY NOIS OR RADIUS
C         CALLS SUBROUTINES TERP, PERNOY, TONE
C         INFLOW:  TP,F,UNITS,IOUT,FDOP,NENG,ISUPP,F1,F2,F3,F4
C                 R,THETA,X,Y,TAU,IJ,KI, RPM,WCORE,TURTS,TCTUR
C         RETURNS: TP,SPL,OASPL,PNL,PNLT
C
C            REQUIRES INPUT OF ATCTUR (OR ATC), ARPM, AWCORE  IN PARAM,
C                   OPTIONAL INPUT OF ATURTS
C
      SUBROUTINE TURB
      DIMENSION AFIG5A(9),AFIG5B(9),ATHET(9),TSUPP(24),SUP(24),-
     1  DP(24),ATM150(24)
      COMMON/GEOM/R,THETA,THETAF,THETAH,PHI,VIEW,HEAD,PSYI,FLAPI,EPPI,-
     1  VI,X,Y,TAU,IJ,KI
      COMMON/SPECT/TP(24),SPL(24),F(24),OASPL,PNL,PNLT,F1,F2,F3,F4
      COMMON/PARAM/VC,VF,TC,TF,FUEL,WAFAN,RPM,TIPM,TIPM2,DELT,FPR,-
     1    WCORE,P3,T3,T4,TURTS,TCTUR
      COMMON UNITS,ISKIP,IOUT(3),IREV,ILG,FDOP,C,TAMB,PAMB,RH,NENG,ISUPP
      NAMELIST/TURBDA/JOUT,ISUPPR,TSUPP,TBNDIA,GEAR,CS,NBLR,ITYPTB,-
     1  EDOP
C         NBLR: NUMBER OF ROTOR BLADES;
C         GEAR: FAN RPM/TURBINE RPM;
C         CS: STATOR CHORD TO ROTOR SPACING (USUALLY >100.%);
C         TBNDIA: DIAM OF LAST STAGE TURBINE IN M(FT);
C         ITYPTB=0: TURBOJETS, OR FANS WITH COPLANAR EXITS
C                1: TURBOFANS WITH CORE EXIT AHEAD OF FAN EXIT, IE., JT8D
C         ISUPPR = 1/0 (Y/N SUPPR. SPECTRUM SUPPLIED FOR TURBINE EXHAUST)
C         TSUPP: SUPPRESSION SPECTRUM;
C         EDOP = EXP. ON SOURCE MOTION (DOPPLER) AMPLIF. (DEFAULT=4.)
      DATA AFIG5A/21.,13.,7.,4.,1.3,0.,1.3,8.7,19./
      DATA AFIG5B/27.5,18.,10.,6.,2.4,0.,2.2,14.,26./
      DATA ATHET/40.,60.,80.,90.,100.,110.,120.,140.,160./
      DATA C1,C2/1.,-2.0176/
      DATA ATM150/7*1.,5*1.023,2*1.047,1.072,1.096,1.122,1.148,1.202,-
     1    1.318,1.38,1.585,1.95,2.63/
      DATA SI,ENG/2HSI,3HENG/,AR,EDOP/.0174533,4./
C
      IF(IJ.NE.1.OR.KI.GT.1) GO TO 5
      IF(KI.EQ.0) GO TO 1
      ISUPPR=ISUPP
      JOUT=IOUT(1)
C
      READ(5,TURBDA)
    1 IF(JOUT.NE.4) GO TO 3
      IF(TURTS.LT..1) TURTS=.036652*GEAR*RPM*TBNDIA
      IF(UNITS.EQ.SI) GO TO 2
      WRITE(6,95) TCTUR,TURTS,WCORE,RPM,GEAR,TBNDIA,NBLR,CS,ITYPTB
      GO TO 3
```

```
    2 TCTURM=TCTUR/1.8
      TURTSM=TURTS/3.28
      WCOREM=WCORE/2.205
      TBNDIM=TBNDIA/3.28
      WRITE(6,96) TCTURM,TURTSM,WCOREM,RPM,GEAR,TBNDIM,NBLR,CS,ITYPTB
    3 IF(ISUPPR.NE.1) GO TO 5
      IF(JOUT.EQ.4) WRITE(6,97) (TSUPP(L),L=1,24)
      DO 4 L=1,24
    4 SUP(L)=10.**(TSUPP(L)/10.)
C
    5 RPMT=GEAR*RPM
      BPF=RPMT*FLOAT(NBLR)/60./FDOP
      IF(TURTS.LT..1) TURTS=.036652*RPMT*TBNDIA
    6 CLR=48.5*SQRT(TCTUR)/1116.
      RSQ=R*R/22500.
      BB=WCORE*NENG/RSQ/CLR**3/FDOP**EDOP
    7 TONEL=BB*CS*TURTS**.6*3981.07
      BB=BB*TURTS**3/10.
      IF(ITYPTB.EQ.1) TONEL=TONEL/10.
      CALL TERP(AFIG5A,THETA,1.,1.,ATHET,1.,1.,9,1,1,FIG5A)
      CALL TERP(AFIG5B,THETA,1.,1.,ATHET,1.,1.,9,1,1,FIG5B)
      BB=BB/10.**(FIG5A/10.)
      TONEL=TONEL/10.**(FIG5B/10.)
      DO 8 L=1,24
      FRAT=BPF/F(L)
      IF(FRAT.GT.1.12201845.OR.FRAT.LT..89125094) GO TO 8
      CF=F(L)
      GO TO 9
    8 CONTINUE
C        IF BPF > 10 KHZ, USE BPF FOR CF OF PEAK BROADBAND
      CF=BPF
    9 DO 10 L=1,24
      FREQ=F(L)/CF
      IF(FREQ.LE.1.) SPEC=FREQ**C1
      IF(FREQ.GT.1.) SPEC=FREQ**C2
   10 DP(L)=BB*SPEC
C  ******  TONE SPECTRUM CALCULATION
      DO 11 IH=1,4
      TONEH=TONEL/10.**(IH-1)
      DO 11 L=1,24
      FRAT=BPF*FLOAT(IH)/F(L)
      FR=1.
      IF(FRAT.GT.F4.OR.FRAT.LT.F1) GO TO 11
      IF(FRAT.GT.F3) FR=(F4-FRAT)/(F4-F3)
      IF(FRAT.LT.F2) FR=(FRAT-F1)/(F2-F1)
      DP(L)=DP(L)+TONEH*FR
   11 CONTINUE
      SUM=0.
      DO 12 L=1,24
      DP(L)=DP(L)*ATM150(L)
      IF(ISUPPR.EQ.1) DP(L)=DP(L)/SUP(L)
      SUM=SUM+DP(L)
      SPL(L)=10.*ALOG10(DP(L))
   12 TP(L)=TP(L)+DP(L)
      IF(JOUT.EQ.0) RETURN
      OASPL=10.*ALOG10(SUM)
      PNL=PERNOY(SPL)
      PNLT=PNL+TONE(SPL)
      IF(JOUT.EQ.1) WRITE(6,93) (SPL(L),L=1,24),OASPL,PNL,PNLT
      IF(JOUT.EQ.2) WRITE(6,94) X,Y,TAU,OASPL,PNL,PNLT
      RETURN
   93 FORMAT(8H TURB  :,17F7.1/8X,7F7.1,21X,8H OASPL =,F7.1,6H PNL =,-
     1   F7.1,7H PNLT =,F7.1)
   94 FORMAT(9H TURB   :,2F8.1,F8.3,3F8.1)
   95 FORMAT(' INPUT PARAMETERS:  EXIT TEMP (TCTUR) =',F6.1,' DEG R;-
     1  ROTOR TIP SPEED (TURTS) =',F6.1,' FPS;  MASS -
     2FLOW (WCORE) =',F7.3,6H LB/S;,/5X,'FAN SPEED (RPM) =',F6.0,' RPM;-
     3  TURBINE/FAN SPEED (GEAR) =',F5.2,-
     4 ';  DIAMETER (TBNDIA) =',F6.3,' FT;  NO. BLADES (NBLR) =',I3,-
```

```
     5 1H;/5X,'STATOR CHORD/ROTOR SPACING (CS) =',F5.1,'%;  TYPE-
     6 (SHORT CORE DUCT=1,COPLANAR OR TURBOJET=0)(TYPTB) =',I1)
  96 FORMAT(' INPUT PARAMETERS:  EXIT TEMP (TCTUR) =',F6.1,' DEG K;-
     1  ROTOR TIP SPEED (TURTS) =',F6.1,' M/S;  MASS -
     2FLOW (WCORE) =',F7.3,6H KG/S;,/5X,'FAN SPEED (RPM) =',F6.0,' RPM;-
     3  TURBINE/FAN SPEED (GEAR) =',F5.2,-
     4 ';  DIAMETER (TBNDIA) =',F6.3,' M;  NO. BLADES (NBLR) =',I3,-
     5 1H;/5X,'STATOR CHORD/ROTOR SPACING (CS) =',F5.1,'%;  TYPE-
     6 (SHORT CORE DUCT=1,COPLANAR OR TURBOJET=0)(TYPTB) =',I1)
  97 FORMAT(' TURB SUPP:',24F5.1//)
      END
```

Subroutine FLAP

```
C           SUBROUTINE FOR FLAP NOISE CALCULATION
C              (OR JET/FLAP INTERACTION NOISE)
C        BY DORSCH ET AL ANOP PREDICTION PROCEDURE (TMX-71768)
C
C        CALLED BY NOIS OR RADIUS
C        CALLS SUBROUTINES TERP, PERNOY, TONE
C        INFLOW:  TP,FP,UNITS,IOUT,FDOP,NENG,ISUPP
C               R,THETA,THETAF,PHI,PSYI,VI,X,Y,TAU,IJ,KI, VC,VF
C        RETURNS:  TP,SPL,OASPL,PNL,PNLT
C
C         REQUIRES PARAM INPUT OF AVC FOR CORE, AVF FOR FAN FLOW
C
      SUBROUTINE FLAP
      DIMENSION DSPL(29,3,2),DOSPL(29,2,2),ASTRU(29),APSY(3,2),APHI(2),-
     1  BETA(25,3),CAY(25,2),DTHET(25,3),DOTHET(25,2),ATHET(25),-
     2   DPHI(13),AOPHI(13),AOPSY(2,2)
      DIMENSION C1(3),C2(3),C3(3),FLSUPP(24)
      COMMON UNITS,ISKIP,IOUT(3),IREV,ILG,FDOP,C,TAMB,PAMB,RH,NENG,ISUPP
      COMMON/GEOM/R,THETA,THETAF,THETAH,PHI,VIEW,HEAD,PSYI,FLAPI,EPPI,-
     1  VI,X,Y,TAU,IJ,KI
      COMMON/SPECT/TP(24),SPL(24),F(24),OASPL,PNL,PNLT
      COMMON/PARAM/VC,VF
      NAMELIST/FLAPDA/JOUT,IUOTW,INOZ,IFWD,INSENS,AC1,AF1,BPR,WINGD,-
     1 ISUPPR,FLSUPP,EDOP
C         IUOTW = 1/0:  OVER-THE-WING/UNDER-THE-WING CONFIGURATION
C         IFWD = 1/0:  (Y/N, FORWARD VELOCITY EFFECTS ON SOURCES)
C         INSENS = 1/0:  (Y/N, NOISE LEVELS REL. INSENSITIVE TO FLAP
C                    ANGLE - AS 3-FLAP DATA)
C         AC1,AF1 = CORE AND FAN EXHAUST AREAS (IN SQ M(SQ FT))
C         BPR = BYPASS RATIO (FOR MIXED FLOW COAXIAL)
C         WINGD = RATIO OF WING CHORD TO TOTAL NOZZLE DIAM (USE ONLY
C                FOR LARGE BPR CORRECTION)
C         INOZ=0:  SINGLE NOZZLE EXHAUST (REQUIRES ONLY AC1 INPUT IN
C                    FLAPDA AND AVC IN PARAM)
C             =1:  COAXIAL NOZZLE, UNMIXED (REQUIRES AC1 AND AF1 IN
C                    FLAPDA AND AVC AND AVF IN PARAM)
C             =2:  COAXIAL NOZZLE, MIXED (REQUIRES AC1, AF1, AND BPR IN
C                    FLAPDA, AND AVC AND AVF IN PARAM)
C         ISUPPR = 1/0:  (Y/N, SUPPRESSION TO BE APPLIED TO PREDICTION)
C         FLSUPP = SUPPRESSION SPECTRUM
C         EDOP = EXP. ON SOURCE MOTION (DOPPLER) AMPLIF.(DEFAULT=4.)
      DATA DSPL/41.,34.,27.,24.,21.5,17.,14.4,12.7,11.5,10.6,10.,9.8,-
     1 2*9.7,9.9,10.,10.1,10.2,10.6,11.,11.5,12.7,16.6,18.5,21.5,25.4,-
     2     29.4,33.1,38.,-
     346.,39.,32.,29.6,27.,23.,19.8,16.9,14.9,12.2,10.6,10.,9.3,9.,8.9,-
     49.1,9.4,9.7,10.,10.5,10.9,11.9,15.7,17.9,20.7,24.5,28.4,32.,37.2,-
     553.,47.,38.,35.,32.,28.,24.,21.2,18.,15.,12.5,11.4,10.7,10.1,9.8,-
     6 9.2,2*9.1,9.3,9.6,9.9,11.,15.,17.1,20.,24.,27.8,31.6,36.8, -
     742.,37.,31.7,29.6,28.,25.,22.5,20.8,19.,16.6,14.5,13.,11.3,10.,-
     8 8.9,8.4,8.2,8.5,9.,9.4,10.,11.,14.5,16.4,19.,22.3,25.6,29.,33.5,-
     942.,37.,31.7,29.6,28.,25.,22.5,20.8,19.,16.6,14.5,13.,11.3,10.,-
     1 8.9,8.4,8.2,8.5,9.,9.4,10.,11.,14.5,16.4,19.,22.3,25.6,29.,33.5,-
     242.,37.,31.7,29.6,28.,25.,22.5,20.8,19.,16.6,14.5,13.,11.3,10.,-
     3 8.9,8.4,8.2,8.5,9.,9.4,10.,11.,14.5,16.4,19.,22.3,25.6,29.,33.5/
```

```
      DATA DOSPL/23.,17.2,12.,10.5,10.2,10.5,11.4,12.,12.3,12.4,12.,-
     1 11.3,10.9,2*10.3,11.,11.5,12.1,13.,13.6,14.,15.1,18.7,20.8,23.2,-
     2      27.2,31.5,36.1,43.,-
     321.4,16.1,11.1,10.2,10.,11.4,12.7,13.5,2*13.8,13.3,12.8,11.9,-
     4 11.4,2*11.1,11.3,11.7,12.,12.5,13.,13.8,16.8,18.7,21.4,25.,29.2,-
     5 34.,41.,-
     633.,29.,25.,24.,23.,21.2,19.9,18.8,17.8,16.4,15.3,14.4,13.7,12.8,-
     7 11.8,10.9,10.,9.7,9.2,9.1,9.3,10.,13.1,15.5,18.4,22.8,27.,31.3,-
     8 37.1,-
     933.,29.,25.,24.,23.,21.2,19.9,18.8,17.8,16.4,15.3,14.4,13.7,12.8,-
     1 11.8,10.9,10.,9.7,9.2,9.1,9.3,10.,13.1,15.5,18.4,22.8,27.,31.3,-
     2  37.1/
      DATA ASTRU/-1.456,-1.301,-1.155,-1.097,-1.046,-.959,-.886,-.824,-
     1 -.77,-0.699,-.638,-.585,-.538,-.481,-.42,-.347,-.301,-.252,-
     2 -.194,-.143,-.097,0.,.301,.477,.699,1.,1.301,1.602,2./
      DATA APHI/0.,90./
      DATA APSY/0.,20.,60.,0.,20.,60./,AOPSY/20.,60.,20.,60./
      DATA ATHET/0.,10.,20.,30.,40.,50.,60.,70.,80.,90.,100.,110.,120.,-
     1 130.,140.,145.,150.,155.,160.,165.,170.,175.,180.,185.,190./
      DATA DTHET/-4.,-3.,-2.,-1.,-.6,-.1,8*0.,.2,.6,1.2,1.8,2.6,-
     1     3.,2.5,1.,0.,.6,1.,-
     2 -2.6,-1.9,-1.,-.6,-.25,-.1,8*0.,1.,1.5,0.,-2.3,-5.,-5.3,-
     3    -4.7,-2.4,-.7,2.,3., -
     4 -.7,.2,.9,1.5,2.,2.1,2.,1.8,1.2,0.,-1.3,-3.8,-6.,-5.7,-3.2,-
     5     -1.2,.5,1.,1.1,1.,.9,.6,.2,-.5,-1./
      DATA DOTHET/-1.,-.5,.5,2*1.,.8,.4,0.,-.4,3*0.,-.5,-1.6,-4.2,-
     1    -4.9,-5.,-4.2,-2.5,.3,3.2,5.8,9.1,9.,8.5, -
     2 0.,.5,.8,1.2,1.3,1.2,1.1,1.,.6,0.,-1.,-1.8,-2.5,-.3,3.2,4.7,-
     3       6.,6.8,7.5,7.6,7.7,7.5,6.9,6.375,6./
      DATA BETA/0.,2.,3.,3.6,4.,6*4.1,4.05,3.8,3.3,2.65,2.3,-
     1  1.93,1.55,1.05,.55,.12,3*0.,.12, -
     2 0.,1.2,2.25,3.05,3.67,4.1,4.45,4.8,5.1,5.35,5.6,5.3,4.95,4.5,-
     3  3.8,3.27,2.55,1.7,-1.95,-2.,-1.65,-1.,0.,-1.,-1.65,-
     4 0.,.9,1.8,2.7,3.6,4.5,5.4,6.2,7.1,8.,7.1,4.5,-2.4,-2.,-1.1,-.4,-
     5  .2,.8,1.2,1.4,1.1,.6,0.,.6,1.1/
      DATA CAY/9*4.,3.95,3.63,3*3.5,3.7,4.1,4.6,5.3,5.9,6*6.,-
     1  8*1.,1.2,1.7,2.7,5.,4*6.,5.7,5.,3.2,2.1,1.6,1.3,1.,.7,.4/
      DATA DPHI/3*0.,-.5,-1.25,-2.3,-3.,-2.9,-2.1,-.75,2.,2.5,3./
      DATA AOPHI/0.,10.,20.,30.,40.,50.,60.,70.,80.,90.,120.,150.,180./
      DATA C1/83.6,91.4,85.1/,C2/.14,.01,.01/,C3/67.,67.,60./,WINGD/3./
      DATA INOZ,IFWD,INSENS/3*0/
      DATA SI,ENG/2HSI,3HENG/,AR,EDOP/.0174533,4./
C
      IF(IJ.NE.1.OR.KI.GT.1) GO TO 6
      IF(KI.EQ.0) GO TO 3
      JOUT=IOUT(1)
      ISUPPR=ISUPP
    1 READ(5,FLAPDA)
      IF(UNITS.EQ.ENG) GO TO 2
      AC1=AC1*10.76
      AF1=AF1*10.76
C
    2 IF(IUOTW.EQ.0) IC=1
      IF(INSENS.EQ.1) IC=2
      IF(IUOTW.EQ.1) IC=3
      ATOT=AC1+AF1
      IF(INOZ.EQ.0) ATOT=AC1
      DTOT=SQRT(4.*ATOT/3.1416)
C
    3 IF(JOUT.NE.4) GO TO 6
      IF(UNITS.EQ.SI) GO TO 4
      WRITE(6,96) IUOTW,INOZ,INSENS,IFWD,AC1,VC,WINGD,AF1,VF,BPR
      GO TO 5
    4 ACM=AC1/10.76
      AFM=AF1/10.76
      VCM=VC/3.28
      VFM=VF/3.28
      WRITE(6,97) IUOTW,INOZ,INSENS,IFWD,ACM,VCM,WINGD,AFM,VFM,BPR
    5 IF(ISUPPR.EQ.1) WRITE(6,98) (FLSUPP(L),L=1,24)
```

```
C ****** START HERE FOR ALL SUBSEQUENT CALCULATIONS
    6 IF(INOZ.EQ.0) VAV=VC
      IF(INOZ.EQ.1) VAV=((AC1*VC**6+AF1*VF**6)/ATOT)**0.1667
      IF(INOZ.EQ.2) VAV=(VF*BPR+VC)/(BPR+1)
    7 RSQ=R*R/1.E04
      SPLOA=C1(IC)+C2(IC)*PSYI+C3(IC)*ALOG10(VAV/500.)+10.*ALOG10(NENG-
     1  *ATOT/RSQ/FDOP**EDOP)
      IF(WINGD.LT.3.) SPLOA=SPLOA+10.*ALOG10(WINGD/3.)
      IF(IJ.EQ.1.AND.JOUT.EQ.4) WRITE(6,95) SPLOA
C          OBTAIN DIRECTIONALITY IN THETA AND PHI DIRECTIONS FROM TABLES
      THET=THETAF
      IF(THET.LT.-90.) THET=360.+THETAF
      IF(IUOTW.EQ.1) GO TO 8
C   ******       UNDER-THE-WING
      CALL TERP(DTHET,THET,PSYI,1.,ATHET,APSY,1.,25,3,1,DTHETX)
      CALL TERP(BETA,THETA,PSYI,1.,ATHET,APSY,1.,25,3,1,BETAX)
C   ***    NOTE THAT FIG 14 OF ANOP TMX RE-INTERPRETED AS THETA FOR
C            ABSCISSA.  THIS CHANGE MADE 2/10/77 TO AVOID ANOMOLY NEAR
C            THETA=90, PHI=90 OF RAPID LEVEL CHANGES.
      DPHIX=BETAX*(COS(PHI*AR)-1.)
      GO TO 9
C   ******       OVER-THE-WING
    8 CALL TERP(DOTHET,THET,PSYI,1.,ATHET,AOPSY,1.,25,2,1,DTHETX)
      PHIAB=ABS(PHI)
      CALL TERP(DPHI,PHIAB,1.,1.,AOPHI,1.,1.,13,1,1,DPHIX)
      IF(PHIAB.LE.65.) PHIT=0.
      IF(PHIAB.GT.65.) PHIT=3.6*(PHIAB-65.)
      IF(PHIAB.GT.90.) PHIT=90.
    9 SPLOA=SPLOA+DTHETX+DPHIX*ABS(SIN(THETA*AR))
C   ***   NOTE SINE FACTOR ADDED TO DPHIX DIRECTIONALITY SO IT ADDS
C            MAXIMUM @ THETA=90, ZERO AT THETA=0,180. 10/23/79.
      IF(IUOTW.EQ.1.OR.IFWD.EQ.0) GO TO 10
      CALL TERP(CAY,THET,PSYI,1.,ATHET,AOPSY,1.,25,2,1,CAYX)
      SPLOA=SPLOA-10.*CAYX*ALOG10(1.-VI/VAV)
   10 SUM=0.
      STRU=ALOG10(DTOT/VAV/FDOP)
      DO 12 L=1,24
      STRUH=ALOG10(F(L))+STRU
      IF(IUOTW.EQ.0) CALL TERP(DSPL,STRUH,PSYI,PHI,ASTRU,APSY,APHI,-
     1    29,3,2,SPEC)
      IF(IUOTW.EQ.1) CALL TERP(DOSPL,STRUH,PSYI,PHIT,ASTRU,AOPSY,APHI,-
     1    29,2,2,SPEC)
      SPL(L)=SPLOA-SPEC
      IF(ISUPPR.EQ.1) SPL(L)=SPL(L)-FLSUPP(L)
      PLEV=10.**(.1*SPL(L))
      SUM=SUM+PLEV
      TP(L)=TP(L)+PLEV
   12 CONTINUE
      IF(JOUT.EQ.0) RETURN
      OASPL=10.*ALOG10(SUM)
      PNL=PERNOY(SPL)
      PNLT=PNL+TONE(SPL)
      IF(JOUT.EQ.1) WRITE(6,93) (SPL(L),L=1,24),OASPL,PNL,PNLT
      IF(JOUT.NE.2) RETURN
      IF(UNITS.EQ.ENG) WRITE(6,94) X,Y,TAU,OASPL,PNL,PNLT
      XM=X/3.28
      YM=Y/3.28
      IF(UNITS.EQ.SI) WRITE(6,94) XM,YM,TAU,OASPL,PNL,PNLT
      RETURN
   93 FORMAT(8H FLAP  :,17F7.1/8X,7F7.1,21X,8H OASPL =,F7.1,6H PNL =,-
     1    F7.1,7H PNLT =,F7.1)
   94 FORMAT(9H FLAP   :,2F8.1,F8.3,3F8.1)
   95 FORMAT(35X,'CALCULATED OASPL-REF =',F5.1,' DB')
   96 FORMAT(' INPUT PARAMETERS:  CONFIGURATION(UTW=0,OTW=1)(IUOTW)=',-
     1 I1,';  NOZZLE(SIMPLE=0,UNMIXED=1,MIXED=2)(INOZ)=',I1,';  FLAP-
     2 ANGLE SENS(INSENS)=',I1,1H;,/20X,'FWD VEL EFFECTS(IFWD)=',I1,-
     3 1H;,/5X,'CORE:  AREA(AC1) =',-
     4 F6.3,' SQ FT;  VELOCITY(VC) =',F6.1,' FPS;  WING-CHORD/DIAM =',-
     5 F6.2/5X,'FAN :  AREA(AF1) =',F6.3,' SQ FT;  VELOCITY(VF) =',-
```

```
     6 F6.1,' FPS;  BYPASS(BPR) =',F5.2)
  97 FORMAT(' INPUT PARAMETERS:  CONFIGURATION(UTW=0,OTW=1)(IUOTW)=',-
     1 I1,';  NOZZLE(SIMPLE=0,UNMIXED=1,MIXED=2)(INOZ)=',I1,';  FLAP-
     2 ANGLE SENS(INSENS)=',I1,1H;,/20X,'FWD VEL EFFECTS(IFWD)=',I1,-
     3 1H;,/5X,'CORE:  AREA(AC1) =',-
     4 F6.3,' SQ M;  VELOCITY(VC) =',F6.1,' M/S;  WING-CHORD/DIAM =',-
     5 F6.2/5X,'FAN :  AREA(AF1) =',F6.3,' SQ M;  VELOCITY(VF) =',-
     6 F6.1,' M/S;  BYPASS(BPR) =',F5.2)
  98 FORMAT(' FLAP SUPP:',24F5.1//)
     END
```

Subroutine AIRFR

```
      SUBROUTINE AIRFR
C         TO CALCULATE AIRFRAME NOISE OF AIRCRAFT DUE TO AIRFLOW
C        OVER WINGS, HORIZONTAL TAIL, VERTICAL TAIL,NOSE AND MAIN
C        LANDING GEAR, DEFLECTED SLOTTED FLAPS, AND LEADING EDGE
C        SLAT.
C           BASED ON PREDICTION BY M.R. FINK IN FAA RD 77-29,
C             AND PROGRAMMED VERSION BY ANOPP-LANGLEY.
C
C         CALLED BY NOIS OR RADIUS
C         CALLS SUBROUTINES PERNOY, TONE
C         INFLOW:  TP,F,UNITS,IOUT,ILG,FDOP,C,TAMB,PAMB,
C                  R,THETA,PHI,FLAPI,VI,X,Y,TAU,IJ,KI
C         RETURNS:  TP,SPL,OASPL,PNL,PNLT
C
      DIMENSION DP(24),A(4),B(4),NG(2),NW(2),C1(3),E1(3),CG(2),DW(2),-
     1 C2(2),S2(2),C3(2),C4(2),E2(2),CPF(2),AM(4),BM(4),DWM(2)
      COMMON/GEOM/R,THETA,THETAF,THETAH,PHI,VIEW,HEAD,PSYI,FLAPI,EPPI,-
     1  VI,X,Y,TAU,IJ,KI
      COMMON/SPECT/TP(24),SPL(24),F(24),OASPL,PNL,PNLT
      COMMON UNITS,ISKIP,IOUT(3),IREV,ILG,FDOP,C,TAMB,PAMB,RH,NENG,ISUPP
      NAMELIST/AIRFDA/JOUT,A,B,ITYPW,ICLEAN,NG,NW,CG,DW,NF,IWING,IFL,-
     1  ISLAT,ILG
C         IWING = 1/0 (Y/N FOR WING AND HORIZ. & VERT. TAIL NOISE)
C         IFL = 1/0 (Y/N FOR SLOTTED FLAP NOISE)
C         ISLAT = 1/0 (Y/N FOR LEADING EDGE SLAT NOISE)
C         ILG = 1/0   (Y/N FOR NOSE AND MAIN LANDING GEAR NOISE - THIS
C            CAN BE ENTERED THROUGH TRAJ INPUT TO FOOTPR)
C         A = AREAS OF WING, HORIZONTAL TAIL, VERTICAL TAIL, AND
C            SLOTTED FLAPS(AW,AH,AV,AF) - SQ M(SQ FT)
C         B = TOTAL SPANS OF WING, HORIZ. TAIL, VERT. TAIL, AND
C            FLAPS(BW,BH,BV,AF/CF) - M(FT)
C         ICLEAN=0/1 FOR AERODYN. CLEAN CONFIG (SAILPLANE)/CONVENTIONAL
C         ITYPW=1/2 FOR CONVENTIONAL/DELTA TYPE WING
C         NG = NUMBERS OF NOSE GEAR AND MAIN GEAR (NNG,NMG)
C         NW = NUMBERS OF WHEELS ON NOSE GEAR, MAIN GEAR (NNGW,NMGW)
C         DW = TIRE DIAMETERS FOR NOSE AND MAIN GEAR (TDNG,TDMG) - M(FT)
C         CG = STRUT LENGTH TO TIRE DIAM. RATIOS, NOSE & MAIN (CNG,CMG)
C         NF = NUMBER OF TRAILING FLAP SLOTS
C           (KIN. VISCOSITY OF AMBIENT AIR IS CALC FROM TAMB AND PAMB)
C
      DATA C1,E1,C2,S2,C3,E2,C4,CPF/3*.613,3*1.5,.0588,.0278,20.,75.,-
     1  .1722,.0579,.55,.0625,265.2,18641.,2.45E-4,6.74E-4/
      DATA SI,ENG/2HSI,3HENG/,AR/.0174533/
C   FOR DEFAULTS
      DATA ICLEAN,ITYPW,NG,NW,NF/3*1,4*2/
      DATA A,B,DW,CG/1000.,4*100.,3*20.,4*3./
C
      IF(VI.GT..1) GO TO 1
      WRITE(6,92)
      RETURN
    1 IF(IJ.NE.1.OR.KI.GT.1) GO TO 6
      IF(KI.EQ.0) GO TO 3
      JOUT=IOUT(1)
      RHOAMB=PAMB/53.3/TAMB/32.2
      XJAI=(RHOAMB*C**2/4.1773E-7)**2
```

```
      GNUAMB=TAMB**1.768/PAMB*5.241E-6
      READ(5,AIRFDA)
      IF(UNITS.EQ.ENG) GO TO 3
      DO 2 I=1,4
      A(I)=A(I)*10.76
      B(I)=B(I)*3.28
    2 IF(I.LE.2) DW(I)=DW(I)*3.28
    3 IF(JOUT.NE.4) GO TO 6
      WRITE(6,95) IWING,IFL,ILG,ISLAT
      IF(UNITS.EQ.SI) GO TO 4
      WRITE(6,96)
      WRITE(6,98) A(1),B(1),ITYPW,ICLEAN,((A(I),B(I)),I=2,4),NF,FLAPI
      WRITE(6,99)
      WRITE(6,101) ((NG(I),NW(I),DW(I),CG(I)),I=1,2)
      GO TO 6
    4 WRITE(6,97)
      DO 5 I=1,4
      AM(I)=A(I)/10.76
      BM(I)=B(I)/3.28
    5 IF(I.LE.2) DWM(I)=DW(I)/3.28
      WRITE(6,98)AM(1),BM(1),ITYPW,ICLEAN,((AM(I),BM(I)),I=2,4),NF,FLAPI
      WRITE(6,100)
      WRITE(6,101) ((NG(I),NW(I),DWM(I),CG(I)),I=1,2)
C
    6 DO 7 L=1,24
    7 DP(L)=0.
      VM=VI/C
      VM5R=VM**5/R/R
      SINPH=SIN(PHI*AR)
      COSPH=COS(PHI*AR)
      SINTH=SIN(THETA*AR)
      COSTH=COS(THETA*AR)
      VIGNU=.37/(VI/GNUAMB)**.2
      IF(IWING.EQ.0) GO TO 11
C**      FOR WING, HORIZ. TAIL, AND VERTICAL TAIL (I=1,2,3)
      IF(ITYPW.LT.2) GO TO 8
      C1(1)=.485
      E1(1)=1.35
    8 FPHI=COSPH**2
      P=XJAI*VM5R*(1.+COSTH)*1.127E-6
C        CONSTANT IS 7.08E-6(LANGLEY)/2*PI
      DO 10 I=1,3
      CC=1.
      IF(I.EQ.1.AND.ICLEAN.EQ.1) CC=6.31
      BLAY=VIGNU*(A(I)/B(I))**.8
      SM=10.*BLAY*FDOP/VI
      IF(I.EQ.3) FPHI=SINPH**2
      PW=P*CC*BLAY*B(I)*FPHI*C1(I)
      DO 9 L=1,24
      S=F(L)*SM
      FS=(S/(S**E1(I)+.5))**4
    9 DP(L)=DP(L)+FS*PW
   10 CONTINUE
   11 IF(ILG.EQ.0) GO TO 15
C**      FOR NOSE AND MAIN LANDING GEAR (NOSE:I=1; MAIN:I=2)
      FPHI=SINPH**2
      PG=.1194*XJAI*VM5R*VM*SINTH**2
      DO 14 I=1,2
      PGG=PG*DW(I)**2*FLOAT(NG(I))
      PG1=PGG*FLOAT(NW(I))*4.3E-4
      PG2=PGG*CG(I)*FPHI*5.44E-4
      SM=(DW(I)*FDOP/VI)**2
      DO 13 L=1,24
      SS=SM*F(L)**2
      IF(NW(I).GT.2) GO TO 12
      F1=13.59*SS/(12.5+SS)**2.25
      F2=3.244*SS/(30.+SS**4)
      GO TO 13
   12 F1=.3888*SS/(4.+SS)**1.5
```

```
      F2=1.135*SS**1.5/(1.06+SS)**3
   13 DP(L)=DP(L)+F1*PG1+F2*PG2
   14 CONTINUE
   15 IF(IFL.EQ.0) GO TO 19
C**         FOR SLOTTED FLAP NOISE
      I=1
      IF(NF.GT.2) I=2
      SINFL=SIN(FLAPI*AR)
      COSFL=COS(FLAPI*AR)
      PF=.2387*XJAI*CPF(I)*VM5R*VM*A(4)*(SINFL*(SINFL*COSTH+-
     1  COSFL*SINTH*COSPH))**2
      SM=A(4)/B(4)*FDOP/VI
      DO 18 L=1,24
      S=F(L)*SM
      IF(S.GE.2.) GO TO 16
      FS=C2(I)*S
      GO TO 18
   16 IF(S.GT.S2(I)) GO TO 17
      FS=C3(I)/S**E2(I)
      GO TO 18
   17 FS=C4(I)/S**3
   18 DP(L)=DP(L)+PF*FS
   19 IF(ISLATS.EQ.0) GO TO 22
C**          FOR SLATTED LEADING EDGE OF WING
      IF(ITYPW.LT.2) GO TO 20
      C1(1)=.485
      E1(1)=1.35
   20 BLAY=VIGNU*(A(1)/B(1))**.8
      PSL=XJAI*VM5R*BLAY*B(1)*(1.+COSTH)*COSPH**2*1.127E-6
      SM=10.*BLAY*FDOP/VI
      DO 21 L=1,24
      SS1=SM*F(L)
      SS2=SS1*.219
      F1=C1(1)*(SS1/(SS1**E1(1)+.5))**4
      F2=.613*(SS2/(SS2**1.5+.5))**4
   21 DP(L)=DP(L)+PSL*(F1+F2)
C
   22 SUM=0.
      DO 23 L=1,24
      SUM=SUM+DP(L)
      TP(L)=TP(L)+DP(L)
   23 SPL(L)=10.*ALOG10(DP(L))
      IF(JOUT.EQ.0) RETURN
      OASPL=10.*ALOG10(SUM)
      PNL=PERNOY(SPL)
      PNLT=PNL+TONE(SPL)
      IF(JOUT.EQ.1) WRITE(6,93) (SPL(L),L=1,24),OASPL,PNL,PNLT
      IF(JOUT.NE.2) RETURN
      IF(UNITS.EQ.ENG) WRITE(6,94) X,Y,TAU,OASPL,PNL,PNLT
      XM=X/3.28
      YM=Y/3.28
      IF(UNITS.EQ.SI) WRITE(6,94) XM,YM,TAU,OASPL,PNL,PNLT
      RETURN
   92 FORMAT(2X,'VI=0;  NO AIRFRAME NOISE;  RETURN')
   93 FORMAT(8H AIRFR :,17F7.1/8X,7F7.1,21X,8H OASPL =,F7.1,6H PNL =,-
     1   F7.1,7H PNLT =,F7.1)
   94 FORMAT(9H AIRFR  :,2F8.1,F8.3,3F8.1)
   95 FORMAT(' INPUT PARAMETERS:  OPTIONS: WING & TAIL NOISE(IWING) =',-
     1 I2,'; SLOTTED FLAP NOISE(IFL) =',I2,1H;,/16X,'LANDING GEAR-
     2 NOISE(ILG) =',I2,'; LEADING EDGE SLAT NOISE(ISLAT) =',I2)
   96 FORMAT(22X,'AREA (SQ FT)       SPAN (FT)')
   97 FORMAT(22X,'AREA (SQ M)        SPAN (M)')
   98 FORMAT(6X,5HWING:,10X,F8.2,6X,F7.2,6X,7HITYPW =,I2,6X,8HICLEAN =,-
     1 I2,/6X,12HHORIZ. TAIL:,3X,F8.2,6X,F7.2/6X,14HVERTICAL TAIL:,1X,-
     2 F8.2,6X,F7.2/6X,13HSLOTTED FLAP:,2X,F8.2,6X,F7.2,6X,11HNO. FLAPS-
     3 =,I2,22H;  FLAP ANGLE(FLAPI) =,F5.1,5H DEG.)
   99 FORMAT(22X,'NO. OF GEAR(NG)   NO. OF WHEELS(NW)   TIRE DIAM.(DW)-
     1-FT   STRUT LEN/TIRE DIAM')
  100 FORMAT(22X,'NO. OF GEAR(NG)   NO. OF WHEELS(NW)   TIRE DIAM.(DW)-
```

```
      1-M    STRUT LEN/TIRE DIAM')
  101 FORMAT(6X,18HNOSE LANDING GEAR:,6X,I2,20X,I2,2(20X,F6.2)/-
     1        6X,18HMAIN LANDING GEAR:,6X,I2,20X,I2,2(20X,F6.2))
      END
```

Function Subroutine AIRATT

```
C           FUNCTION ROUTINE FOR CALCULATION OF AIR ATTEN PER FOOT
C            BY ARP 866 (MODIFIED FROM F. MONTEGANI PROGRAM)
C
C         CALLED BY NOIS OR RADIUS
C         INFLOW: TEM,RH,FREQ;  RETURNS: AIRATT
C
      FUNCTION AIRATT(TEM,RH,FREQ)
      DIMENSION A(22)
      DATA A/.87,.75,.652,.57,.505,.452,.406,.369,.335,.308,.286,.268,-
     1        .253,.24,.231,.225,.22,.215,.21,.208,.202,.2/
      T=TEM-460.
      AC=(.1*(FREQ/1000.)**2.05)/(1.651-.00103*T)**2.05
      AMM=(10.*(FREQ/1000.)**1.003)/10.**(.52-.00504*(T+SQRT(256.-
     1 -(10.-T/5.)**2)))
      HA=.25*RH/10.**(1.493-.01638*T-.02*SQRT(128.2-(10.-T/5.)**2))
      HMM=10.**(.4973*ALOG10(FREQ)-1.4894)
      HH=HA/HMM
      IF(HH.GT..25) GO TO 1
      AA=1.2*HH
      GO TO 8
    1 IF(HH.GT..6) GO TO 2
      AA=1.543*HH-.086
      GO TO 8
    2 IF(HH.GT..95) GO TO 3
      AA=.84+.16*SIN(3.1416/2.*(HH-.6)/.35)
      GO TO 8
    3 IF(HH.GT.1.25) GO TO 4
      AA=.87+.13*COS(3.1416/2.*(HH-.95)/.3)
      GO TO 8
    4 IF(HH.GT.6.5) GO TO 7
      HTEST=1.25
      DO 5 I=2,22
      HTEST=HTEST+.25
      IF(HH.LE.HTEST) GO TO 6
    5 CONTINUE
    6 AA=A(I)+((HTEST-HH)/.25)*(A(I-1)-A(I))
      GO TO 8
    7 AA=.2
    8 CONTINUE
      AIRATT=AMM*AA+AC
      RETURN
      END
```

Subroutine BASAT

```
      SUBROUTINE BASAT(R,TAMB,PAMB,RH,SSPL)
C   * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C   *  THIS PROGRAM SUBTRACTS THE ATMOSPHERIC ATTENUATION AT DISTANCE   *
C   *  R FROM A LOSSLESS INPUT SPECTRUM TO GIVE AN OUTPUT SPECTRUM.     *
C   *  AIR ATTENUATION FOR EACH BAND IS DETERMINED BY NUMERICAL         *
C   *  INTEGRATION FOLLOWING RIGOROUS FORMULATIONS THAT ACCOUNT FOR     *
C   *  SPECTRUM AND ATTENUATION GRADIENTS AND RETAIN NON-LINEAR         *
C   *  DEPENDENCE ON DISTANCE.  IDEAL FILTER CHARACTERISTICS ARE        *
C   *  IMPLIED, AND THE CALCULATIONS ARE BASED ON INTERNATIONALLY-      *
C   *  PREFERRED BAND CENTER FREQUENCIES.                               *
C   *       CALLED BY NOIS OR RADIUS                                    *
C   *                                                                   *
C   * INFLOW:                                                           *
C   *  SSPL(24)  INPUT FRACTIONAL-OCTAVE-BAND SOUND PRESSURE LEVEL      *
C   *             SPECTRUM                                              *
C   *  R         DISTANCE FROM SOURCE, IN FEET                          *
```

```
C    *  TAMB       AMBIENT TEMPERATURE IN DEGREES RANKINE                        *
C    *  PAMB       AMBIENT PRESSURE IN PSF                                       *
C    *  RH         RELATIVE HUMIDITY IN PERCENT                                  *
C    * RETURNS:                                                                  *
C    *  SSPL(24)   OUTPUT SPECTRUM                                               *
C    *                                                            F. MONTEGANI   *
C    * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
        DIMENSION EM(24,2),SSPL(24),C(3)
        COMMON/SPECT/TP(24),SPL(24),F(24)
        DATA C/1.033441,1.068,1.1037155/
        DO 1 I=1,23
        EM(I,2)=(SSPL(I+1)-SSPL(I))/70.
      1 EM(I+1,1)=EM(I,2)
        EM(1,1)=EM(1,2)
        EM(24,2)=EM(24,1)
      2 DO 5 I=1,24
        FC1=F(I)*.8767124
        CALL ATMB(R,TAMB,PAMB,RH,F(I),AC)
        SUMN=10.**(-.1*AC)
        SUMD=1.
      3 DO 4 J=1,3
        F1=FC1*C(J)
        F2=F(I)*C(J)
        CALL ATMB(R,TAMB,PAMB,RH,F1,A1)
        CALL ATMB(R,TAMB,PAMB,RH,F2,A2)
        SL1=EM(I,1)*FLOAT(J-4)
        SL2=EM(I,2)*FLOAT(J)
        SUMN=SUMN+10.**(SL1-.1*A1)+10.**(SL2-.1*A2)
      4 SUMD=SUMD+10.**SL1+10.**SL2
      5 SSPL(I)=SSPL(I)+10.*ALOG10(SUMN/SUMD)
        RETURN
        END
```

Subroutine ATMB

```
        SUBROUTINE ATMB(R,TAMB,PAMB,RH,FREQ,ATT)
C    * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C    *  COMPUTES ATMOSPHERIC ATTENUATION IN DECIBELS FOR SPECIFIED               *
C    *  TEMPERATURE, RELATIVE HUMIDITY, DISTANCE, AND FREQUENCY                  *
C    *  FOLLOWING BASS AND SHIELDS, NASA CR-2760.                                *
C    *  APPLICABLE FROM 50 TO 100000 HERTZ, 0 TO 100 F, ANY HUMIDITY.            *
C    *     CALLED BY BASAT                                                       *
C    *     INFLOW:  R,TAMB,PAMB,RH,FREQ;  RETURN:  ATT                           *
C    *                                                                           *
C    *  R        DISTANCE (FEET)                                                 *
C    *  TAMB     TEMPERATURE (DEGREES RANKINE)                                   *
C    *  PAMB     PRESSURE (POUNDS FORCE PER SQ FT)                               *
C    *  RH       RELATIVE HUMIDITY (PERCENT)                                     *
C    *  FREQ     FREQUENCY (HERTZ)                                               *
C    *  ATT      ATTENUATION (DB)                                                *
C    *  NO ERROR MESSAGES ARE CODED                                              *
C    *                                                            F. MONTEGANI   *
C    * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
        P=PAMB/2116.
        T=TAMB/1.8
        T1=T/293.
        T2=T/273.16
        T3=2239.1/T
        T4=3352./T
        PS=10.79586*(1.-1./T2)-5.02808*ALOG10(T2)                                 -
      1 +1.50474E-4*(1.-10.**(-8.29692*(T2-1.)))                                  -
      2 +0.42873E-3*(10.**(4.76955*(1.-1./T2))-1.)-2.2195983
        H=RH/P*10.**PS
        FSQ=FREQ**2
        FRO=P*(24.+4.41E+4*H*(.05+H)/(.391+H))
        FRN=P/SQRT(T1)*(9.+350.*H*EXP(6.142*(1.-1./T1**.333)
        ALPHA=SQRT(T1)*FSQ/P*(1.84E-11+2.1913E-4/T1*P*T3**2*EXP(-T3)/            -
      1 (FRO+FSQ/FRO)+8.1619E-4/T1*P*T4**2*EXP(-T4)/(FRN+FSQ/FRN))*8.686
```

```
      ATT=ALPHA/3.28084*R
      RETURN
      END
```

Subroutine EGAC

```
C         SUBROUTINE TO CALCULATE EXTRA GROUND ATTENUATION DUE
C           TO TURBULENT SCATTERING (DOWNWIND ATTENUATION, FIG 4,
C           OF SAE AIR 923) BASED ON NASA CR-114649 FROM BOEING.
C
C        CALLED BY NOIS OR RADIUS
C        CALLS SUBROUTINE TERP
C        INFLOW:  SSPL,R,VIEW,F;  RETURNS:  SSPL
C
      SUBROUTINE EGAC(SSPL)
      DIMENSION SSPL(24)
      DIMENSION AFZERO(16,7),AFACT(7,6),ADIST(16),AFREQ(7),ABETA(6)
      COMMON/GEOM/R,THETA,THETAF,THETAH,PHI,VIEW
      COMMON/SPECT/TP(24),SPL(24),F(24)
      DATA ADIST/0.,2.,2.1761,2.301,2.4771,2.6021,2.7781,2.9031,-
     1  3.,3.1461,3.301,3.4771,3.6021,3.7781,3.9031,4./
      DATA AFREQ/1.7245,2.0256,2.3266,2.6276,2.9287,3.2297,-
     1  3.8318/
      DATA ABETA/0.,2.,10.,20.,45.,90./
      DATA AFZERO/0.,.2,.3,.5,.7,.8,1.1,1.5,2.,3.,4.2,5*5.,-
     1 0.,.3,.5,.7,1.1,1.5,2.1,2.5,3.,4.3,6.,7.,7.1,3*7.2,-
     2 0.,.5,.6,1.,1.4,1.9,2.6,3.2,4.,5.6,7.7,9.1,9.7,9.9,2*10.,-
     3 0.,.6,.8,1.2,1.8,2.4,3.2,4.,5.,7.1,9.7,11.2,11.8,3*12.,-
     4 0.,.7,1.,1.5,2.2,2.7,3.6,4.8,6.,8.5,11.1,13.1,14.,14.6,2*14.8,-
     5 0.,.8,1.1,1.7,2.4,3.1,4.4,5.8,7.2,10.1,13.,14.7,15.4,15.9,2*16.,-
     6 0.,.8,1.1,1.7,2.4,3.1,4.4,5.8,7.2,10.1,13.,14.7,15.4,15.9,2*16./
      DATA AFACT/14*1.,.186,.297,.352,.406,.468,2*.534,-
     1  .163,.183,.188,.198,.214,2*.235,14*0./
C
      IF(R.LE.1.) RETURN
      DIST=ALOG10(R)
      DO 1 I=1,24
      FREQ=ALOG10(F(I))
      CALL TERP(AFZERO,DIST,FREQ,1.,ADIST,AFREQ,1.,16,7,1,FZERO)
      CALL TERP(AFACT,FREQ,VIEW,1.,AFREQ,ABETA,1.,7,6,1,FACT)
    1 SSPL(I)=SSPL(I)-FZERO*FACT
      RETURN
      END
```

Subroutine GNDRFL

```
C     SUBROUTINE TO COMPUTE GROUND REFLECTION EFFECT ON TOTAL NOISE,
C         BASED ON TMX 56033 BY T. W. PUTNAM OF DFRC, FOR ANOP USE.
C         THIS PROGRAM IS BASED ON WHITE NOISE APPROXIMATION, WITH
C         PROVISION FOR DISTRIBUTED SOURCE HEIGHTS AND FOR TONES.
C
C      CALLED BY NOIS OR RADIUS
C      INFLOW:  SSPL,UNITS,IOUT,C,R,IJ,KI,ZO,ZI,F
C      RETURNS:  SSPL
C
      SUBROUTINE GNDRFL(SSPL)
      DIMENSION SSPL(24),ENN(24),QABS(24),FSHIFT(24),DK(10)
      COMMON UNITS,ISKIP,IOUT(3),IREV,ILG,FDOP,C,TAMB,PAMB,RH,NENG,ISUPP
      COMMON/GEOM/R,THETA,THETAF,THETAH,PHI,VIEW,HEAD,PSYI,FLAPI,EPPI,-
     1 VI,X,Y,TAU,IJ,KI,ZO,ZI
      COMMON/SPECT/TP(24),SPL(24),F(24)
      NAMELIST/GNDDA/JOUT,QABS,FSHIFT,DK,NS,ITONE
C        JOUT=1/0 (Y/N TO PRINT GROUND REFLECTION MODIFICATION
```

```
C              OVERRIDING IOUT(1).
C          QABS:  ABSOLUTE VALUES OF GROUND REFLECTIVITY AS A FUNCTION
C              OF FREQUENCY (DEFAULT=24*1.)
C          FSHIFT: PHASE SHIFTS OF THE REFLECTED WAVE AS FUNCTION OF
C              FREQUENCY, IN DEGREES (DEFAULT=24*0.)
C          NS:   NUMBER OF HEIGHTS TO BE ENTERED FOR A MULTIPLE SOURCE
C              MODELLING (DEFAULT=1)
C          DK:   HEIGHTS OF THE MULTIPLE SOURCES FROM THE SOURCE CENTER
C              (DEFAULT=10*0.)
C          ITONE=1/0 (Y/N TO TREAT 1/3-OCTAVE BANDS 3 DB OR MORE
C              ABOVE ADJACENT BANDS AS TONES FOR REFL. CALC.
      DATA QABS,FSHIFT,DK,NS,ITONE/24*1.,24*0.,10*0.,1,0/
      DATA SI,ENG/2HSI,3HENG/
C
      IF(IJ.NE.1.OR.KI.GT.1) GO TO 3
      JOUT=IOUT(1)
    1 READ(5,GNDDA)
      IF(UNITS.EQ.ENG) GO TO 3
      DO 2 I=1,NS
    2 DK(I)=DK(I)*3.28
    3 ZEE=SQRT(1.+4.*ZO*ZI/R/R)
      DRC=R*(ZEE-1.)/C
      PHS=.7249775*DRC
    4 PHC=6.324872*DRC
      DO 8 L=1,24
      PS=PHS
      PC=PHC
    5 IF(ITONE.EQ.0)  GO TO 6
      SPLM=SSPL(L+1) + 3.
      SPLN=SSPL(L-1) + 3.
      IF(L.EQ.1) SPLN=SSPL(1)+3.
      IF(L.EQ.24) SPLM=SSPL(24)+3.
      IF(SSPL(L).LT.SPLM.AND.SSPL(L).LT.SPLN) GO TO 6
      PS=.0000001*DRC
      PC=6.2831853*DRC
    6 SUM=0.
      DO 7 I=1,NS
      DKI=1.+DK(I)/ZI
    7 SUM=SUM+SIN(PS*F(L)*DKI)*COS(PC*F(L)*DKI+.0174533*FSHIFT(L))/DKI
      ENN1=1.+(QABS(L)/ZEE)**2+2.*QABS(L)/ZEE/PS/F(L)*SUM/NS
      IF(ENN1.LE.0.) ENN1=1.E-20
    8 ENN(L)=10.*ALOG10(ENN1)
      DO 9 L=1,24
    9 SSPL(L)=SSPL(L)+ENN(L)
      IF(JOUT.EQ.1)  WRITE(6,90) (ENN(L),L=1,24)
   90 FORMAT(8H GNDRF :,17F7.1/8X,7F7.1)
      RETURN
      END
```

Subroutine SHLD

```
C             SHIELDING SUBROUTINE - CONSISTS OF WING AND FUSELAGE
C                SHIELDING TERMS;  IN PARTICULAR,
C         FUSELAGE:  FUNCTION IS HYPERBOLIC SECANT, MAXIMIZING AT
C             THETAH=90 DEGREES, WITH A MAXIMUM OF "SFUSE" AND ANGULAR
C            WIDTH OF "SWIDE" DEGREES AT 1/E DOWN FROM PEAK.
C             ATTENUATION DECREASES WITH FREQUENCY FOR WAVE LENGTHS
C             LONGER THAN CHARACTERISTIC FUSELAGE DIMENSION (SUCH AS
C             DIAMETER), CFUSE
C         WING:  UNDER-THE-WING:  NONE
C                OVER-THE-WING:  COSINE FUNCTION OF PHI FOR PHI>60 DEG,
C                    WITH MAX OF 1; MULTIPLIED BY COSINE FUNCTION
C                    OF THETAF WITH MAX OF SWING AND MAX DIRECTION OF SMX.
C             ATTENUATION DECREASES WITH FREQUENCY FOR WAVE LENGTHS
C             LONGER THAN CHARACTERISTIC WING DIMENSION (SUCH AS CHORD),
C             CWING
C
C          CALLED BY NOIS OR RADIUS
```

```
C          INFLOW:  UNITS,TP,F,THETAF,THETAH,PHI,IJ,KI,IOUT
C          RETURNS:  TP, ATTEN. SPECTRUM (AS SPL), ATTEN. OASPL,PNL,PNLT
C
      SUBROUTINE SHLD
      DIMENSION SSPL(24)
      COMMON/GEOM/R,THETA,THETAF,THETAH,PHI,VIEW,HEAD,PSYI,FLAPI,EPPI,-
     1  VI,X,Y,TAU,IJ,KI
      COMMON/SPECT/TP(24),SPL(24),F(24),OASPL,PNL,PNLT
      COMMON UNITS,ISKIP,IOUT(3),IREV,ILG,FDOP,C,TAMB,PAMB,RH,NENG,ISUPP
      NAMELIST/SHLDA/IUOTW,SFUSE,SWIDE,SWING,SMX,CFUSE,CWING
C       DEFAULT VALUES
      DATA SFUSE,SWING,CFUSE,CWING,SWIDE,SMX/4*10.,60.,90./
      DATA SI,ENG/2HSI,3HENG/,AR/.0174533/
C
      IF(IJ.NE.1.OR.KI.NE.1) GO TO 4
      IF(KI.EQ.0) GO TO 1
      JOUT=IOUT(1)
      READ(5,SHLDA)
    1 IF(JOUT.NE.4) GO TO 3
      IF(IUOTW.EQ.0) WRITE(6,98) SWIDE,SFUSE
      IF(IUOTW.EQ.1) WRITE(6,99) SWIDE,SFUSE,SWING,SMX
      IF(UNITS.EQ.SI)  GO TO 2
      WRITE(6,100) CFUSE,CWING
      GO TO 3
    2 WRITE(6,101) CFUSE,CWING
      CFUSE=CFUSE*3.28
      CWING=CWING*3.28
    3 FWING=C/CWING
      FFUSE=C/CFUSE
C          FUSELAGE SHIELDING (UTW OR OTW ENGINE) FOR PHI>70 DEG.
      DELF=0.
    4 IF(PHI.GT.70.) DELF=SFUSE/COSH((THETAH-90.)*3.315/SWIDE)*-
     1  SIN((PHI-70.)*4.5*AR)/FFUSE
      IF(DELF.LT.0.) DELF=0.
      DELW=0.
      IF(IUOTW.EQ.0) GO TO 8
C          WING SHIELDING FOR OTW ENGINE
    6 IF(PHI.LE.60.) THDELT=SWING
      IF(PHI.GT.60.) THDELT=SWING*COS(3.*(PHI-60.)*AR)
      DELW=THDELT*COS((THETAF-SMX)*AR)
    8 DELW=DELW/FWING
      IF(DELW.LT.0.) DELW=0.
      SUM=0.
      DO 9 L=1,24
      DEF=DELF*AMIN1(F(L),FFUSE)
      DEW=DELW*AMIN1(F(L),FWING)
      SPL(L)=DEF+DEW
      TP(L)=TP(L)/10.**(SPL(L)/10.)
      SSPL(L)=10.*ALOG10(TP(L))
    9 SUM=SUM+TP(L)
      IF(JOUT.EQ.0) RETURN
      OASPL=10.*ALOG10(SUM)
      PNL=PERNOY(SSPL)
      PNLT=PNL+TONE(SSPL)
      IF(JOUT.EQ.1) WRITE(6,102) (SPL(L),L=1,24),OASPL,PNL,PNLT
      IF(JOUT.EQ.2) WRITE(6,103) OASPL,PNL,PNLT
      RETURN
   98 FORMAT(' UNDER-THE-WING SHIELDING:     SHIELDED OVER',-
     1 F8.2,' DEGREES ARC BY FUSELAGE, MAXIMUM OF',F8.2,3H DB)
   99 FORMAT(' OVER-THE-WING SHIELDING:     SHIELDED OVER',-
     1 F8.2,' DEGREES ARC BY FUSELAGE, MAXIMUM OF',F8.2,3H DB/-
     2 22X,'WING SHIELDING MAXIMUM OF',F8.2,' DB AT ANGLE OF',F8.2,-
     3 8H DEGREES)
  100 FORMAT(22X,'CHARACTERISTIC DIMENSIONS:  CFUSE =',F9.3,-
     1 ' FEET;  CWING =',F9.3,5H FEET)
  101 FORMAT(22X,'CHARACTERISTIC DIMENSIONS:  CFUSE =',F9.3,-
     1 ' METERS;  CWING =',F9.3,7H METERS)
  102 FORMAT(8H SHIELD:,17F7.1/8X,7F7.1,29H  (AFTER SHIELDING):-
     1  OASPL =,F7.1,6H PNL =,F7.1,7H PNLT =,F7.1)
```

```
  103 FORMAT(18H  SHIELDED LEVELS:,15X,3F7.1)
      END
```

Subroutine PERNOY

```
C          FUNCTION ROUTINE FOR CALC PERCEIVED NOISE
C
C         CALLED BY NOIS OR RADIUS AND ALL NOISE SOURCE MODULES
C         INFLOW:  SPL;         RETURNS:  PERNOY
C
      FUNCTION PERNOY(SPL)
      DIMENSION ELL1(24),ELL2(24),ELL3(24),ELLC(24),ELL4(24),SPL(27)
      DIMENSION SLOPE1(24),SLOPE2(24),SLOPE3(24),SLOPE4(24)
      DATA ELL1/49.,44.,39.,34.,30.,27.,24.,21.,18.,5*16.,15.,12.,9.,-
     1   5.,4.,5.,6.,10.,17.,21./
      DATA ELL2/55.,51.,46.,42.,39.,36.,33.,30.,27.,5*25.,23.,21.,18.,-
     1   15.,14.,14.,15.,17.,23.,29./
      DATA ELL3/64.,60.,56.,53.,51.,48.,46.,44.,42.,5*40.,38.,34.,32.,-
     1   30.,2*29.,30.,31.,37.,41./
      DATA ELLC/91.01,85.88,87.32,79.85,79.76,75.96,73.96,74.91,94.68,-
     1   13*100.,44.29,50.72/
      DATA ELL4/52.,51.,49.,47.,46.,45.,43.,42.,41.,5*40.,38.,34.,32.,-
     1   30.,2*29.,30.,31.,34.,37./
      DATA SLOPE1/.07952,2*.06816,.05964,10*.053013,.05964,2*.053013,-
     1          2*.047712,2*.053013,.06816,.07952,.05964/
      DATA SLOPE2/2*.058098,.052288,.047534,2*.043573,.040221,.037349,-
     1          7*.034859,.040221,.037349,4*.034859,2*.037349,.043573/
      DATA SLOPE3/.043478,.04057,2*.036831,.035336,2*.033333,.032051,-
     1          .030675,6*.030103,7*.02996,2*.042285/
      DATA SLOPE4/15*.030103,9*.02996/
      SNOY=0.
      XNOYMX=0.
      DO 1 N=1,24
      IF(SPL(N).GT.150.) WRITE(6,10) SPL(N)
      IF(SPL(N).LT.ELL2(N)) XNOY=.1*10.**(SLOPE1(N)*(SPL(N)-ELL1(N)))
      IF(SPL(N).GE.ELL2(N).AND.SPL(N).LT.ELL3(N)) XNOY=10.**(SLOPE2(N)*-
     1 (SPL(N)-ELL3(N)))
      IF(SPL(N).GE.ELL3(N).AND.SPL(N).LT.ELLC(N)) XNOY=10.**(SLOPE3(N)*-
     1 (SPL(N)-ELL3(N)))
      IF(SPL(N).GE.ELLC(N)) XNOY=10.**(SLOPE4(N)*(SPL(N)-ELL4(N)))
      SNOY=SNOY+XNOY
      IF(XNOY.GT.XNOYMX) XNOYMX=XNOY
    1 CONTINUE
      EN=XNOYMX+.15*(SNOY-XNOYMX)
      PERNOY=40.+33.22*ALOG10(EN)
      RETURN
   10 FORMAT(25H PNDB SUBROUTINE WARNING:,F6.1,46H DB EXCEEDS RANGE-
     1 (150 DB) FOR VALID PNDB CALC)
      END
```

Subroutine TONE

```
C          FUNCTION SUBROUTINE TO CALCULATE TONE CORRECTION
C            FOR PNLT AS AN ADDITION TO PNL.
C
C         CALLED BY NOIS OR RADIUS AND ALL NOISE SOURCE MODULES
C         INFLOW:  SPL;    RETURNS: TONE
C
      FUNCTION TONE(SPL)
      DIMENSION SPL(24),SL(25),SP(24)
      LOGICAL N(24)
      DO 1 I=4,24
      N(I)=.FALSE.
    1 SL(I)=SPL(I)-SPL(I-1)
      DO 2 I=5,24
      IF(ABS(SL(I)-SL(I-1)).LE.5.) GO TO 2
      IF(SL(I).GT.0..AND.SL(I).GT.SL(I-1)) N(I)=.TRUE.
      IF(SL(I).LE.0..AND.SL(I-1).GT.0.) N(I-1)=.TRUE.
```

```
    2 CONTINUE
      DO 3 I=1,23
      SP(I)=SPL(I)
      IF(N(I)) SP(I)=.5*(SPL(I-1)+SPL(I+1))
    3 CONTINUE
      SP(24)=SPL(24)
      IF(N(24)) SP(24)=SPL(23)+SL(23)
      DO 4 I=4,24
    4 SL(I)=SP(I)-SP(I-1)
      SL(3)=SL(4)
      SL(25)=SP(24)
      SP(3)=SPL(3)
      TONE=0.
      DO 5 I=4,24
      FACT=2.
      SP(I)=SP(I-1)+.3333*(SL(I-1)+SL(I)+SL(I+1))
      FDEL=SPL(I)-SP(I)
      IF(I.LE.21.AND.I.GE.11) FACT=1.
      T=FDEL/3./FACT
C       FOLLOWING STATEMENT INACTIVATED, PER MARCH 1978 VERSION
C     IF(FDEL.LT.3.) T=0.
      IF(FDEL.GT.20.) T=6.66667/FACT
    5 IF(T.GE.TONE) TONE=T
      RETURN
       END
```

Subroutine EPNL

```
C          FUNCTION SUBROUTINE  TO INTEGRATE EPNL FROM PNL TIME HISTORY,
C            ASSUMING PNLT IS LINEAR WITH TIME BETWEEN POINTS.  ROUTINE
C            DOUBLES AREA INTEGRATED AND WARNS USER IF EITHER FIRST OR
C            LAST VALUE OF PNL IS THE MAXIMUM SO THAT INTEGRAL WOULD NOT
C            BE FINITE.
C
C         CALLED BY NOIS
C         INFLOW:  F,FMAX,T,N;  RETURNS: EPNL,TS,TF
C
      FUNCTION EPNL(F,FMAX,T,N,TS,TF)
      DIMENSION F(1),T(1)
      EP(F2,F1,T2,T1)=4.3429*(T2-T1)*(10.**(.1*F2)-10.**(.1*F1))/(F2-F1)
      IK=0
      IL=0
      IWS=0
      IWF=0
      EPSUM=0.
      F10=FMAX-10.
      IF(F(1).EQ.FMAX) IWS=1
      IF(F(N).EQ.FMAX) IWF=1
      DO 2 J=1,N
      IF(IK.EQ.1.AND.IL.EQ.1) GO TO 3
      IF(IK.EQ.1) GO TO 1
      IF(F(J).LT.F10) GO TO 1
      I=J
      IK=1
    1 IF(IL.EQ.1) GO TO 2
      L=N-J+1
      IF(F(L).LT.F10) GO TO 2
      K=L
      IL=1
    2 CONTINUE
    3 KM=K-1
      DO 5 J=I,KM
      IF(ABS(F(J+1)-F(J)).GT..001) GO TO 4
      EPSUM=EPSUM+(T(J+1)-T(J))*10.**(.1*F(J))
      GO TO 5
```

```
    4 EPSUM=EPSUM+EP(F(J+1),F(J),T(J+1),T(J))
    5 CONTINUE
      IJ=I
      JK=K
      IF(IJ.EQ.1) IJ=2
      IF(JK.EQ.N) JK=N-1
      IF(IWS.EQ.0) TS=T(IJ)-(F(IJ)-F10)*(T(IJ)-T(IJ-1))/(F(IJ)-F(IJ-1))
      IF(TS.LE.T(I)) GO TO 6
      TS=T(I)
      WRITE(6,93)
    6 IF(IWF.EQ.0) TF=T(JK)+(F10-F(JK))*(T(JK+1)-T(JK))/(F(JK+1)-F(JK))
      IF(TF.GE.T(K)) GO TO 7
      TF=T(K)
      WRITE(6,94)
    7 IF(F(I)-F10.LT..001) GO TO 8
      IF(IWS.EQ.0) EPSUM=EPSUM+EP(F(I),F10,T(I),TS)
    8 IF(F(K)-F10.LT..001) GO TO 9
      IF(IWF.EQ.0) EPSUM=EPSUM+EP(F10,F(K),TF,T(K))
    9 IF(IWS.EQ.1) WRITE(6,90) F(1)
      IF(IWF.EQ.1) WRITE(6,91) F(N)
      IF(IWS.NE.1.AND.IWF.NE.1) GO TO 10
      WRITE(6,92)
      EPSUM=2.*EPSUM
   10 EPNL=10.*ALOG10(EPSUM/10.)
      RETURN
   90 FORMAT(2X,'EPNL WARNING: FIRST PNLT(',F5.1,') IS MAXIMUM')
   91 FORMAT(2X,'EPNL WARNING: LAST PNLT(',F5.1,') IS MAXIMUM')
   92 FORMAT(4X,'APPROXIMATE EPNL ASSUMING SYMMETRICAL TIME HISTORY.-
     1 INCREASE TIME (TD OR NT) FOR VALID CALCULATION')
   93 FORMAT(' EPNL APPROX. -LEVELS DECREASE AT START OF TIME INTERVAL')
   94 FORMAT(' EPNL APPROX. -LEVELS INCREASE AT END OF TIME INTERVAL')
      END
```

Subroutine TERP

```
C        INTERPOLATION SUBROUTINE FOR FINDING "FX" AS FUNCTION OF
C        ABSCISSA "AX" AND INDEPENDENT CURVES IN PARAMETERS "B" AND "C".
C         CALLED BY MANY MODULES;   CALLS SERCH
C         INFLOW:  F,AX,BX,CX,A,B,C,NA,NB,NC;   RETURNS:  FX
C           A:    ARRAY OF NA ABSCISSA VALUES COMMON TO "B" AND "C"
C           B:    2-DIMEN. ARRAY OF NB CURVE VALUES FOR EACH "C" SET,
C           C:    ARRAY OF NC VALUES OF C
C           F:    3-DIMEN. ARRAY AS A FUNCTION OF "A", "B", AND "C"
C          AX:    INPUT VALUE OF A
C          BX:    INPUT VALUE OF B
C          CX:    INPUT VALUE OF C
C          FX:    INTERPOLATED OUTPUT
C
      SUBROUTINE TERP(F,AX,BX,CX,A,B,C,NA,NB,NC,FX)
      DIMENSION FFF(2),FF(2,2),F(NA,NB,NC),A(NA),B(NB,NC),C(NC),-
     1   B1(20),B2(20)
C
      CALL SERCH(AX,A,NA,KA,AFR)
      CALL SERCH(CX,C,NC,KC,CFR)
      KC1=KC+1
      IF(NC.EQ.1) KC1=KC
      DO 1 KB=1,NB
      B1(KB)=B(KB,KC)
      B2(KB)=B(KB,KC1)
    1 CONTINUE
      CALL SERCH(BX,B1,NB,KB1,BFR1)
      CALL SERCH(BX,B2,NB,KB2,BFR2)
      BF=BFR1
      J1=KB1
      J1P1=J1+1
      IF(NB.EQ.1) J1P1=J1
      DO 3 I=KC,KC1
      DO 2 J=J1,J1P1
```

```
      FF(J,I)=F(KA,J,I)+AFR*(F(KA+1,J,I)-F(KA,J,I))
    2 CONTINUE
      FFF(I)=FF(J1,I)+BF*(FF(J1P1,I)-FF(J1,I))
      J1=KB2
      J1P1=J1+1
      BF=BFR2
    3 CONTINUE
      FX=FFF(KC)+CFR*(FFF(KC1)-FFF(KC))
      RETURN
      END
```

Subroutine SERCH

```
C         SUBROUTINE TO FIND KA,KA+1 INTERVAL WHERE AX FALLS IN NA VALUES
C           OF ARRAY "A", AND TO CALCULATE FRACTION AFR WITHIN INTERVAL.
C
C         CALLED BY TERP
C         INFLOW:  AX,A,NA;    RETURNS:  KA,AFR
      SUBROUTINE SERCH(AX,A,NA,KA,AFR)
      DIMENSION A(NA)
      IF(NA.GT.1) GO TO 1
      AFR=0.
      KA=1
      RETURN
    1 IF(AX.LE.A(1)) GO TO 4
      NAM1=NA-1
      DO 2 I=1,NAM1
      IF(AX.GE.A(I).AND.AX.LT.A(I+1)) GO TO 3
    2 CONTINUE
    3 KA=I
      GO TO 5
    4 KA=1
    5 IF(A(KA+1).NE.A(KA)) GO TO 6
      AFR=0.
      RETURN
    6 AFR=(AX-A(KA))/(A(KA+1)-A(KA))
      RETURN
      END
```

References

1. Heidmann, M. F.: Interim Prediction Method for Fan and Compressor Source Noise. NASA TM X-71763, 1975. (Corrected 1979 reprint available).
2. Stone, J. R.: Interim Prediction Method for Jet Noise. NASA TM X-71618, 1974. (With errata.)
3. Huff, R. G.; Clark, B. J.; and Dorsch, R. G.: Interim Prediction Method for Low Frequency Core Engine Noise. NASA TM X-71627, 1974.
4. Krejsa, E. A.; and Valerino,M. F.: Interim Prediction Method for Turbine Noise. NASA TM X-73566, 1976.
5. Dorsch, R. G.; Clark, B. J.; and Reshotko, M.: Interim Prediction Method for Externally Blown Flap Noise. NASA TM X-71768, 1975.
6. Clark, B. J.; McArdle, J. G.; and Homyak, L.: Measured and Predicted Noise of the AVCO-Lycoming YF-102 Turbofan Engine. AIAA Paper 79-0641, 1979.
7. Stone, J. R.: Flight Effects on Exhaust Noise for Turbojet and Turbofan Engines—Comparison of Experimental Data with Prediction. NASA TM X-73552, 1976.
8. Stone, J. R.: An Empirical Model for Inverted-Velocity-Profile Jet Noise Prediction. NASA TM X-73838, 1977.
9. Stone, J. R.: An Improved Method for Predicting the Effects of Flight on Jet Mixing Noise. NASA TM X-79155, 1979.
10. Matta, R. K.; Sandusky, G. T.; and Doyle, V. L.: GE Core Engine Noise Investigation—Low Emission Engines. FAA-RD-77-4, U.S. Dept. of Transportation, 1977, pp. 152-153. (Available from NTIS as AD-A048590.)
11. Fink, M. R.: Airframe Noise Prediction Method. R77-912607-11, United Technologies; FAA-RD-77-19, 1977. (Available from NTIS as AD-A039664.)
12. Standard Values of Atmospheric Absorption as a Function of Temperature and Humidity. Aerospace Recommended Practice 866, 1964, SAE.
13. Montegani, F. J.: Some Propulsion System Noise Data Handling Conventions and Computer Programs Used at the Lewis Research Center. NASA TM X-3013, 1974.
14. Bass, H. E.; and Shields, F. D.: Atmospheric Absorption of High Frequency Noise and Application to Fractional Octave Bands. NASA CR-2760, 1977.
15. Montegani, F. J.: Computation of Atmospheric Attenuation of Sound for Fractional-Octave Bands. NASA TP-1412, 1979.
16. Dunn, D. G.; and Peart, N. A.: Aircraft Noise Source and Contour Estimation. (D6-60233, Boeing Commercial Airplane Co.; NASA Contract NAS 2-6969.) NASA CR-114649, 1973.
17. Method for Calculating the Attenuation of Aircraft Ground to Ground Noise Propagation During Takeoff and Landing. Aerospace Information Report 923, Aug. 15, 1966, SAE.
18. Putnam, T. W.: Review of Aircraft Noise Propagation. NASA TM X-56033, 1975.
19. Definitions and Procedures for Computing the Perceived Noise Level of Aircraft Noise. Aerospace Recommended Practice 865A, Aug. 15, 1969, SAE.
20. Noise Standards: Aircraft Type Certification. FAA Federal Aviation Regulations Part 36, March 1978. Appendix B: Aircraft Noise Evaluation Under Section 36.103.

TABLE I. - PREDICTION SOURCE EQUATIONS AND FIGURES

Reference	Source	Component	Level prediction	Directivity	Spectrum
1	Fan	Inlet broadband	Eq. (4); figs. 4(a), 6(b)	Fig. 7(a)	Eq. (2)
		Inlet tones	Eq. (6); figs. 10(a), 12	Fig. 13(a)	Figs. 8, 9
		Inlet multiple pure tones	Eq. (8); fig. 15(a)	Fig. 16	Fig. 14
		Exhaust broadband	Eq. (10); figs. 4(b), 6(b)	Fig. 7(b)	Eq. (2)
		Exhaust tones	Eq. (12); figs. 10(b), 12	Fig. 13(b)	Fig. 8
2	Jet	Subsonic (conical, slot, or plug)	Eqs. (12), (16)	Eq. (14); fig. 5	Eq. (17); fig. 5
		Shocks	Eq. (11)	---------------	Eq. (13); fig. 7
		Coaxial	Eqs. (14), (16), (18), (19)	Eq. (14); fig. 5	Eqs. (17), (20); figs. 5, 12
3	Core	----------------	Eq. (9)	Fig. 1	Eq. (12); fig. 2
4	Turbine	Broadband	Eq. (1)	Fig. 5(a)	Fig. 6(a)
		Tones	Eq. (4)	Fig. 5(b)	Fig. 6(b)
5	Flap	Under the wing	Eqs. (10), (11), (16), (22); fig. 19	Eq. (14); figs. 13, 14	Figs. 15(a) and (b)
		Over the wing	Eqs. (17), (18)	Figs. 17(a) and (b)	Figs. 18(a) and (b)
11	Air-frame[a]	Wing, tail	Eq. (10)		Eq. (7)
		Slotted flap	Eq. (21)		Eqs. (22) to (28)
		Landing gear	Eqs. (14), (15), (19)		Eqs. (11) to (13), (16) to (18)
		Slatted leading edge	Eq. (10)		Eq. (7)

[a]In form only: constants in equations modified by Langley Research Center, with consultation by M. R. Fink, United Technologies, Corp.

TABLE II. - CHECKLIST OF DATA INPUT

Main program FOOTPR

(1) Title card	Alphanumeric, 20A4	
(2) &GRID	Namelist ↓	&END ↓
(3) &TRAJ		
(4) &AMB		
(5) &SOURCE		
(6) &PARAM		
*(7) &FANDA		
*(8) &JETDA		
*(9) &COREDA		
*(10) &TURBDA		
*(11) &SHLDA		
*(12) &FLAPDA		
*(13) &AIRFDA		
*(14) &GNDDA		

Main program RADIUS

(1) Title card	Alphanumeric, 20A4	
(2) &GEOMT	Namelist ↓	&END ↓
(3) &AMB		
(4) &SOURCE		
(5) &PARAM		
(6) &OPER		
*(7) &FANDA		
*(8) &JETDA		
*(9) &COREDA		
*(10) &TURBDA		
*(11) &SHLDA		
*(12) &FLAPDA		
*(13) &AIRFDA		
*(14) &GNDDA		
(15) &OPER		
*(16) &GNDDA		
(17) &OPER		
*(18) &GNDDA		
etc.		

*Only required when corresponding source routines are used.

TABLE III. - INPUT VARIABLES

Program	Block	Variables	Dimension	Definition and Units, SI(English)	Default Values	Required for -
FOOTPR	-	COMENT	20	User-supplied title for output, one line		
	&GRID	NXO,NYO	1	No. of XO and YO values	1,2	
		XO,YO	20	Observer coordinates, m(ft)	500.,500.,1000.	
		ZO	1	Observer altitude, m(ft)	4.	
		NCONTR	1	No. of sound level contours desired (for IOUT(3)>0)	1	
		CONTR	5	Contour levels (PNL, PNLT, or EPNdB)	90.,95.,100.	
		UNITS	1	For English or SI units, input and output (3HENG,2HSI)	ENG	
	&TRAJ	NP	1	No. of points to define aircraft path and flight conditions	2	
		XA,YA,ZA	50	Coordinates of aircraft path, m(ft)	0.,47496.;2*0.;8.,5000.	
		ALF1	50	Engine angles of attack, deg	0.	
		GAM	50	Banking angles of aircraft, deg	0.	
		VA	50	Aircraft velocities, m/s(fps)	150.	
		EPP	50	Engine performance parameters (as % thrust or % speed)	100.	
		PSY	50	Trailing flap angles for powered lift, deg	0.	FLAP
		FLAPA	50	Angles of slotted flaps for airframe noise, deg	0.	AIRFR
		ILGR	50	Landing gear down indicator (1/0=yes/no)	0	AIRFR
		IREVR	50	Thrust reverser deployed indicator (1/0=yes/no)	0	REVR
		TSTART	1	Time reference at first trajectory point, sec.	0.	
		NT	1	No. of time increments desired (max. of 100)	21	
		TD	1	Size of time increment, sec	1.	
		ICPA	1	Indicator to center time history on closest point of approach (=1), or start history at first trajectory point (=0)	1	
		IGEOM	1	Indicator for printout of geometric relations at each point in time (1/0=yes/no)	0	
		ITITLE	1	Indicator to title output with input geometry (1/0=yes/no)	1	
	&AMB	TAMB	1	Ambient temperature, °K(°R)	518.7°R	
		PAMB	1	Ambient pressure, absolute, N/m²(psf)	2116.psf	
		RH	1	Percent relative humidity, ambient	70.	
NOIS	&SOURCE	NENG	1	No. of engines	1	
		IFAN,IJET, ICORE,ITURB, IFLAP,IAIRF	1	Sources to be calculated (1/0=yes/no); input must be supplied for each source	All=0	
		ISUPP	1	Suppression spectra to be applied to each source for which suppr. spectra supplied; may be over-ridden by ISUPPR in individual source inputs	0	
		IDOP	1	Doppler amplification and shift to be applied to sources (1/0=yes/no)	0	
		IGND	1	Ground reflection correction. Use IGND=0, for no reflection (free-field) 1, for simple 3 dB addition 2, for reflection calc. by Putnam's TMX 56033 (requires &GNDDA input)	0	
		IATM	1	Atmospheric absorption to be applied, as IATM=0: for no atmospheric attenuation 1: for ARP-866 attenuation prediction 2: for Bass & Shields prediction	0	
		IEGA	1	Extra ground attenuation to be applied (1/0=yes/no)	0	
		ISHLD	1	For shielding of engine sources (1/0=yes/no) (requires &SHLDA input)	0	
		ITOT	1	Set = 0, to reject output of total of all sources	1	
		FILBW	1	Fraction of filter bandwidth having gain of 1.	1.	

TABLE III. - Continued.

Program	Block	Variables	Dimension	Definition and Units, SI(English)	Default Values	Required for -
		IOUT	3	Selects level of printout desired: i.e., IOUT(1)=0: No time histories 1: Each source spectrum, OASPL,PNL,PNLT 2: Each source OASPL,PNL,PNLT only 3: Total OASPL,PNL,PNLT (Note that IOUT(1) can be over-ridden in any individual source program by specifying JOUT in input data to that source) IOUT(2)=0: No levels at grid points 1: PNL-max at grid points 2: PNLT-max at grid points 3: EPNL at grid points IOUT(3)=0: No contour calculation 1: Coordinates of PNL-max contours 2: Coordinates of PNLT-max contours 3: Coordinates of EPNL contours		
	&PARAM	NPARAM	1	No. of engine performance points in array file containing data on parameters affecting noise		
		AEPP	10	Array of values of engine performance (in % thrust or % speed)		
		****		(Parameters listed below must be supplied according to individual noise sources to be calculated)	****	
		AWAFAN	10	Array of total engine air flows, kg/s(lb/sec)		FAN
		ARPM	10	Array of fan speeds, rpm		FAN,TURB
		ATIPM(ATIPM2)	10	Array of fan relative tip Mach numbers (These approximated by program if not supplied), first (second) stage		FAN
		ADELT	10	Array of fan temperature rises, °K(°R)		FAN
		(or) AFPR	10	Array of fan pressure ratios (if ADELT not supplied)		FAN
		AWCORE	10	Array of core and turbine air flows, kg/s(lb/sec) (in JET, required only if calculating GAMMAC and GASRC)		JET,CORE,TURB
		AFUEL	10	Array of engine fuel flows, kg/s(lb/sec) (for core gas properties based on "A-1" fuel)		JET,CORE,TURB
		AP3	10	Array of combustor inlet pressures, N/m²(psf)		CORE
		AT3	10	Array of combustor inlet temperatures, °K(°R) (These approximated by program if not supplied)		CORE
		AT4	10	Array of combustor exit temperatures, °K(°R) (These approximated from fuel/air if not supplied)		CORE
		ATURTS	10	Array of turbine last stage rotor relative tip speeds, m/s(fps) (These are approximated if not supplied)		TURB
		ATCTUR	10	Array of turbine exit temp., °K(°R) (assumed same as ATC if not supplied)		TURB
		AVC(AVF)	10	Array of core (fan) nozzle exhaust vel., m/s(fps)		JET,FLAP
		ATC(ATF)	10	Array of core (fan) nozzle exhaust temp., °K(°R)		JET,FLAP
		ICORR	1	Corrections to be applied to engine parameters to correct for ambient conditions (1/0=yes/no)	0	
		TCORXP	1	Exponent for core temp. corr. in engine param.	1.	
FAN	&FANDA	JOUT	1	Over-ride on IOUT(1) for printout		
		IGV	1	Inlet guide vanes? (1/0=yes/no)	0	
		IFD	1	Inlet flow distortion? (1/0=yes/no)	0	
		IEXH	1	Inlet noise only(=0); exhaust only(=1); both included(=2)	2	
		NSTG	1	No. of fan stages	1	
		NBL(NBL2)	1	No. of fan blades, first (second) stage		
		NVAN(NVAN2)	1	No. of stator vanes, first (second) stage		
		FANDIA(FAND2)	1	Fan diameter, first (second) stage, m(ft)		
		FANHUB	1	Diameter of fan hub, m(ft) (for fan face Mach no. calculation)		
		TIPMD(TIPMD2)	1	Design relative tip Mach number, first (second) stage		
		RSS(RSS2)	1	Rotor/stator spacing in percent, first (second) stage		
		NH	1	No. of harmonics of blade-passing tone desired	5	
		GAMMAF	1	Gamma of fan air (required for DELT if AFPR in &PARAM)	1.4	
		FANEFF(FANEF2)	1	Fan efficiency (<1.) (assumed constant at all fan speeds), first (second) stage (required for DELT if AFPR supplied rather than ADELT in &PARAM)		

TABLE III. - Continued.

Program	Block	Variables	Dimension	Definition and Units, SI(English)	Default Values	Required for -
		DECMPT	1	Decrement to combination tones, dB	0.	
		EDOP(EDOP2)	1	Exponent for source motion amplification, first (second) stage when IDOP=1	4.(4.)	
		ISUPPR	1	Over-ride on ISUPP in &SOURCE input		
		SUPPIN	24	Fan inlet suppression spectrum, dB		
		SUPPEX	24	Fan exhaust suppression spectrum, dB		
		TRAT	1	Second/first stage temperature rise ratio		NSTG>1
		(or) PRAT	1	Second/first stage FPR ratio (requires GAMMAF and FANEF2)		NSTG>1
JET	&JETDA	JOUT	1	Over-ride on IOUT(1) for printout		
		INOZ	1	Coaxial (=1), core nozzle only (=0) (Coaxial requires fan stream flow properties)	0	
		IPLUG	1	Plug nozzle? (1/0=yes/no) (requires ANNHT)	0	
		ISLOT	1	Slot nozzle? (1/0=yes/no) (requires DHC)	0	
		IFWD	1	Forward velocity effects to be applied to source (1/0=y/n)	0	
		EDOP	1	Exponent for source motion amplification on shock noise	1.	
		AC(AF)	1	Core (fan) nozzle area, $m^2(ft^2)$		
		MDC(MDF)	1	Design Mach number of core (fan) nozzle (if M>1)	1.(1.)	
		GAMMAC(GAMMAF)	1	Gamma of core (fan) exhaust flow	1.4(1.4)	
		GASRC(GASRF)	1	Gas const. of core(fan) exhaust, J/kg/°K(ft-lb/lbm/°R) (GAMMAC & GASRC are calc. from FUEL flow if not supplied)	53.35(53.35)ft-lb/lbm/°R	
		DHC(DHF)	1	Hydraulic diam of core (fan) nozzle, m(ft) (slot nozzles only)		ISLOT=1
		ANNHT(ANNHTF)	1	Annular height of core (fan) nozzle, m(ft) (plug, coannular) (ANNHTF is calc. if not supplied - for circular nozzle, thin wall)		INOZ=1,IPLUG=1
CORE	&COREDA	JOUT	1	Over-ride on IOUT(1) for printout		
		ISUPPR	1	Over-ride on ISUPP in &SOURCE input		
		CSUPP	24	Core suppression spectrum, dB		
		EDOP	1	Exponent for source motion amplification	2.	
		GAMMA	1	Required if AP3 rather than AT3 in &PARAM	1.4	Calc.T3
		IMOD	1	Modified core level prediction (1/0=yes/no)	0	
		DTEMD	1	Design turbine temperature drop (T4,d - TCTUR,d), °K(°R) (Required for modified level prediction)		IMOD=1
TURB	&TURBDA	JOUT	1	Over-ride on IOUT(1) for printout		
		ISUPPR	1	Over-ride in ISUPP in &SOURCE input		
		TSUPP	24	Turbine suppression spectrum, dB		
		TBNDIA	1	Diameter of last stage turbine, m(ft)		
		GEAR	1	Gear ratio for turbine rpm / fan rpm		
		CS	1	Stator chord to rotor spacing ratio, percent (usually >100%)		
		NBLR	1	No. of blades, last stage rotor		
		ITYPTB	1	Turbofans, core exit ahead of fan exit (JT8D) (=1) Turbojets, or fans with coplanar exits (=0)		
		EDOP	1	Exponent for source motion amplification	4.	
SHLD	&SHLDA	IUOTW	1	Under-the-wing engine (=0), over-the-wing (=1)		
		SFUSE	1	Max of fuselage shielding at THETA=90°, dB	10.	
		SWIDE	1	Degrees of arc where fuselage shielding is greater than SFUSE/e (e=2.718...)	60.	
		SWING	1	Max of wing shielding for OTW engine, dB	10.	IUOTW=1
		SMX	1	Angle in flyover plane (THETAF) of max OTW shielding, deg	90.	IUOTW=1
		CFUSE	1	Characteristic fuselage dimension, such as diam., m(ft)	10.	
		CWING	1	Characteristic wing dimension, such as chord, m(ft)	10.	
FLAP	&FLAPDA	JOUT	1	Over-ride on IOUT(1) for printout		
		ISUPPR	1	Over-ride on ISUPP in &SOURCE input		
		FLSUPP	24	Flap noise suppression spectrum, dB		
		IUOTW	1	Under-the-wing (=0), over-the-wing (=1)		
		INOZ	1	Nozzle type: Single nozzle flow (=0) Unmixed coaxial nozzle flow (=1) Mixed nozzle flows (=2)	0	
		IFWD	1	Forward velocity effects on source (1/0=yes/no)	0	IUOTW=0
		INSENS	1	Configuration with levels insensitive to flap angle(yes=1)	0	IUOTW=0
		EDOP	1	Exponent for source motion amplification	4.	
		AC1(AF1)	1	Core (fan) nozzle area, $m^2(ft^2)$		
		VC(VF)	1	Core (fan) exhaust velocity, m/s(fps) (normally in &PARAM)		

TABLE III. - Continued.

Program	Block	Variables	Dimension	Definition and Units, SI(English)	Default Values	Required for -
		BPR	1	Bypass ratio, for mixed exhaust case		
		WINGD	1	Ratio of wing chord to total nozzle diam. (Use for large BPR design when WINGD<3.)	3.	
AIRFR	&AIRFDA	JOUT	1	Over-ride on IOUT(1) for printout		
		IWING	1	Include wing, horizontal and vertical tail noise (1/0=yes/no)		
		IFL	1	Include slotted flap noise (1/0=yes/no)		
		ISLAT	1	Include slatted leading-edge noise (1/0=yes/no)		
		ILG	1	Include landing gear noise (nose and main) (1/0=yes/no) (May be entered as ILGR in &TRAJ input to FOOTPR)		
		A	4	Areas of wing, horizontal tail, vertical tail, slotted flap surfaces, $m^2(ft^2)$	1000.,3*100.	IWING=1
		B	4	Total spans of wing, hor. tail, vert. tail, flaps, m(ft)	100.,3*20.	IWING=1
		ICLEAN	1	Aero. clean aircraft, as sailplane (=0), conventional (=1)	1	IWING=1
		ITYPW	1	Conventional wing (=1), delta wing (=2)	1	IWING=1
		NF	1	No. of trailing flap slots (up to 3)	2	IFL=1
		NG	2	No. of landing gear, nose and main	1,2	ILG=1
		NW	2	No. of wheels per gear, noise and main	2,2	ILG=1
		DW	2	Tire diam. of wheels, nose and main, m(ft)	3.,3.	ILG=1
		CG	2	Ratio of strut length to tire diam., nose and main	3.,3.	ILG=1
GNDRFL	&GNDDA	JOUT	1	Over-ride on IOUT(1) for printout		
		QABS	24	Absolute values of ground reflectivity as a function of frequency (values from 0. to 1.)	24*1.	
		FSHIFT	24	Phase shift of reflected signal, deg	24*0.	
		ITONE	1	If ITONE=1, 1/3-octave bands exceeding adjacent bands by 3 dB or more are approximated as tones	0	
		NS	1	No. of heights to be used to approximate a distributed source by multiple sources	1	
		DK	10	Heights of multiple sources from source center described by ZI, m(ft)	10*0.	NS>1
RADIUS	-	COMENT	20	User-supplied title for output, one line		
	&GEOMT	R	1	Radial distance to observer points, m(ft)	100. ft	
		ATHETA	20	THETA values of observer positions, deg	(0-180°,every 10°)	
		APHI	10	PHI values for non-axisymmetric sources, deg	0.,45.,90.°	
		NTHETA,NPHI	1	No. of THETA, PHI values	19,3	
		VIEW	1	Elevation angle of source from observer (for EGA), deg		
		HEAD	1	Direction of ground track from X-axis, deg		
		ZI,ZO	1	Height of source, observer, above ground plane m(ft), for ground reflection calculation		IGND=2
		UNITS	1	For English or SI units, input and output (3HENG,2HSI)	ENG	
	&AMB	TAMB,PAMB,RH	1	Ambient conditions as in FOOTPR	518.7°R,2116.psf,70.%	
	&SOURCE	NENG,IFAN IJET,ICORE ITURB,IFLAP, IAIRF,IDOP, IATM,ISHLD, IEGA,IGND, ISUPP	1	Selection of sources and effects as in FOOTPR, except omit IOUT	(All=0)	
		ITOT	1	To reject ouput of total of all sources (=0)	1	
		FILBW	1	Fraction of filter bandwidth having gain of 1.	1.	
	&PARAM	NPARAM,AEPP, ARPM AWAFAN, ATIPM,ATIPM2, ADELT or AFPR, AWCORE,AFUEL, AP3,AT3,AT4, ATURTS,ATCTUR, AVC,AVF,ATC, ATF	10	Array of engine operating parameters as in &PARAM under FOOTPR		

TABLE III. - Concluded.

Program	Block	Variables	Dimension	Definition and Units, SI(English)	Default Values	Required for -
		ICORR,TCORXP	1	For ambient temperature corrections, as in FOOTPR	0,1.	
	&OPER	EPPI	1	Engine performance parameter (operating condition)		
		VI	1	Aircraft forward velocity, m/s(fps) (for Doppler or forward velocity corrections)		
		PSYI	1	Trailing flap angle (for flap noise), deg		FLAP
		FLAPI	1	Slotted flap angle (for airframe noise), deg		AIRFR
		ILG	1	Landing gear down indicator (1/0=yes/no)		AIRFR
	&FANDA &JETDA &COREDA &TURBDA &SHLDA &FLAPDA &AIRFDA			As required for sources chosen		
	&GNDDA			(Only if IGND=2)		
	&OPER &GNDDA			Changes in engine, velocity, and flap conditions are made by repeated entries of &OPER (and &GNDDA if IGND=2)		

TABLE IV. - SAMPLE INPUTS

The following are examples of input data required for particular calculations. They are discussed in detail in the text. A general list of inputs is given in table III. Computed outputs from these inputs are shown in tables V to X and discussed in the text.

SAMPLE ONE - For a landing calculation:

```
QSRA LANDING CALCULATION, ENGINE MAP FROM TEST DATA
&GRID NXO=3,XO=-2000.,-1000.,0.,ZO=0., &END
&TRAJ NP=3,XA=-5000.,0.,1500.,ZA=658.3,2*0.,
 ALF1=6.,2*10.,VA=2*118.2,0.,EPP=55.,2*20.,
 PSY=60.,2*0.,NT=11,TD=1.,IGEOM=1,ITITLE=1   &END
&AMB TAMB=544. ,PAMB=2065.,RH=48.,  &END
&SOURCE NENG=4,IFAN=1,ICORE=1,ITURB=1,IFLAP=1,IGND=1,IATM=1,IOUT=1,1,0,  &END
&PARAM NPARAM=7,AEPP=37.2,51.53,61.45,77.28,87.88,90.93,96.67,
  AWAFAN=95.82,134.23,162.07,206.33,236.78,247.64,261.27,
  ARPM=2753.,3813.,4547.,5719.,6503.,6729.,7154.,
  AFPR=1.0523,1.1028,1.1526,1.2569,1.3517,1.3889,1.4427,
  AWCORE=16.14,18.87,22.52,28.43,33.11,35.29,37.22,
  AP3=6399.,9356.,11655.,15821.,19359.,20902.,22730.,
  AT3=779.2,879.,939.5,1027.9,1090.5,1115.7,1147.2,
  AT4=1612.,1722.,1821.,2147.,2370.,2444.,2642.,
  AVC=351.7,504.1,623.7,859.1,1062.7,1157.1,1271.4,
  AVF=298.,414.6,503.,644.7,750.2,784.,832.2,
  ATC=1212.5,1205.3,1293.8,1458.3,1603.3,1654.8,1742.8,
  ATF=539.8,546.8,554.4,569.4,582.6,587.4,595.2,
   ICORR=1,TCORXP=1.022   &END
&FANDA NBL=40,NVAN=85,FANDIA=3.392,FANHUB=1.45,
  TIPMD=1.24,RSS=275.,FANEFF=.84   &END
&JETDA INOZ=1,GAMMAC=1.36,GASRC=53.38,AC=1.215,AF=3.951,  &END
&COREDA IMOD=1,DTEMD=900.,GAMMA=1.4,  &END
&TURBDA TBNDIA=1.53,CS=700.,GEAR=2.302,NBLR=60,ITYPTB=1, &END
&SHLDA IUOTW=1,SFUSE=3.,SWIDE=60.,SWING=5.,SMX=80.,  &END
&FLAPDA IUOTW=1,INOZ=2,IFWD=1,BPR=6.1,AC1=1.215,AF1=3.951   &END
```

SAMPLE TWO - For similar calculations of takeoff, without unloading FOOTPR:

```
QSRA TAKEOFF CALCULATION, ENGINE MAP FROM TEST DATA
&GRID NXO=3,XO=1500.,2500.,3500.,ZO=0., &END
&TRAJ NP=3,XA=0.,1500.,6500.,ZA=2*0.,534.3,
 ALF1=3*10.,VA=0.,2*148.6,EPP=3*85.,
 PSY=3*0.,NT=21,TD=1.,IGEOM=1,ITITLE=0   &END
&AMB &END
&SOURCE IOUT=2,2,0  &END
&PARAM  &END
&FANDA  &END
&JETDA  &END
&COREDA  &END
&TURBDA  &END
&FLAPDA  &END
```

TABLE IV. - Continued.

SAMPLE THREE - Combines One and Two, without unloading FOOTPR:

```
 &SRA LANDING AND TAKEOFF, ENGINE MAP FROM TEST DATA
 &GRID NXO=1,XO=-2000.,NYO=1,ZO=0., &END
 &TRAJ NP=4,XA=-5000.,0.,1500.,6500.,ZA=658.3,2*0.,534.3,
  ALF1=6.,3*10.,VA=2*118.2,2*148.6,EPP=55.,3*85.,
  PSY=60.,3*0.,NT=41,TD=1.,IGEOM=1,ITITLE=0    &END
 &AMB &END
 &SOURCE IOUT=3,0,0  &END
 &PARAM  &END
 &FANDA  &END
 &JETDA  &END
 &COREDA  &END
 &TURBDA  &END
 &FLAPDA  &END
```

SAMPLE FOUR - For static test predictions on a radius:

```
 &SRA (YF102) NOISE: SINGLE ENGINE, NO FLAPS, NO ATTENUATION
&GEOMT &END
&AMB &END
&SOURCE IFAN=1,IJET=1,ICORE=1,ITURB=1,IGND=1, &END
&PARAM NPARAM=7,AEPP=37.2,51.53,61.45,77.28,87.88,90.93,96.67,
   AWAFAN=95.82,134.23,162.07,206.33,236.78,247.64,261.27,
   ARPM=2753.,3813.,4547.,5719.,6503.,6729.,7154.,
   AFPR=1.0523,1.1028,1.1526,1.2569,1.3517,1.3889,1.4427,
   AWCORE=16.14,18.87,22.52,28.43,33.11,35.29,37.22,
   AP3=6399.,9356.,11655.,15821.,19359.,20902.,22730.,
   AT3=779.2,879.,939.5,1027.9,1090.5,1115.7,1147.2,
   AT4=1612.,1722.,1821.,2147.,2370.,2444.,2642.,
   AVC=351.7,504.1,623.7,859.1,1062.7,1157.1,1271.4,
   AVF=298.,414.6,503.,644.7,750.2,784.,832.2,
   ATC=1212.5,1205.3,1293.8,1458.3,1603.3,1654.8,1742.8,
   ATF=539.8,546.8,554.4,569.4,582.6,587.4,595.2,
    ICORR=1,TCORXP=1.022  &END
&OPER EPPI=37.78,VI=200.,PSYI=0., &END
&FANDA IFD=1,NBL=40,NVAN=85,FANDIA=3.392,FANHUB=1.45,
   TIPMD=1.24,RSS=275.,FANEFF=.84,
   ISUPPR=0,SUPPIN=9*.1,.4,.5,.8,1.4,2.2,4.,8.,9.3,11.6,11.6,10.4,
    8.8,7.3,4.8,0., SUPPEX=7*0.,.2,.3,.4,.8,1.,1.5,2.2,3.1,5.8,15.2,
    11.,15.2,23.1,12.8,9.4,7.1,5.5,  &END
&JETDA INOZ=1,GAMMAC=1.36,GASRC=53.38,AC=1.215,AF=3.951, &END
&COREDA IMOD=1,DTEMD=900.,GAMMA=1.4, &END
&TURBDA TBNDIA=1.53,CS=700.,GEAR=2.302,NBLR=60,ITYPTB=1,&END
&FLAPDA IUOTW=1,INOZ=2,IFWD=1,BPR=6.1,AC1=1.215,AF1=3.951  &END
&OPER EPPI=87.7 &END
```

TABLE IV. - Concluded.

SAMPLE FIVE - For predictions involving airframe noise:

```
  APPROACH NOISE CALC FOR GE EEE AIRCRAFT
 &GRID UNITS=3HENG,XO=-7518.,NYO=1,YO=0.,ZO=0.,    &END
 &TRAJ NP=2,XA=-7518.,0.,ZA=394.,0.,ALF1=2*8.83,
   FLAPA=2*42.,ILGR=2*1,EPP=24.5,24.5,VA=2*228.,TD=.5      &END
 &AMB &END
 &SOURCE NENG=3,IFAN=1,IJET=1,ICORE=1,ITURB=1,IAIRF=1,IDOP=1,IGND=1,
   IATM=2,IEGA=0,ISUPP=1,IOUT=1,3,0   &END
 &PARAM NPARAM=2,AEPP=24.5,100.,AWAFAN=842.,1350.,ARPM=2028.,3189.,AFPR=1.133,1.469,
   ATIPM=.79,1.25,AWCORE=76.,149.,AP3=24048.,56160.,AT3=1173.,1475.,AT4=2103.,2919.,
   AFUEL=.925,3.104,ATURTS=434.,683.,ATCTUR=1162.,1413.,AVC=534.,951.,ATC=604.,647.,   &END
 &FANDA NBL=32,NVAN=36,FANDIA=7.31,FANHUB=2.47,TIPMD=1.25,RSS=360.,FANEFF=.818,
    SUPPIN=1.2,1.4,1.6,1.9,2.1,2.5,2.8,3.3,3.7,4.3,5.,5.7,6.6,7.6,
      8.7,10.1,11.5,10.3,9.2,8.1,7.3,6.5,5.8,5.1,
    SUPPEX=.5,.6,.8,.9,1.1,1.3,1.6,1.9,2.3,2.7,3.3,3.9,4.8,5.7,6.8,
      8.3,7.4,6.6,5.9,5.2,4.7,4.1,3.7,3.3     &END
 &JETDA IFWD=1,AC=23.81,GAMMAC=1.393,GASRC=53.33  &END
 &COREDA IMOD=1,DTEMD=1550.    &END
 &TURBDA TBNDIA=4.092,GEAR=1.,CS=300.,NBLR=102,ITYPTB=1,
     TSUPP=.2,.3,.4,.5,.6,.7,.8,.9,1.1,1.3,1.5,1.7,2.,2.3,2.7,
        3.2,3.7,4.2,5.,4.8,4.3,3.9,3.4,3.1     &END
 &AIRFDA A=4007.6,927.82,577.,880.5,B=200.19,68.11,29.45,108.4,
  NG=1,2,NW=2,4,CG=3.93,3.46,DW=2.925,4.17,ICLEAN=0,
  IWING=1,IFL=1,ISLAT=0    &END
```

SAMPLE SIX - Footprint calculation of landing of Example One:

```
 QSRA FOOTPRINT CONTOUR, LANDING AND GROUND ROLL
 &GRID NXO=11,XO=-7500.,-7000.,-6000.,-4000.,-2000.,-1000.,0.,500.,1000.,1500.,1600.,
        ZO=0.,NCONTR=1  &END
 &TRAJ NP=3,XA=-5000.,0.,1500.,ZA=658.3,2*0.,
  ALF1=6.,2*10.,VA=2*118.2,0.,EPP=55.,20.,3.,
  PSY=60.,2*0.,NT=21,TD=1.,IGEOM=0,ITITLE=0    &END
 &AMB TAMB=544. ,PAMB=2065.,RH=48.,  &END
 &SOURCE NENG=4,IFAN=1,ICORE=1,ITURB=1,IFLAP=1,IGND=1,IATM=1,IOUT=0,3,3  &END
 &PARAM NPARAM=8,AEPP=0.,37.2,51.53,61.45,77.28,87.88,90.93,96.67,
   AWAFAN=0.,95.82,134.23,162.07,206.33,236.78,247.64,261.27,
   ARPM=0.,2753.,3813.,4547.,5719.,6503.,6729.,7154.,
   AFPR=1.,1.0523,1.1028,1.1526,1.2569,1.3517,1.3889,1.4427,
   AWCORE=0.,16.14,18.87,22.52,28.43,33.11,35.29,37.22,
   AP3=2112.,6399.,9356.,11655.,15821.,19359.,20902.,22730.,
   AT3=519.,779.2,879.,939.5,1027.9,1090.5,1115.7,1147.2,
   AT4=519.,1612.,1722.,1821.,2147.,2370.,2444.,2642.,
   AVC=0.,351.7,504.1,623.7,859.1,1062.7,1157.1,1271.4,
   AVF=0.,298.,414.6,503.,644.7,750.2,784.,832.2,
   ATC=519.,1212.5,1205.3,1293.8,1458.3,1603.3,1654.8,1742.8,
   ATF=519.,539.8,546.8,554.4,569.4,582.6,587.4,595.2,
    ICORR=1,TCORXP=1.022    &END
 &FANDA NBL=40,NVAN=85,FANDIA=3.392,FANHUB=1.45,
   TIPMD=1.24,RSS=275.,FANEFF=.84    &END
 &COREDA IMOD=1,DTEMD=900.,GAMMA=1.4,   &END
 &TURBDA TBNDIA=1.53,CS=700.,GEAR=2.302,NBLR=60,ITYPTB=1, &END
 &FLAPDA IUOTW=1,INOZ=2,IFWD=1,BPR=6.1,AC1=1.215,AF1=3.951    &END
```

TABLE V. - OUTPUT FROM EXAMPLE ONE

```
                    QSRA LANDING CALCULATION, ENGINE MAP FROM TEST DATA
 OBSERVER COORDINATES (IN FEET).
   XO: -2000.0 -1000.0     0.0
   YO:   500.0  1000.0
   ZO:     0.0
 AIRCRAFT TRAJECTORY POINTS AND OPERATING CONDITIONS.
   XA: -5000.0     0.0  1500.0
   YA:     0.0     0.0     0.0
   ZA:   658.3     0.0     0.0
  EPP:    55.0    20.0    20.0
   VA:   118.2   118.2     0.0
 ALF1:     6.0    10.0    10.0
  GAM:     0.0     0.0     0.0
  PSY:    60.0     0.0     0.0
FLAPA:     0.0     0.0     0.0
 ILGR:       0       0       0
IREVR:       0       0       0
```

TABLE V. - Continued.

```
GEOMETRIC RELATIONS OF AIRCRAFT/OBSERVER
      KI    XI       YI      ZI      R        THETA  THETAF THETAH   PHI       TI       TAU      EPPI      VI
  GEOM:  1 -2551.9    0.0   336.0   817.0      46.7   29.8   41.7   57.3    20.89    21.60      55.0    118.2

                  SPECTRA FOR EACH NOISE SOURCE
  FREQ       50     63      79      99      125     158     199    251     316     398     501     630     794     999   1258     1584     1995
           2511   3162    3981    5011    6309    7943    9999
          SOURCES WHEN    XO=-2000.0 FT,  YO=   500.0 FT,   TAU =    21.6 SEC,  R =  817.0 FT,   THETA =   46.7 DEG
 FAN   :  -19.6  -11.8    -4.5     2.6     9.2    15.4    21.3    26.9    32.0    36.8    41.2    45.2   48.9    52.2   55.2    57.7     59.9
           64.0   63.2    64.3    68.0    65.3    67.0    65.9                           OASPL =   74.5 PNL =   87.2 PNLT =   88.3
 CORE  :   42.1   44.7    47.3    49.3    51.2    53.2    54.3    55.3    55.8    56.0    55.8    55.4   54.8    53.8   52.9    51.9     50.5
           49.1   47.7    46.3    44.6    42.9    41.2    39.5                           OASPL =   65.9 PNL =   74.7 PNLT =   74.7
 TURB  :   28.9   29.9    30.9    31.9    32.9    33.9    34.9    36.0    37.0    38.0    39.0    40.0   41.1    42.1   43.2    44.3     45.4
           46.5   47.7    49.1    50.3    51.9    53.8    56.9                           OASPL =   61.2 PNL =   72.6 PNLT =   72.6
 FLAP  :   65.8   66.9    67.1    66.6    65.9    64.9    64.0    63.0    62.0    61.0    59.9    58.8   57.5    56.3   55.1    53.9     52.7
           51.3   49.9    48.4    46.8    45.2    43.6    41.8                           OASPL =   75.6 PNL =   79.6 PNLT =   79.6
 TOTALS:   68.7   69.8    70.0    69.5    68.9    68.0    67.2    66.3    65.5    64.6    63.6    62.6   61.6    60.7   60.4    60.6     61.0
           63.3   61.4    60.8    62.4    56.6    53.9    46.7                           OASPL =   79.2 PNL =   87.9 PNLT =   89.1

  GEOM:  2 -2434.7     0.0   320.5   736.0      53.0   34.9   48.5   58.3    21.89    22.53      55.0    118.2
          SOURCES WHEN    XO=-2000.0 FT,  YO=   500.0 FT,   TAU =    22.5 SEC,  R =  736.0 FT,   THETA =   53.0 DEG
 FAN   :  -20.0  -12.2    -4.9     2.1     8.8    15.0    20.9    26.4    31.6    36.4    40.8    44.8   48.5    51.8   54.7    57.3     59.5
           63.7   62.8    63.8    67.8    64.9    66.7    65.5                           OASPL =   74.1 PNL =   86.9 PNLT =   88.0
 CORE  :   43.8   46.4    49.0    51.0    53.0    54.9    56.0    57.0    57.6    57.8    57.5    57.1   56.5    55.6   54.6    53.6     52.2
           50.8   49.4    48.0    46.3    44.6    42.9    41.2                           OASPL =   67.6 PNL =   76.5 PNLT =   76.5
 TURB  :   32.3   33.3    34.3    35.3    36.3    37.3    38.3    39.4    40.4    41.4    42.4    43.4   44.5    45.5   46.6    47.7     48.8
           49.9   51.1    52.5    53.7    55.3    57.2    60.4                           OASPL =   64.7 PNL =   76.1 PNLT =   76.1
 FLAP  :   66.5   67.6    67.8    67.3    66.6    65.6    64.7    63.7    62.7    61.7    60.6    59.5   58.3    57.0   55.9    54.7     53.4
           52.0   50.6    49.1    47.5    45.9    44.3    42.5                           OASPL =   76.3 PNL =   80.3 PNLT =   80.3
 TOTALS:   69.5   70.5    70.8    70.3    69.6    68.8    68.0    67.2    66.5    65.7    64.7    63.8   62.7    61.8   61.3    61.2     61.4
           63.7   61.7    61.3    63.1    57.7    55.5    49.2                           OASPL =   80.0 PNL =   88.6 PNLT =   89.8

  GEOM:  3 -2317.5     0.0   305.1   666.3      60.8   42.4   56.9   59.3    22.89    23.47      55.0    118.2
          SOURCES WHEN    XO=-2000.0 FT,  YO=   500.0 FT,   TAU =    23.5 SEC,  R =  666.3 FT,   THETA =   60.8 DEG
 FAN   :  -20.8  -13.0    -5.6     1.4     8.0    14.3    20.1    25.7    30.8    35.6    40.0    44.1   47.7    51.0   54.0    56.5     58.7
           63.0   62.0    63.1    67.1    64.1    66.0    64.8                           OASPL =   73.4 PNL =   86.2 PNLT =   87.3
 CORE  :   45.5   48.0    50.6    52.6    54.6    56.5    57.7    58.6    59.2    59.4    59.1    58.8   58.1    57.2   56.2    55.3     53.9
           52.5   51.1    49.6    48.0    46.3    44.6    42.9                           OASPL =   69.3 PNL =   78.2 PNLT =   78.2
 TURB  :   36.2   37.2    38.2    39.2    40.2    41.2    42.2    43.3    44.3    45.3    46.3    47.3   48.4    49.4   50.5    51.6     52.7
           53.8   55.0    56.4    57.6    59.2    61.1    64.4                           OASPL =   68.6 PNL =   80.0 PNLT =   80.0
 FLAP  :   67.1   68.2    68.4    67.9    67.2    66.2    65.3    64.4    63.4    62.3    61.2    60.1   58.9    57.7   56.5    55.3     54.0
           52.6   51.2    49.7    48.2    46.6    44.9    43.1                           OASPL =   77.0 PNL =   81.0 PNLT =   81.0
 TOTALS:   70.1   71.2    71.4    70.9    70.3    69.5    68.8    68.1    67.4    66.7    65.8    64.9   63.9    62.9   62.3    62.0     61.9
           63.8   62.1    61.7    63.5    58.7    57.0    52.1                           OASPL =   80.7 PNL =   89.2 PNLT =   90.3

  GEOM:  4 -2200.3     0.0   289.7   611.6      70.1   53.8   67.4   60.4    23.89    24.43      55.0    118.2
          SOURCES WHEN    XO=-2000.0 FT,  YO=   500.0 FT,   TAU =    24.4 SEC,  R =  611.6 FT,   THETA =   70.1 DEG
 FAN   :  -21.4  -13.6    -6.2     0.8     7.4    13.7    19.6    25.1    30.2    35.0    39.4    43.5   47.1    50.4   53.4    55.9     58.1
           62.4   61.4    62.5    66.5    63.5    65.3    64.2                           OASPL =   72.8 PNL =   85.6 PNLT =   86.7
 CORE  :   46.9   49.5    52.1    54.1    56.1    58.0    59.1    60.1    60.7    60.9    60.6    60.3   59.6    58.7   57.7    56.7     55.4
           54.0   52.5    51.1    49.5    47.8    46.1    44.4                           OASPL =   70.8 PNL =   79.7 PNLT =   79.7
 TURB  :   39.8   40.8    41.8    42.8    43.8    44.8    45.8    46.9    47.9    48.9    49.9    50.9   52.0    53.0   54.1    55.2     56.3
           57.4   58.6    60.0    61.2    62.8    64.7    68.1                           OASPL =   72.3 PNL =   83.6 PNLT =   83.6
 FLAP  :   67.5   68.6    68.8    68.3    67.6    66.6    65.7    64.7    63.7    62.7    61.6    60.5   59.3    58.0   56.9    55.7     54.4
           53.0   51.6    50.1    48.5    46.9    45.3    43.5                           OASPL =   77.3 PNL =   81.4 PNLT =   81.4
```

TABLE V. - Continued.

```
TOTALS:   70.5   71.6   71.8   71.4   70.8   70.0   69.4   68.8   68.2   67.6   66.8   65.9  65.0   64.1  63.4   63.0   62.9
          64.3   62.9   62.7   64.1   60.4   58.9   55.6                       OASPL =   81.4 PNL =  90.0 PNLT =  90.9

  GEOM:  5 -2083.1    0.0  274.3   576.3    81.0   71.6  79.8   61.5   24.89   25.39     55.0    118.2
          SOURCES WHEN  XO=-2000.0 FT,  YO=  500.0 FT,  TAU =   25.4 SEC,  R =  576.3 FT,  THETA =  81.0 DEG
FAN    : -20.3  -12.6   -5.2    1.8    8.4   14.7   20.6   26.1   31.3   36.0   40.5   44.5  48.2   51.5  54.4   57.0   59.2
          63.4   62.4   63.5   67.5   64.6   66.3   65.2                       OASPL =   73.8 PNL □  86.5 PNLT =  87.7
CORE   :  48.5   51.1   53.7   55.6   57.6   59.6   60.7   61.7   62.2   62.4   62.2   61.8  61.2   60.2  59.3   58.3   56.9
          55.5   54.1   52.7   51.0   49.3   47.6   45.9                       OASPL =   72.3 PNL =  81.3 PNLT =  81.3
TURB   :  43.5   44.5   45.5   46.5   47.5   48.5   49.5   50.6   51.6   52.6   53.6   54.6  55.7   56.7  57.8   58.9   60.0
          61.1   62.3   63.7   64.9   66.5   68.4   72.2                       OASPL =   76.1 PNL □  87.4 PNLT =  87.4
FLAP   :  67.7   68.7   69.0   68.4   67.8   66.8   65.9   64.9   63.9   62.9   61.8   60.6  59.4   58.2  57.0   55.8   54.5
          53.2   51.8   50.3   48.7   47.1   45.5   43.7                       OASPL =   77.5 PNL □  81.5 PNLT =  81.6
TOTALS:   70.7   71.8   72.0   71.6   71.1   70.4   69.9   69.4   69.0   68.5   67.8   67.1  66.3   65.6  65.1   64.9   64.9
          66.2   65.2   65.2   66.3   63.3   62.1   60.0                       OASPL =   82.1 PNL =  91.7 PNLT =  92.2

*****  CLOSEST POINT OF APPROACH
  GEOM:  6 -1965.9    0.0  258.8   564.1    92.8   96.0  93.1   62.6   25.89   26.38     55.0    118.2
          SOURCES WHEN  XO=-2000.0 FT,  YO=  500.0 FT,  TAU =   26.4 SEC,  R =  564.1 FT,  THETA □  92.8 DEG
FAN    : -17.7  -10.0   -2.6    4.4   11.0   17.3   23.2   28.7   33.8   38.6   43.0   47.1  50.7   54.0  57.0   59.5   61.7
          66.0   65.0   66.1   70.0   67.1   68.9   67.8                       OASPL =   76.4 PNL =  89.1 PNLT =  90.3
CORE   :  50.3   52.9   55.4   57.4   59.4   61.3   62.5   63.4   64.0   64.2   63.9   63.6  62.9   62.0  61.0   60.1   58.7
          57.3   55.9   54.5   52.8   51.1   49.4   47.7                       OASPL =   74.1 PNL =  83.1 PNLT =  83.1
TURB   :  47.2   48.2   49.2   50.2   51.2   52.2   53.2   54.3   55.3   56.3   57.3   58.3  59.4   60.4  61.5   62.6   63.7
          64.8   66.0   67.4   68.6   70.2   72.1   76.2                       OASPL =   79.9 PNL □  91.1 PNLT =  91.1
FLAP   :  66.3   67.4   67.6   67.1   66.4   65.4   64.5   63.5   62.5   61.5   60.4   59.3  58.0   56.8  55.6   54.4   53.2
          51.8   50.4   48.9   47.3   45.7   44.1   42.3                       OASPL =   76.1 PNL =  80.1 PNLT =  80.1
TOTALS:   69.4   70.5   70.8   70.5   70.2   69.8   69.6   69.5   69.3   69.1   68.6   68.2  67.7   67.2  67.1   67.3   67.6
          69.0   68.2   68.3   69.4   66.7   65.6   64.1                       OASPL =   82.6 PNL =  93.9 PNLT =  94.3

*****
  GEOM:  7 -1848.7    0.0  243.4   576.3   104.6  120.4 106.2   63.7   26.89   27.39     55.0    118.2
          SOURCES WHEN  XO=-2000.0 FT,  YO=  500.0 FT,  TAU =   27.4 SEC,  R =  576.3 FT,  THETA □ 104.6 DEG
FAN    : -15.7   -8.0   -0.6    6.4   13.0   19.3   25.2   30.7   35.8   40.6   45.0   49.1  52.7   56.0  59.0   61.5   63.7
          68.0   67.0   68.1   72.0   69.1   70.9   69.8                       OASPL =   78.4 PNL =  91.1 PNLT =  92.3
CORE   :  51.4   54.0   56.6   58.6   60.5   62.5   63.6   64.6   65.2   65.4   65.1   64.7  64.1   63.1  62.2   61.2   59.8
          58.4   57.0   55.6   53.9   52.2   50.5   48.8                       OASPL =   75.2 PNL =  84.3 PNLT =  84.3
TURB   :  49.5   50.5   51.5   52.5   53.5   54.5   55.5   56.6   57.6   58.6   59.6   60.6  61.7   62.7  63.8   64.9   66.0
          67.1   68.3   69.7   70.9   72.5   74.4   79.0                       OASPL =   82.5 PNL =  93.6 PNLT □  93.7
FLAP   :  64.4   65.5   65.7   65.2   64.5   63.5   62.6   61.6   60.6   59.6   58.5   57.4  56.1   54.9  53.7   52.5   51.3
          49.9   48.5   47.0   45.4   43.8   42.2   40.4                       OASPL =   74.2 PNL □  78.1 PNLT =  78.1
TOTALS:   67.7   68.8   69.3   69.1   69.1   69.2   69.3   69.5   69.7   69.6   69.4   69.1  68.8   68.6  68.7   69.0   69.5
          71.0   70.2   70.4   71.4   68.8   67.6   66.4                       OASPL =   83.1 PNL □  95.3 PNLT =  95.7

  GEOM:  8 -1731.5    0.0  228.0   611.6   115.4  138.2 117.7   64.8   27.89   28.43     55.0    118.2
          SOURCES WHEN  XO=-2000.0 FT,  YO=  500.0 FT,  TAU =   28.4 SEC,  R =  611.6 FT,  THETA = 115.4 DEG
FAN    : -15.0   -7.2    0.1    7.1   13.8   20.0   25.9   31.4   36.6   41.4   45.8   49.8  53.5   56.8  59.7   62.3   64.5
          68.9   67.8   68.8   73.0   69.9   71.8   70.6                       OASPL =   79.2 PNL =  92.0 PNLT =  93.2
CORE   :  51.5   54.1   56.7   58.7   60.6   62.6   63.7   64.7   65.2   65.5   65.2   64.8  64.2   63.2  62.3   61.3   59.9
          58.5   57.1   55.7   54.0   52.3   50.6   48.9                       OASPL =   75.3 PNL □  84.4 PNLT =  84.4
TURB   :  49.0   50.0   51.0   52.0   53.0   54.0   55.0   56.1   57.1   58.1   59.1   60.1  61.2   62.2  63.3   64.4   65.5
          66.6   67.8   69.2   70.4   72.0   73.9   78.5                       OASPL =   82.0 PNL =  93.1 PNLT =  93.2
FLAP   :  69.0   70.1   70.3   69.8   69.1   68.2   67.3   66.3   65.3   64.3   63.2   62.0  60.8   59.6  58.4   57.2   55.9
          54.5   53.1   51.7   50.1   48.5   46.8   45.1                       OASPL =   78.9 PNL =  83.0 PNLT =  83.0
TOTALS:   72.1   73.2   73.5   73.1   72.7   72.2   71.8   71.5   71.2   70.9   70.4   69.9  69.4   69.0  68.9   69.1   69.5
          71.2   70.1   70.1   71.4   68.2   66.8   65.1                       OASPL =   84.7 PNL =  95.9 PNLT =  96.3

  GEOM:  9 -1614.4    0.0  212.5   666.3   124.8  149.6 127.2   66.0   28.89   29.47     55.0    118.2
          SOURCES WHEN  XO=-2000.0 FT,  YO=  500.0 FT,  TAU =   29.5 SEC,  R □  666.3 FT,  THETA □ 124.8 DEG
FAN    : -15.2   -7.4   -0.1    6.9   13.6   19.8   25.7   31.3   36.4   41.2   45.6   49.6  53.3   56.6  59.5   62.1   64.3
          68.6   67.6   68.6   72.7   69.7   71.6   70.4                       OASPL =   79.0 PNL =  91.8 PNLT =  93.0
```

TABLE V. - Continued.

```
CORE  :   50.9    53.5    56.1    58.1    60.0    62.0    63.1    64.1    64.6    64.9   64.6   64.2   63.6    62.6   61.7    60.7    59.3
          57.9    56.5    55.1    53.4    51.7    50.0    48.3                           OASPL =   74.7 PNL =   83.7 PNLT =  83.8
TURB  :   45.9    46.9    47.9    48.9    49.9    50.9    51.9    53.0    54.0    55.0   56.0   57.0   58.1    59.1   60.2    61.3    62.4
          63.5    64.7    66.1    67.3    68.9    70.8    74.9                           OASPL =   78.6 PNL =   89.8 PNLT =  89.8
FLAP  :   71.8    72.9    73.2    72.8    72.1    71.2    70.3    69.3    68.3    67.3   66.2   65.0   63.8    62.6   61.4    60.2    58.9
          57.5    56.1    54.6    53.0    51.5    49.8    48.1                           OASPL =   81.8 PNL =   86.1 PNLT =  86.1
TOTALS:   74.8    75.9    76.2    75.8    75.3    74.5    73.9    73.2    72.6    71.9   71.1   70.3   69.4    68.6   68.2    68.1    68.2
          70.0    68.5    68.3    69.7    65.7    64.0    60.7                           OASPL =   85.9 PNL =   95.2 PNLT =  96.2

  GEOM: 10 -1497.2      0.0   197.1   736.0    132.5  157.1  134.9   67.2    29.89   30.53      55.0    118.2
          SOURCES WHEN   XO=-2000.0 FT,  YO=   500.0 FT,  TAU =   30.5 SEC,  R =  736.0 FT,  THETA = 132.5 DEG
FAN   :  -16.4    -8.6    -1.3     5.7    12.4    18.6    24.5    30.0    35.2    40.0   44.4   48.4   52.1    55.4   58.3    60.9    63.1
          67.4    66.4    67.4    71.4    68.5    70.3    69.2                           OASPL =   77.8 PNL =   90.5 PNLT =  91.7
CORE  :   50.0    52.6    55.2    57.2    59.1    61.1    62.2    63.2    63.7    64.0   63.7   63.3   62.7    61.7   60.8    59.8    58.4
          57.0    55.6    54.2    52.5    50.8    49.1    47.4                           OASPL =   73.8 PNL =   82.8 PNLT =  82.9
TURB  :   42.2    43.2    44.2    45.2    46.2    47.2    48.2    49.3    50.3    51.3   52.3   53.3   54.4    55.4   56.5    57.6    58.7
          59.8    61.0    62.4    63.6    65.2    67.1    70.6                           OASPL =   74.7 PNL =   86.0 PNLT =  86.0
FLAP  :   72.3    73.5    73.8    73.4    72.9    71.9    71.1    70.1    69.1    68.0   66.9   65.7   64.5    63.3   62.1    60.8    59.6
          58.2    56.8    55.3    53.7    52.2    50.5    48.8                           OASPL =   82.5 PNL =   86.8 PNLT =  86.8
TOTALS:   75.3    76.4    76.7    76.4    75.9    75.1    74.3    73.6    72.8    72.0   71.0   70.0   69.0    67.9   67.2    66.7    66.5
          68.1    66.3    65.9    67.3    62.5    60.4    55.5                           OASPL =   86.0 PNL =   94.0 PNLT =  95.0

  GEOM: 11 -1380.0      0.0   181.7   817.0    138.8  162.2  140.9   68.4    30.89   31.60      55.0    118.2
          SOURCES WHEN   XO=-2000.0 FT,  YO=   500.0 FT,  TAU =   31.6 SEC,  R =  817.0 FT,  THETA = 138.8 DEG
FAN   :  -18.6   -10.8    -3.4     3.6    10.2    16.5    22.3    27.9    33.0    37.8   42.2   46.3   49.9    53.2   56.2    58.7    60.9
          65.2    64.2    65.3    69.3    66.3    68.1    67.0                           OASPL =   75.6 PNL =   88.3 PNLT =  89.5
CORE  :   49.0    51.6    54.2    56.2    58.2    60.1    61.2    62.2    62.8    63.0   62.7   62.4   61.7    60.8   59.8    58.8    57.4
          56.0    54.6    53.2    51.5    49.8    48.1    46.5                           OASPL =   72.8 PNL =   81.8 PNLT =  81.9
TURB  :   38.9    39.9    40.9    41.9    42.9    43.9    44.9    46.0    47.0    48.0   49.0   50.0   51.1    52.1   53.2    54.3    55.4
          56.5    57.7    59.1    60.3    61.9    63.8    67.1                           OASPL =   71.3 PNL =   82.7 PNLT =  82.8
FLAP  :   72.0    73.2    73.6    73.3    72.8    71.9    71.0    70.0    69.0    68.0   66.9   65.7   64.4    63.2   62.0    60.7    59.5
          58.1    56.7    55.2    53.6    52.1    50.4    48.7                           OASPL =   82.3 PNL =   86.7 PNLT =  86.7
TOTALS:   75.0    76.1    76.5    76.2    75.8    74.9    74.2    73.3    72.5    71.6   70.6   69.5   68.3    67.1   66.0    65.2    64.6
          65.7    63.7    63.0    64.2    58.9    56.3    50.3                           OASPL =   85.6 PNL =   92.3 PNLT =  93.3

  GEOM:  1 -2551.9      0.0   336.0  1190.6     61.9   29.8   60.7   72.2    20.89   21.93      55.0    118.2
          SOURCES WHEN   XO=-2000.0 FT,  YO=  1000.0 FT,  TAU =   21.9 SEC,  R = 1190.6 FT,  THETA =  61.9 DEG
FAN   :  -26.0   -18.3   -10.9    -3.9     2.7     9.0    14.9    20.4    25.5    30.3   34.7   38.8   42.4    45.7   48.7    51.2    53.4
          57.7    56.7    57.8    61.8    58.8    60.7    59.5                           OASPL =   68.1 PNL =   80.9 PNLT =  82.0
CORE  :   40.5    43.1    45.7    47.7    49.6    51.6    52.7    53.7    54.2    54.5   54.2   53.8   53.2    52.2   51.3    50.3    48.9
          47.5    46.1    44.7    43.0    41.3    39.6    37.9                           OASPL =   64.3 PNL =   73.1 PNLT =  73.1
TURB  :   31.5    32.5    33.5    34.5    35.5    36.5    37.5    38.6    39.6    40.6   41.6   42.6   43.7    44.7   45.8    46.9    48.0
          49.1    50.3    51.7    52.9    54.5    56.4    59.7                           OASPL =   63.9 PNL =   75.3 PNLT =  75.3
FLAP  :   61.7    62.9    63.5    63.5    63.2    62.4    61.5    60.5    59.5    58.4   57.2   56.0   54.8    53.5   52.3    51.0    49.7
          48.3    46.9    45.4    43.9    42.3    40.8    39.1                           OASPL =   72.5 PNL =   76.6 PNLT =  76.6
TOTALS:   64.6    65.8    66.4    66.4    66.1    65.4    64.6    63.8    62.9    62.0   61.0   59.8   58.6    57.3   56.3    55.5    54.9
          56.0    53.6    52.3    52.6    45.9    41.4    32.5                           OASPL =   75.7 PNL =   81.8 PNLT =  83.0

  GEOM:  2 -2434.7      0.0   320.5  1136.5     67.1   34.9   66.1   72.8    21.89   22.88      55.0    118.2
          SOURCES WHEN   XO=-2000.0 FT,  YO=  1000.0 FT,  TAU =   22.9 SEC,  R = 1136.5 FT,  THETA =  67.1 DEG
FAN   :  -26.5   -18.8   -11.4    -4.4     2.3     8.5    14.4    19.9    25.1    29.9   34.3   38.3   42.0    45.3   48.2    50.8    53.0
          57.3    56.2    57.3    61.3    58.4    60.2    59.1                           OASPL =   67.7 PNL =   80.4 PNLT =  81.6
CORE  :   41.3    43.9    46.5    48.5    50.4    52.4    53.5    54.5    55.1    55.3   55.0   54.6   54.0    53.0   52.1    51.1    49.7
          48.3    46.9    45.5    43.8    42.1    40.4    38.7                           OASPL =   65.1 PNL =   73.9 PNLT =  73.9
TURB  :   33.5    34.5    35.5    36.5    37.5    38.5    39.5    40.6    41.6    42.6   43.6   44.6   45.7    46.7   47.8    48.9    50.0
          51.1    52.3    53.7    54.9    56.5    58.4    61.8                           OASPL =   65.9 PNL =   77.2 PNLT =  77.3
FLAP  :   62.0    63.3    63.9    63.9    63.6    62.9    62.0    61.0    60.0    58.9   57.7   56.5   55.3    54.0   52.7    51.5    50.1
          48.7    47.3    45.9    44.4    42.8    41.2    39.6                           OASPL =   73.0 PNL =   77.1 PNLT =  77.1
TOTALS:   65.0    66.2    66.8    66.9    66.6    65.9    65.2    64.4    63.6    62.7   61.6   60.5   59.3    58.1   57.0    56.2    55.5
          56.3    54.1    52.9    53.1    47.1    42.8    35.0                           OASPL =   76.2 PNL =   82.4 PNLT =  83.4
```

TABLE V. - Continued.

```
  GEOM:  3 -2317.5      0.0   305.1  1092.7     72.7   42.4   72.0   73.5    22.89   23.85      55.0   118.2
          SOURCES WHEN   XO=-2000.0 FT,  YO= 1000.0 FT,  TAU =    23.8 SEC,  R □ 1092.7 FT,  THETA =  72.7 DEG
 FAN   : -26.5  -18.8  -11.4   -4.4    2.2    8.5   14.4   19.9   25.0   29.8   34.2   38.3   41.9   45.2   48.2   50.7   52.9
          57.2   56.2   57.3   61.3   58.3   60.1   59.0                        OASPL =   67.6 PNL =   80.4 PNLT □  81.5
 CORE  :  42.1   44.7   47.3   49.3   51.3   53.2   54.3   55.3   55.9   56.1   55.8   55.5   54.8   53.9   52.9   51.9   50.5
          49.1   47.7   46.3   44.6   42.9   41.3   39.6                        OASPL =   65.9 PNL =   74.7 PNLT =  74.8
 TURB  :  35.5   36.5   37.5   38.5   39.5   40.5   41.5   42.6   43.6   44.6   45.6   46.6   47.7   48.7   49.8   50.9   52.0
          53.1   54.3   55.7   56.9   58.5   60.4   63.9                        OASPL =   68.0 PNL =   79.3 PNLT =  79.3
 FLAP  :  62.3   63.6   64.2   64.3   64.1   63.3   62.4   61.4   60.4   59.3   58.1   56.9   55.7   54.4   53.1   51.9   50.5
          49.1   47.7   46.3   44.7   43.2   41.6   40.0                        OASPL □   73.3 PNL =   77.5 PNLT =  77.5
 TOTALS:  65.3   66.5   67.1   67.3   67.0   66.4   65.7   64.9   64.1   63.3   62.3   61.2   60.1   58.9   57.8   57.0   56.3
          57.0   55.0   54.0   54.0   48.6   44.5   37.7                        OASPL =   76.7 PNL □   83.1 PNLT =  84.1

  GEOM:  4 -2200.3      0.0   289.7  1060.2     78.7   53.8   78.3   74.1    23.89   24.82      55.0   118.2
          SOURCES WHEN   XO=-2000.0 FT,  YO= 1000.0 FT,  TAU =    24.8 SEC,  R = 1060.2 FT,  THETA =  78.7 DEG
 FAN   : -25.9  -18.2  -10.8   -3.8    2.8    9.1   15.0   20.5   25.6   30.4   34.8   38.9   42.6   45.9   48.8   51.3   53.5
          57.8   56.8   57.9   61.8   58.9   60.7   59.6                        OASPL =   68.2 PNL □   80.9 PNLT =  82.1
 CORE  :  42.9   45.5   48.1   50.1   52.1   54.0   55.1   56.1   56.7   56.9   56.6   56.3   55.6   54.7   53.7   52.7   51.4
          49.9   48.5   47.1   45.4   43.7   42.1   40.4                        OASPL =   66.8 PNL □   75.6 PNLT =  75.6
 TURB  :  37.6   38.6   39.6   40.6   41.6   42.6   43.6   44.7   45.7   46.7   47.7   48.7   49.8   50.8   51.9   53.0   54.1
          55.2   56.4   57.8   59.0   60.6   62.5   66.2                        OASPL =   70.1 PNL =   81.4 PNLT =  81.4
 FLAP  :  62.4   63.7   64.3   64.5   64.3   63.5   62.6   61.6   60.6   59.5   58.4   57.1   55.9   54.6   53.3   52.0   50.7
          49.3   47.9   46.5   44.9   43.4   41.8   40.2                        OASPL =   73.5 PNL =   77.7 PNLT =  77.8
 TOTALS:  65.4   66.6   67.3   67.5   67.3   66.7   66.0   65.3   64.6   63.8   62.8   61.8   60.8   59.7   58.7   58.1   57.5
          58.1   56.4   55.4   55.4   50.4   46.6   40.5                        OASPL □   77.1 PNL =   84.1 PNLT =  84.6

  GEOM:  5 -2083.1      0.0   274.3  1040.3     85.0   71.6   84.8   74.8    24.89   25.80      55.0   118.2
          SOURCES WHEN   XO=-2000.0 FT,  YO= 1000.0 FT,  TAU =    25.8 SEC,  R = 1040.3 FT,  THETA =  85.0 DEG
 FAN   : -24.7  -17.0   -9.6   -2.6    4.0   10.3   16.2   21.7   26.8   31.6   36.0   40.1   43.7   47.0   50.0   52.5   54.7
          59.0   58.0   59.1   63.1   60.1   61.9   60.8                        OASPL □   69.4 PNL =   82.1 PNLT =  83.3
 CORE  :  43.9   46.5   49.1   51.1   53.0   55.0   56.1   57.1   57.6   57.9   57.6   57.2   56.6   55.6   54.7   53.7   52.3
          50.9   49.5   48.1   46.4   44.7   43.0   41.3                        OASPL □   67.7 PNL =   76.6 PNLT =  76.6
 TURB  :  39.6   40.6   41.6   42.6   43.6   44.6   45.6   46.7   47.7   48.7   49.7   50.7   51.8   52.8   53.9   55.0   56.1
          57.2   58.4   59.8   61.0   62.6   64.5   68.4                        OASPL =   72.3 PNL =   83.5 PNLT =  83.5
 FLAP  :  62.3   63.6   64.3   64.5   64.3   63.6   62.7   61.7   60.7   59.6   58.4   57.2   55.9   54.7   53.4   52.1   50.7
          49.3   47.9   46.5   45.0   43.4   41.9   40.2                        OASPL □   73.5 PNL □   77.7 PNLT =  77.8
 TOTALS:  65.3   66.6   67.3   67.5   67.4   66.9   66.2   65.6   65.0   64.3   63.4   62.5   61.5   60.5   59.8   59.3   58.9
          59.6   58.0   57.2   57.1   52.4   48.7   43.1                        OASPL □   77.4 PNL =   85.2 PNLT □  85.7

 *****  CLOSEST POINT OF APPROACH
  GEOM:  6 -1965.9      0.0   258.8  1033.5     91.5   96.0   91.6   75.4    25.89   26.79      55.0   118.2
          SOURCES WHEN   XO=-2000.0 FT,  YO= 1000.0 FT,  TAU =    26.8 SEC,  R = 1033.5 FT,  THETA =  91.5 DEG
 FAN   : -23.2  -15.5   -8.1   -1.1    5.5   11.8   17.7   23.2   28.3   33.1   37.5   41.6   45.2   48.5   51.5   54.0   56.2
          60.5   59.5   60.6   64.5   61.6   63.4   62.3                        OASPL =   70.9 PNL =   83.6 PNLT =  84.8
 CORE  :  44.8   47.4   50.0   52.0   54.0   55.9   57.0   58.0   58.6   58.8   58.5   58.2   57.5   56.6   55.6   54.6   53.2
          51.8   50.4   49.0   47.3   45.6   43.9   42.3                        OASPL =   68.6 PNL □   77.5 PNLT =  77.6
 TURB  :  41.6   42.6   43.6   44.6   45.6   46.6   47.6   48.7   49.7   50.7   51.7   52.7   53.8   54.8   55.9   57.0   58.1
          59.2   60.4   61.8   63.0   64.6   66.5   70.6                        OASPL □   74.3 PNL □   85.4 PNLT =  85.5
 FLAP  :  60.8   62.1   62.8   63.1   63.0   62.2   61.4   60.3   59.3   58.3   57.1   55.8   54.6   53.3   52.0   50.7   49.3
          47.9   46.6   45.1   43.6   42.1   40.5   38.9                        OASPL □   72.1 PNL =   76.3 PNLT □  76.4
 TOTALS:  63.9   65.2   66.0   66.3   66.3   65.9   65.5   65.0   64.6   64.1   63.4   62.7   61.9   61.2   60.7   60.4   60.3
          61.1   59.7   58.9   58.8   54.3   50.6   45.4                        OASPL =   76.9 PNL =   86.0 PNLT =  86.5

 *****
  GEOM:  7 -1848.7      0.0   243.4  1040.3     98.0  120.4   98.2   76.1    26.89   27.80      55.0   118.2
          SOURCES WHEN   XO=-2000.0 FT,  YO= 1000.0 FT,  TAU =    27.8 SEC,  R = 1040.3 FT,  THETA =  98.0 DEG
 FAN   : -22.0  -14.2   -6.8    0.2    6.8   13.1   18.9   24.5   29.6   34.4   38.8   42.9   46.5   49.8   52.8   55.3   57.5
          61.7   60.8   61.9   65.7   62.9   64.6   63.5                        OASPL =   72.1 PNL =   84.9 PNLT =  86.0
```

TABLE V. - Continued.

```
CORE  :  45.7   48.2   50.8   52.8   54.8   56.7   57.9   58.8   59.4   59.6   59.3   59.0   58.3   57.4   56.4   55.5   54.1
         52.7   51.3   49.8   48.2   46.5   44.8   43.1                        OASPL =  69.5 PNL =   78.4 PNLT =  78.4
TURB  :  43.3   44.3   45.3   46.3   47.3   48.3   49.3   50.4   51.4   52.4   53.4   54.4   55.5   56.5   57.6   58.7   59.8
         60.9   62.1   63.5   64.7   66.3   68.2   72.5                        OASPL =  76.1 PNL =   87.2 PNLT =  87.3
FLAP  :  59.0   60.3   61.0   61.3   61.2   60.5   59.7   58.6   57.6   56.5   55.3   54.1   52.9   51.6   50.3   48.9   47.6
         46.2   44.8   43.4   41.9   40.3   38.8   37.1                        OASPL =  70.4 PNL =   74.5 PNLT =  74.5
TOTALS:  62.2   63.5   64.4   64.8   65.0   64.9   64.7   64.6   64.4   64.1   63.6   63.0   62.5   61.9   61.6   61.6   61.5
         62.4   61.1   60.3   60.1   55.8   52.0   47.0                        OASPL =  76.5 PNL =   86.8 PNLT =  87.2

  GEOM: 8 -1731.5      0.0   228.0  1060.2    104.3  138.2  104.7   76.8    27.89   28.82      55.0   118.2
         SOURCES WHEN   XO=-2000.0 FT,  YO= 1000.0 FT,  TAU =   28.8 SEC,  R = 1060.2 FT,  THETA = 104.3 DEG
FAN   : -21.1  -13.3   -6.0    1.0    7.7   13.9   19.8   25.4   30.5   35.3   39.7   43.7   47.4   50.7   53.6   56.2   58.4
         62.6   61.7   62.7   66.7   63.8   65.6   64.5                        OASPL =  73.1 PNL =   85.8 PNLT =  86.9
CORE  :  46.1   48.7   51.3   53.3   55.2   57.2   58.3   59.3   59.8   60.1   59.8   59.4   58.8   57.8   56.9   55.9   54.5
         53.1   51.7   50.3   48.6   46.9   45.2   43.5                        OASPL =  69.9 PNL =   78.8 PNLT =  78.9
TURB  :  44.2   45.2   46.2   47.2   48.2   49.2   50.2   51.3   52.3   53.3   54.3   55.3   56.4   57.4   58.5   59.6   60.7
         61.8   63.0   64.4   65.6   67.2   69.1   73.7                        OASPL =  77.1 PNL =   88.3 PNLT =  88.3
FLAP  :  63.9   65.2   65.9   66.3   66.2   65.5   64.7   63.7   62.6   61.6   60.3   59.1   57.8   56.6   55.2   53.9   52.6
         51.2   49.8   48.3   46.8   45.3   43.8   42.1                        OASPL =  75.4 PNL =   79.8 PNLT =  79.8
TOTALS:  66.9   68.2   69.0   69.4   69.4   68.9   68.3   67.7   67.1   66.5   65.6   64.9   64.1   63.3   62.9   62.7   62.5
         63.3   61.9   61.1   60.9   56.4   52.6   47.6                        OASPL =  79.6 PNL =   88.4 PNLT =  88.9

  GEOM: 9 -1614.4      0.0   212.5  1092.7    110.3  149.6  110.8   77.5    28.89   29.85      55.0   118.2
         SOURCES WHEN   XO=-2000.0 FT,  YO= 1000.0 FT,  TAU =   29.8 SEC,  R = 1092.7 FT,  THETA = 110.3 DEG
FAN   : -20.5  -12.7   -5.4    1.6    8.3   14.5   20.4   26.0   31.1   35.9   40.3   44.3   48.0   51.3   54.2   56.8   59.0
         63.4   62.3   63.3   67.5   64.4   66.3   65.1                        OASPL =  73.7 PNL =   86.5 PNLT =  87.7
CORE  :  46.3   48.9   51.5   53.5   55.4   57.4   58.5   59.5   60.0   60.3   60.0   59.6   59.0   58.0   57.1   56.1   54.7
         53.3   51.9   50.5   48.8   47.1   45.4   43.7                        OASPL =  70.1 PNL =   79.0 PNLT =  79.1
TURB  :  44.6   45.6   46.6   47.6   48.6   49.6   50.6   51.7   52.7   53.7   54.7   55.7   56.8   57.8   58.9   60.0   61.1
         62.2   63.4   64.8   66.0   67.6   69.5   74.3                        OASPL =  77.7 PNL =   88.8 PNLT =  88.8
FLAP  :  67.0   68.3   69.2   69.6   69.5   68.8   68.0   67.0   66.0   64.9   63.6   62.4   61.1   59.9   58.5   57.2   55.8
         54.5   53.1   51.6   50.1   48.6   47.1   45.4                        OASPL =  78.6 PNL =   83.2 PNLT =  83.2
TOTALS:  70.0   71.3   72.1   72.5   72.5   71.9   71.1   70.3   69.5   68.6   67.6   66.5   65.6   64.6   63.9   63.5   63.1
         63.9   62.3   61.4   61.1   56.4   52.5   47.4                        OASPL =  82.1 PNL =   89.7 PNLT =  90.2

  GEOM: 10 -1497.2     0.0   197.1  1136.5    116.0  157.1  116.5   78.1    29.89   30.88      55.0   118.2
         SOURCES WHEN   XO=-2000.0 FT,  YO= 1000.0 FT,  TAU =   30.9 SEC,  R = 1136.5 FT,  THETA = 116.0 DEG
FAN   : -20.3  -12.6   -5.2    1.8    8.4   14.7   20.6   26.1   31.3   36.0   40.5   44.5   48.2   51.5   54.4   57.0   59.2
         63.5   62.4   63.5   67.7   64.6   66.5   65.3                        OASPL =  73.9 PNL =   86.7 PNLT =  87.9
CORE  :  46.1   48.7   51.3   53.3   55.3   57.2   58.3   59.3   59.9   60.1   59.8   59.5   58.8   57.9   56.9   55.9   54.5
         53.1   51.7   50.3   48.6   46.9   45.2   43.6                        OASPL =  69.9 PNL =   78.9 PNLT =  78.9
TURB  :  43.6   44.6   45.6   46.6   47.6   48.6   49.6   50.7   51.7   52.7   53.7   54.7   55.8   56.8   57.9   59.0   60.1
         61.2   62.4   63.8   65.0   66.6   68.5   73.0                        OASPL =  76.5 PNL =   87.7 PNLT =  87.7
FLAP  :  68.0   69.3   70.1   70.6   70.6   69.9   69.1   68.1   67.0   65.9   64.7   63.5   62.2   60.9   59.6   58.2   56.9
         55.5   54.1   52.7   51.2   49.6   48.1   46.5                        OASPL =  79.7 PNL =   84.3 PNLT =  84.3
TOTALS:  70.9   72.2   73.0   73.5   73.5   72.9   72.0   71.1   70.2   69.3   68.1   67.0   65.3   64.7   63.8   63.2   62.7
         63.4   61.6   60.6   60.4   55.2   51.0   45.1                        OASPL =  82.8 PNL =   89.6 PNLT =  90.2

  GEOM: 11 -1380.0     0.0   181.7  1190.6    121.1  162.2  121.6   78.8    30.89   31.93      55.0   118.2
         SOURCES WHEN   XO=-2000.0 FT,  YO= 1000.0 FT,  TAU =   31.9 SEC,  R = 1190.6 FT,  THETA = 121.1 DEG
FAN   : -20.3  -12.6   -5.2    1.8    8.4   14.7   20.6   26.1   31.3   36.0   40.4   44.5   48.2   51.5   54.4   57.0   59.1
         63.5   62.4   63.5   67.6   64.5   66.5   65.3                        OASPL =  73.9 PNL =   86.7 PNLT =  87.9
CORE  :  45.9   48.4   51.0   53.0   55.0   56.9   58.0   59.0   59.6   59.8   59.5   59.2   58.5   57.6   56.6   55.7   54.3
         52.9   51.4   50.0   48.4   46.7   45.0   43.3                        OASPL =  69.7 PNL =   78.6 PNLT =  78.6
TURB  :  42.2   43.2   44.2   45.2   46.2   47.2   48.2   49.3   50.3   51.3   52.3   53.3   54.4   55.4   56.5   57.6   58.7
         59.8   61.0   62.4   63.6   65.2   67.1   71.5                        OASPL =  75.1 PNL =   86.2 PNLT =  86.2
FLAP  :  68.1   69.5   70.3   70.8   70.9   70.2   69.4   68.3   67.3   66.2   65.0   63.7   62.5   61.2   59.8   58.5   57.1
         55.7   54.3   52.9   51.4   49.9   48.4   46.8                        OASPL =  79.9 PNL =   84.6 PNLT =  84.6
TOTALS:  71.0   72.4   73.2   73.7   73.7   73.1   72.3   71.3   70.4   69.4   68.1   66.9   65.7   64.5   63.4   62.6   62.0
         62.8   60.7   59.5   59.4   53.6   49.1   42.3                        OASPL =  82.9 PNL =   89.2 PNLT =  89.8
```

TABLE V. - Continued.

```
 GEOM:  1 -1568.9      0.0   206.6   785.1     43.0   18.5   41.1   69.0    29.28   29.96      55.0   118.2
         SOURCES WHEN   XO=-1000.0 FT,  YO=   500.0 FT,  TAU =   30.0 SEC,  R =  785.1 FT,  THETA =  43.0 DEG
FAN   :  -18.5  -10.8    -3.4    3.6    10.2    16.5    22.4    27.9    33.1    37.9   42.3    46.3   50.0    53.3   56.2     58.8    61.0
          64.9   64.2    65.3   68.9    66.4    67.9    66.9                          OASPL □  75.5 PNL =    88.2 PNLT □   89.2
CORE  :   41.8   44.4    47.0   49.0    51.0    52.9    54.0    55.0    55.6    55.8   55.5    55.2   54.5    53.6   52.6     51.6    50.3
          48.9   47.4    46.0   44.4    42.7    41.0    39.3                          OASPL =   65.7 PNL =    74.4 PNLT =   74.5
TURB  :   27.8   28.8    29.8   30.8    31.8    32.8    33.8    34.9    35.9    36.9   37.9    38.9   40.0    41.0   42.1     43.2    44.3
          45.4   46.6    48.0   49.2    50.8    52.7    55.7                          OASPL =   60.1 PNL =    71.4 PNLT =   71.5
FLAP  :   65.5   66.6    67.1   66.8    66.4    65.5    64.6    63.6    62.6    61.6   60.4    59.2   58.0    56.8   55.5     54.3    53.0
          51.6   50.2    48.8   47.2    45.6    44.0    42.3                          OASPL =   75.9 PNL =    80.0 PNLT =   80.0
TOTALS:   68.4   69.6    70.0   69.8    69.3    68.5    67.7    66.8    65.9    65.0   64.0    62.9   61.9    61.2   61.0     61.3    61.9
          64.3   62.5    62.1   63.6    58.1    55.4    48.4                          OASPL =   79.5 PNL =    88.7 PNLT □   89.9

 GEOM:  2 -1451.7      0.0   191.1   700.4     49.3   21.4   47.6   70.3    30.28   30.89      55.0   118.2
         SOURCES WHEN   XO=-1000.0 FT,  YO=   500.0 FT,  TAU =   30.9 SEC,  R =  700.4 FT,  THETA =  49.3 DEG
FAN   :  -18.7  -11.0    -3.6    3.4    10.0    16.3    22.2    27.7    32.8    37.6   42.0    46.1   49.8    53.1   56.0     58.5    60.7
          64.9   64.0    65.1   69.0    66.1    67.9    66.8                          OASPL □   75.4 PNL □    88.1 PNLT =   89.2
CORE  :   43.8   46.4    49.0   51.0    53.0    54.9    56.0    57.0    57.6    57.8   57.5    57.2   56.5    55.6   54.6     53.7    52.3
          50.9   49.4    48.0   46.4    44.7    43.0    41.3                          OASPL □   67.7 PNL □    76.5 PNLT =   76.6
TURB  :   31.3   32.3    33.3   34.3    35.3    36.3    37.3    38.4    39.4    40.4   41.4    42.4   43.5    44.5   45.6     46.7    47.8
          48.9   50.1    51.5   52.7    54.3    56.2    59.3                          OASPL =   63.6 PNL =    75.0 PNLT =   75.0
FLAP  :   66.3   67.5    67.9   67.8    67.4    66.6    65.7    64.7    63.7    62.6   61.5    60.3   59.1    57.8   56.6     55.3    54.0
          52.6   51.2    49.8   48.2    46.6    45.0    43.3                          OASPL □   76.9 PNL □    81.1 PNLT =   81.1
TOTALS:   69.3   70.4    70.9   70.8    70.4    69.7    68.9    68.1    67.2    66.4   65.4    64.3   63.3    62.4   62.0     62.1    62.5
          64.9   63.0    62.7   64.6    59.3    57.2    51.0                          OASPL □   80.6 PNL =    89.6 PNLT =   90.8

 GEOM:  3 -1334.5      0.0   175.7   626.7     57.3   26.2   55.9   71.5    31.28   31.83      55.0   118.2
         SOURCES WHEN   XO=-1000.0 FT,  YO=   500.0 FT,  TAU =   31.8 SEC,  R =  626.7 FT,  THETA =  57.3 DEG
FAN   :  -19.5  -11.8    -4.4    2.6     9.2    15.5    21.4    26.9    32.1    36.8   41.3    45.3   49.0    52.3   55.2     57.8    60.0
          64.2   63.2    64.3   68.3    65.4    67.2    66.0                          OASPL =   74.6 PNL =    87.4 PNLT =   88.6
CORE  :   45.6   48.2    50.8   52.8    54.8    56.7    57.8    58.8    59.4    59.6   59.3    59.0   58.3    57.4   56.4     55.5    54.1
          52.7   51.2    49.8   48.2    46.5    44.8    43.1                          OASPL =   69.5 PNL =    78.4 PNLT =   78.4
TURB  :   35.4   36.4    37.4   38.4    39.4    40.4    41.4    42.5    43.5    44.5   45.5    46.5   47.6    48.6   49.7     50.8    51.9
          53.0   54.2    55.6   56.8    58.4    60.3    63.5                          OASPL =   67.8 PNL □    79.2 PNLT =   79.2
FLAP  :   67.2   68.4    69.0   68.9    68.6    67.8    66.9    65.9    64.9    63.8   62.7    61.5   60.2    59.0   57.7     56.4    55.1
          53.7   52.3    50.9   49.3    47.8    46.2    44.5                          OASPL =   78.0 PNL =    82.3 PNLT =   82.3
TOTALS:   70.2   71.4    71.9   71.9    71.6    70.9    70.2    69.4    68.6    67.8   66.8    65.8   64.8    63.8   63.1     62.8    62.9
          65.0   63.2    63.0   65.0    60.1    58.5    53.6                          OASPL =   81.7 PNL =    90.3 PNLT =   91.5

 GEOM:  4 -1217.3      0.0   160.3   568.3     67.1   34.9   66.1   72.8    32.28   32.78      55.0   118.2
         SOURCES WHEN   XO=-1000.0 FT,  YO=   500.0 FT,  TAU =   32.8 SEC,  R =  568.3 FT,  THETA =  67.1 DEG
FAN   :  -20.5  -12.7    -5.4    1.6     8.3    14.5    20.4    26.0    31.1    35.9   40.3    44.3   48.0    51.3   54.2     56.8    59.0
          63.3   62.3    63.3   67.4    64.4    66.2    65.1                          OASPL =   73.7 PNL □    86.4 PNLT □   87.6
CORE  :   47.3   49.9    52.5   54.5    56.5    58.4    59.5    60.5    61.1    61.3   61.0    60.7   60.0    59.1   58.1     57.1    55.8
          54.3   52.9    51.5   49.8    48.1    46.5    44.8                          OASPL =   71.1 PNL □    80.1 PNLT =   80.1
TURB  :   39.5   40.5    41.5   42.5    43.5    44.5    45.5    46.6    47.6    48.6   49.6    50.6   51.7    52.7   53.8     54.9    56.0
          57.1   58.3    59.7   60.9    62.5    64.4    67.8                          OASPL □   71.9 PNL =    83.3 PNLT =   83.3
FLAP  :   68.1   69.3    69.9   69.9    69.7    68.9    68.0    67.0    66.0    64.9   63.8    62.5   61.3    60.0   58.8     57.5    56.2
          54.8   53.4    51.9   50.4    48.8    47.3    45.6                          OASPL =   79.0 PNL □    83.4 PNLT =   83.4
TOTALS:   71.1   72.3    72.9   73.0    72.8    72.1    71.4    70.6    69.9    69.1   68.2    67.2   66.2    65.2   64.4     63.9    63.7
          65.2   63.8    63.6   65.3    61.4    60.1    56.9                          OASPL □   82.8 PNL =    91.2 PNLT =   92.1

 GEOM:  5 -1100.2      0.0   144.8   530.1     78.7   53.8   78.3   74.1    33.28   33.74      55.0   118.2
         SOURCES WHEN   XO=-1000.0 FT,  YO=   500.0 FT,  TAU =   33.7 SEC,  R =  530.1 FT,  THETA =  78.7 DEG
FAN   :  -19.9  -12.2    -4.8    2.2     8.8    15.1    21.0    26.5    31.7    36.5   40.9    44.9   48.6    51.9   54.8     57.4    59.6
          63.8   62.8    63.9   67.9    65.0    66.7    65.6                          OASPL □   74.2 PNL =    87.0 PNLT =   88.1
CORE  :   49.0   51.6    54.1   56.1    58.1    60.0    61.2    62.1    62.7    62.9   62.6    62.3   61.6    60.7   59.7     58.8    57.4
          56.0   54.6    53.2   51.5    49.8    48.1    46.4                          OASPL =   72.8 PNL =    81.8 PNLT =   81.8
TURB  :   43.6   44.6    45.6   46.6    47.6    48.6    49.6    50.7    51.7    52.7   53.7    54.7   55.8    56.8   57.9     59.0    60.1
          61.2   62.4    63.8   65.0    66.6    68.5    72.2                          OASPL □   76.2 PNL =    87.4 PNLT =   87.5
```

TABLE V. - Continued.

```
FLAP   :  68.4   69.7   70.3   70.5   70.3   69.5   68.7   67.6   66.6   65.6   64.4   63.2   61.9   60.6   59.4   58.1   56.7
          55.3   53.9   52.5   51.0   49.4   47.9   46.2                        OASPL =   79.5 PNL =   84.0 PNLT =   84.1
TOTALS:   71.4   72.7   73.4   73.6   73.5   72.9   72.2   71.5   70.9   70.2   69.3   68.5   67.6   66.7   66.1   65.7   65.6
          66.8   65.8   65.8   67.1   64.2   63.2   61.3                        OASPL =   83.7 PNL =   92.9 PNLT =   93.3

*****  CLOSEST POINT OF APPROACH
  GEOM:  6  -983.0     0.0   129.4   516.8    91.5   96.0   91.6   75.4   34.28   34.73      55.0   118.2
          SOURCES WHEN   XO=-1000.0 FT,  YO=  500.0 FT,  TAU =   34.7 SEC,  R =  516.8 FT,  THETA =  91.5 DEG
FAN    : -17.2   -9.5   -2.1    4.9   11.5   17.8   23.7   29.2   34.4   39.1   43.5   47.6   51.3   54.6   57.5   60.1   62.2
          66.5   65.5   66.6   70.6   67.6   69.4   68.3                        OASPL =   76.9 PNL =   89.6 PNLT =   90.8
CORE   :  50.9   53.4   56.0   58.0   60.0   61.9   63.1   64.0   64.6   64.8   64.5   64.2   63.5   62.6   61.6   60.7   59.3
          57.9   56.5   55.0   53.4   51.7   50.0   48.3                        OASPL =   74.7 PNL =   83.7 PNLT =   83.7
TURB   :  47.6   48.6   49.6   50.6   51.6   52.6   53.6   54.7   55.7   56.7   57.7   58.7   59.8   60.8   61.9   63.0   64.1
          65.2   66.4   67.8   69.0   70.6   72.5   76.6                        OASPL =   80.3 PNL =   91.5 PNLT =   91.5
FLAP   :  66.9   68.1   68.8   69.1   69.0   68.2   67.4   66.4   65.4   64.3   63.1   61.8   60.6   59.3   58.0   56.7   55.4
          54.0   52.6   51.1   49.6   48.1   46.5   44.9                        OASPL =   78.2 PNL =   82.6 PNLT =   82.7
TOTALS:   70.0   71.3   72.1   72.4   72.4   72.1   71.7   71.3   70.9   70.5   69.9   69.3   68.7   68.2   68.0   68.1   68.3
          69.8   69.0   69.2   70.4   67.9   67.0   65.8                        OASPL =   83.9 PNL =   95.0 PNLT =   95.4

*****
  GEOM:  7  -865.8     0.0   114.0   530.1   104.3  138.2  104.7   76.8   35.28   35.74      55.0   118.2
          SOURCES WHEN   XO=-1000.0 FT,  YO=  500.0 FT,  TAU =   35.7 SEC,  R =  530.1 FT,  THETA = 104.3 DEG
FAN    : -15.1   -7.3    0.1    7.1   13.7   20.0   25.9   31.4   36.5   41.3   45.7   49.8   53.4   56.7   59.7   62.2   64.4
          68.7   67.7   68.8   72.7   69.8   71.6   70.5                        OASPL =   79.1 PNL =   91.8 PNLT =   93.0
CORE   :  52.1   54.7   57.3   59.3   61.2   63.2   64.3   65.3   65.9   66.1   65.8   65.4   64.8   63.9   62.9   61.9   60.5
          59.1   57.7   56.3   54.6   52.9   51.2   49.5                        OASPL =   75.9 PNL =   85.0 PNLT =   85.0
TURB   :  50.2   51.2   52.2   53.2   54.2   55.2   56.2   57.3   58.3   59.3   60.3   61.3   62.4   63.4   64.5   65.6   66.7
          67.8   69.0   70.4   71.6   73.2   75.1   79.7                        OASPL =   83.2 PNL =   94.3 PNLT =   94.4
FLAP   :  69.9   71.2   72.0   72.3   72.3   71.6   70.7   69.7   68.7   67.6   66.4   65.1   63.9   62.6   61.3   59.9   58.6
          57.2   55.8   54.4   52.9   51.3   49.8   48.2                        OASPL =   81.4 PNL =   86.0 PNLT =   86.1
TOTALS:   73.0   74.3   75.1   75.5   75.5   75.1   74.5   74.0   73.4   72.9   72.2   71.5   70.9   70.4   70.2   70.3   70.6
          72.0   71.3   71.5   72.6   70.2   69.2   68.4                        OASPL =   86.5 PNL =   97.4 PNLT =   97.8

  GEOM:  8  -748.6     0.0    98.6   568.3   116.0  157.1  116.5   78.1   36.28   36.78      55.0   118.2
          SOURCES WHEN   XO=-1000.0 FT,  YO=  500.0 FT,  TAU =   36.8 SEC,  R =  568.3 FT,  THETA = 116.0 DEG
FAN    : -14.3   -6.6    0.8    7.8   14.5   20.7   26.6   32.1   37.3   42.1   46.5   50.5   54.2   57.5   60.4   63.0   65.2
          69.6   68.4   69.5   73.7   70.6   72.5   71.3                        OASPL =   79.9 PNL =   92.7 PNLT =   93.9
CORE   :  52.2   54.7   57.3   59.3   61.3   63.2   64.4   65.3   65.9   66.1   65.8   65.5   64.8   63.9   62.9   62.0   60.6
          59.2   57.8   56.3   54.7   53.0   51.3   49.6                        OASPL =   76.0 PNL =   85.0 PNLT =   85.1
TURB   :  49.6   50.6   51.6   52.6   53.6   54.6   55.6   56.7   57.7   58.7   59.7   60.7   61.8   62.8   63.9   65.0   66.1
          67.2   68.4   69.8   71.0   72.6   74.5   79.1                        OASPL =   82.5 PNL =   93.7 PNLT =   93.7
FLAP   :  74.0   75.3   76.2   76.6   76.6   75.9   75.1   74.1   73.1   72.0   70.7   69.5   68.2   66.9   65.6   64.3   62.9
          61.5   60.1   58.7   57.2   55.7   54.1   52.5                        OASPL =   85.7 PNL =   90.6 PNLT =   90.6
TOTALS:   77.0   78.3   79.2   79.6   79.6   79.0   78.3   77.4   76.6   75.7   74.7   73.7   72.7   71.8   71.2   71.0   71.0
          72.3   71.3   71.3   72.5   69.5   68.3   66.9                        OASPL =   89.4 PNL =   98.5 PNLT =   99.0

  GEOM:  9  -631.4     0.0    83.1   626.7   125.8  165.8  126.2   79.5   37.28   37.83      55.0   118.2
          SOURCES WHEN   XO=-1000.0 FT,  YO=  500.0 FT,  TAU =   37.8 SEC,  R =  626.7 FT,  THETA = 125.8 DEG
FAN    : -14.6   -6.9    0.5    7.5   14.1   20.4   26.3   31.8   37.0   41.7   46.2   50.2   53.9   57.2   60.1   62.7   64.9
          69.2   68.1   69.2   73.3   70.3   72.1   71.0                        OASPL =   79.6 PNL =   92.3 PNLT =   93.5
CORE   :  51.4   54.0   56.6   58.6   60.5   62.5   63.6   64.6   65.2   65.4   65.1   64.7   64.1   63.2   62.2   61.2   59.8
          58.4   57.0   55.6   53.9   52.2   50.5   48.8                        OASPL =   75.2 PNL =   84.3 PNLT =   84.3
TURB   :  46.1   47.1   48.1   49.1   50.1   51.1   52.1   53.2   54.2   55.2   56.2   57.2   58.3   59.3   60.4   61.5   62.6
          63.7   64.9   66.3   67.5   69.1   71.0   75.0                        OASPL =   78.8 PNL =   90.0 PNLT =   90.0
FLAP   :  73.8   75.2   76.1   76.7   76.8   76.1   75.3   74.2   73.2   72.1   70.9   69.6   68.4   67.1   65.7   64.4   63.0
          61.6   60.2   58.8   57.3   55.8   54.2   52.7                        OASPL =   85.8 PNL =   90.7 PNLT =   90.8
TOTALS:   76.8   78.2   79.1   79.6   79.7   79.1   78.3   77.4   76.5   75.6   74.4   73.3   72.2   71.1   70.2   69.7   69.5
          70.9   69.4   69.2   70.7   66.7   65.2   62.0                        OASPL =   89.2 PNL =   97.3 PNLT =   98.2
```

TABLE V. - Continued.

```
 GEOM: 10  -514.2     0.0    67.7   700.4    133.7  170.6  134.1   80.9    38.28   38.89     55.0   118.2
           SOURCES WHEN  XO=-1000.0 FT,  YO=  500.0 FT,  TAU =   38.9 SEC,  R =  700.4 FT,  THETA = 133.7 DEG
FAN    :  -16.2   -8.4   -1.1    5.9   12.6   18.8   24.7   30.2   35.4   40.2   44.6   48.6   52.3   55.6   58.5   61.1   63.3
           67.6   66.5   67.6   71.6   68.7   70.5   69.4                        OASPL =   78.0 PNL =   90.7 PNLT =   91.9
CORE   :   50.4   53.0   55.6   57.6   59.5   61.5   62.6   63.6   64.2   64.4   64.1   63.7   63.1   62.1   61.2   60.2   58.8
           57.4   56.0   54.6   52.9   51.2   49.5   47.8                        OASPL =   74.2 PNL =   83.3 PNLT =   83.3
TURB   :   42.2   43.2   44.2   45.2   46.2   47.2   48.2   49.3   50.3   51.3   52.3   53.3   54.4   55.4   56.5   57.6   58.7
           59.8   61.0   62.4   63.6   65.2   67.1   70.6                        OASPL =   74.7 PNL =   86.0 PNLT =   86.0
FLAP   :   73.2   74.5   75.5   76.2   76.3   75.7   74.9   73.8   72.8   71.7   70.5   69.2   67.9   66.6   65.2   63.9   62.5
           61.1   59.7   58.3   56.8   55.3   53.8   52.2                        OASPL =   85.3 PNL =   90.3 PNLT =   90.3
TOTALS:    76.1   77.5   78.5   79.1   79.3   78.7   77.9   76.9   76.0   75.0   73.8   72.6   71.3   70.1   68.9   68.1   67.6
           68.8   67.0   66.5   67.9   63.2   61.3   56.6                        OASPL =   88.5 PNL =   95.6 PNLT =   96.6

 GEOM: 11  -397.0     0.0    52.3   785.1    140.0  173.5  140.3   82.3    39.28   39.96     55.0   118.2
           SOURCES WHEN  XO=-1000.0 FT,  YO=  500.0 FT,  TAU =   40.0 SEC,  R =  785.1 FT,  THETA = 140.0 DEG
FAN    :  -18.4  -10.7   -3.3    3.7   10.3   16.6   22.5   28.0   33.1   37.9   42.3   46.4   50.0   53.3   56.3   58.8   61.0
           65.3   64.3   65.4   69.4   66.4   68.2   67.1                        OASPL =   75.7 PNL =   88.5 PNLT =   89.6
CORE   :   49.4   52.0   54.5   56.5   58.5   60.4   61.6   62.5   63.1   63.3   63.1   62.7   62.0   61.1   60.1   59.2   57.8
           56.4   55.0   53.6   51.9   50.2   48.5   46.8                        OASPL =   73.2 PNL =   82.2 PNLT =   82.2
TURB   :   38.9   39.9   40.9   41.9   42.9   43.9   44.9   46.0   47.0   48.0   49.0   50.0   51.1   52.1   53.2   54.3   55.4
           56.5   57.7   59.1   60.3   61.9   63.8   67.0                        OASPL =   71.2 PNL =   82.7 PNLT =   82.7
FLAP   :   72.2   73.6   74.7   75.4   75.7   75.1   74.2   73.2   72.2   71.1   69.8   68.5   67.3   65.9   64.6   63.2   61.8
           60.4   59.0   57.6   56.1   54.6   53.1   51.6                        OASPL =   84.6 PNL =   89.6 PNLT =   89.6
TOTALS:    75.2   76.6   77.6   78.4   78.6   78.0   77.2   76.2   75.3   74.2   72.9   71.7   70.4   69.0   67.6   66.5   65.6
           66.4   64.4   63.6   64.7   59.5   57.0   51.3                        OASPL =   87.6 PNL =   93.7 PNLT =   94.8

 GEOM:  1 -1568.9     0.0   206.6  1168.9     60.6   18.5   60.1   79.2    29.28   30.30     55.0   118.2
           SOURCES WHEN  XO=-1000.0 FT,  YO= 1000.0 FT,  TAU =   30.3 SEC,  R = 1168.9 FT,  THETA =  60.6 DEG
FAN    :  -25.6  -17.9  -10.5   -3.5    3.2    9.4   15.3   20.8   26.0   30.8   35.2   39.2   42.9   46.2   49.1   51.7   53.9
           58.2   57.1   58.2   62.3   59.3   61.1   60.0                        OASPL =   68.6 PNL =   81.3 PNLT =   82.5
CORE   :   40.6   43.1   45.7   47.7   49.7   51.6   52.8   53.7   54.3   54.5   54.2   53.9   53.2   52.3   51.3   50.4   49.0
           47.6   46.2   44.7   43.1   41.4   39.7   38.0                        OASPL =   64.4 PNL =   73.1 PNLT =   73.2
TURB   :   31.3   32.3   33.3   34.3   35.3   36.3   37.3   38.4   39.4   40.4   41.4   42.4   43.5   44.5   45.6   46.7   47.8
           48.9   50.1   51.5   52.7   54.3   56.2   59.4                        OASPL =   63.7 PNL =   75.0 PNLT =   75.0
FLAP   :   61.4   62.8   63.7   64.2   64.3   63.6   62.8   61.8   60.7   59.6   58.4   57.2   55.9   54.6   53.2   51.9   50.5
           49.1   47.7   46.3   44.8   43.3   41.8   40.2                        OASPL =   73.3 PNL =   77.7 PNLT =   77.7
TOTALS:    64.4   65.7   66.6   67.1   67.2   66.6   65.8   64.9   64.0   63.0   61.8   60.6   59.3   58.0   56.8   56.0   55.3
           56.5   54.1   52.8   53.3   46.5   42.1   33.2                        OASPL =   76.4 PNL =   82.5 PNLT =   83.7

 GEOM:  2 -1451.7     0.0   191.1  1113.8     65.8   21.4   65.5   79.8    30.28   31.25     55.0   118.2
           SOURCES WHEN  XO=-1000.0 FT,  YO= 1000.0 FT,  TAU =   31.3 SEC,  R = 1113.8 FT,  THETA =  65.8 DEG
FAN    :  -26.2  -18.4  -11.0   -4.0    2.6    8.9   14.7   20.3   25.4   30.2   34.6   38.7   42.3   45.6   48.6   51.1   53.3
           57.6   56.6   57.7   61.7   58.7   60.5   59.4                        OASPL =   68.0 PNL =   80.7 PNLT =   81.9
CORE   :   41.4   44.0   46.6   48.6   50.5   52.5   53.6   54.6   55.1   55.4   55.1   54.7   54.1   53.1   52.2   51.2   49.8
           48.4   47.0   45.6   43.9   42.2   40.5   38.8                        OASPL =   65.2 PNL =   74.0 PNLT =   74.0
TURB   :   33.3   34.3   35.3   36.3   37.3   38.3   39.3   40.4   41.4   42.4   43.4   44.4   45.5   46.5   47.6   48.7   49.8
           50.9   52.1   53.5   54.7   56.3   58.2   61.5                        OASPL =   65.7 PNL =   77.0 PNLT =   77.0
FLAP   :   61.9   63.2   64.2   64.8   64.9   64.2   63.4   62.3   61.3   60.2   59.0   57.7   56.5   55.2   53.8   52.4   51.1
           49.7   48.3   46.9   45.4   43.9   42.3   40.8                        OASPL =   73.8 PNL =   78.3 PNLT =   78.3
TOTALS:    64.8   66.2   67.1   67.7   67.8   67.2   66.4   65.5   64.6   63.7   62.5   61.3   60.1   58.7   57.5   56.6   55.9
           56.7   54.5   53.3   53.6   47.5   43.4   35.6                        OASPL =   77.0 PNL =   83.0 PNLT =   84.1

 GEOM:  3 -1334.5     0.0   175.7  1069.0     71.5   26.2   71.3   80.5    31.28   32.21     55.0   118.2
           SOURCES WHEN  XO=-1000.0 FT,  YO= 1000.0 FT,  TAU =   32.2 SEC,  R = 1069.0 FT,  THETA =  71.5 DEG
FAN    :  -26.3  -18.6  -11.2   -4.2    2.4    8.7   14.6   20.1   25.3   30.1   34.5   38.5   42.2   45.5   48.4   51.0   53.2
           57.4   56.4   57.5   61.5   58.6   60.4   59.2                        OASPL =   67.9 PNL =   80.6 PNLT =   81.8
CORE   :   42.2   44.8   47.4   49.4   51.3   53.3   54.4   55.4   56.0   56.2   55.9   55.5   54.9   53.9   53.0   52.0   50.6
           49.2   47.8   46.4   44.7   43.0   41.3   39.6                        OASPL =   66.0 PNL =   74.8 PNLT =   74.9
TURB   :   35.3   36.3   37.3   38.3   39.3   40.3   41.3   42.4   43.4   44.4   45.4   46.4   47.5   48.5   49.6   50.7   51.8
           52.9   54.1   55.5   56.7   58.3   60.2   63.7                        OASPL =   67.8 PNL =   79.1 PNLT =   79.1
```

TABLE V. - Continued.

```
FLAP   :  62.4   63.8   64.7   65.4   65.5   64.9   64.0   63.0   62.0   60.9   59.6    58.4   57.1    55.8   54.4    53.1    51.7
          50.3   48.9   47.5   46.0   44.5   43.0   41.4                        OASPL =  74.5 PNL =  78.9 PNLT =   79.0
TOTALS:   65.3   66.7   67.7   68.3   68.4   67.9   67.1   66.2   65.4   64.4   63.3    62.1   60.9    59.6   58.4    57.5    56.7
          57.4   55.4   54.3   54.4   49.0   45.1   38.3                        OASPL □  77.7 PNL =  83.8 PNLT □   84.8

 GEOM:  4 -1217.3     0.0   160.3  1035.8    77.7   34.9   77.5   81.2   32.28   33.18        55.0    118.2
          SOURCES WHEN   XO=-1000.0 FT,  YO= 1000.0 FT,  TAU □    33.2 SEC,  R □ 1035.8 FT,  THETA =  77.7 DEG
FAN    : -25.9  -18.1  -10.7   -3.7    2.9    9.2   15.0   20.6   25.7   30.5   34.9    39.0   42.6    45.9   48.9    51.4    53.6
          57.9   56.9   58.0   61.9   59.0   60.8   59.7                        OASPL =  68.3 PNL □  81.0 PNLT =   82.2
CORE   :  43.0   45.6   48.2   50.2   52.2   54.1   55.2   56.2   56.8   57.0   56.7    56.4   55.7    54.8   53.8    52.8    51.5
          50.1   48.6   47.2   45.6   43.9   42.2   40.5                        OASPL =  66.9 PNL □  75.7 PNLT =   75.7
TURB   :  37.4   38.4   39.4   40.4   41.4   42.4   43.4   44.5   45.5   46.5   47.5    48.5   49.6    50.6   51.8    52.8    53.9
          55.0   56.2   57.6   58.8   60.4   62.3   66.0                        OASPL =  70.0 PNL □  81.3 PNLT =   81.3
FLAP   :  62.8   64.2   65.2   65.9   66.1   65.5   64.6   63.6   62.6   61.5   60.2    59.0   57.7    56.4   55.0    53.6    52.3
          50.9   49.5   48.0   46.5   45.1   43.5   42.0                        OASPL =  75.0 PNL □  79.5 PNLT =   79.6
TOTALS:   65.8   67.2   68.2   68.9   69.0   68.5   67.8   66.9   66.1   65.1   64.0    62.9   61.7    60.5   59.4    58.6    57.9
          58.4   56.6   55.7   55.7   50.8   47.1   41.1                        OASPL =  78.3 PNL =  84.8 PNLT =   85.4

 GEOM:  5 -1100.2     0.0   144.8  1015.4    84.1   53.8   84.1   81.9   33.28   34.17        55.0    118.2
          SOURCES WHEN   XO=-1000.0 FT,  YO= 1000.0 FT,  TAU □    34.2 SEC,  R □ 1015.4 FT,  THETA =  84.1 DEG
FAN    : -24.7  -17.0   -9.6   -2.6    4.0   10.3   16.2   21.7   26.9   31.6   36.1    40.1   43.8    47.1   50.0    52.6    54.8
          59.0   58.0   59.1   63.1   60.2   62.0   60.8                        OASPL =  69.4 PNL □  82.2 PNLT □   83.3
CORE   :  44.0   46.6   49.2   51.2   53.1   55.1   56.2   57.2   57.7   57.9   57.7    57.3   56.7    55.7   54.8    53.8    52.4
          51.0   49.6   48.2   46.5   44.8   43.1   41.4                        OASPL =  67.8 PNL =  76.7 PNLT =   76.7
TURB   :  39.6   40.6   41.6   42.6   43.6   44.6   45.6   46.7   47.7   48.7   49.7    50.7   51.8    52.8   53.9    55.0    56.1
          57.2   58.4   59.8   61.0   62.6   64.5   68.3                        OASPL =  72.2 PNL =  83.4 PNLT =   83.4
FLAP   :  62.9   64.3   65.4   66.1   66.3   65.7   64.9   63.9   62.8   61.7   60.5    59.2   57.9    56.6   55.2    53.8    52.5
          51.1   49.7   48.2   46.8   45.3   43.8   42.2                        OASPL □  75.2 PNL =  79.8 PNLT □   79.8
TOTALS:   65.9   67.3   68.4   69.1   69.3   68.8   68.1   67.3   66.5   65.6   64.6    63.5   62.4    61.3   60.4    59.7    59.2
          59.9   58.3   57.4   57.3   52.8   49.2   43.8                        OASPL □  78.7 PNL =  85.9 PNLT =   86.4

*****  CLOSEST POINT OF APPROACH
 GEOM:  6  -983.0     0.0   129.4  1008.5    90.8   96.0   90.8   82.6   34.28   35.16        55.0    118.2
          SOURCES WHEN   XO=-1000.0 FT,  YO= 1000.0 FT,  TAU =    35.2 SEC,  R □ 1008.5 FT,  THETA =  90.8 DEG
FAN    : -23.2  -15.4   -8.1   -1.1    5.6   11.8   17.7   23.3   28.4   33.2   37.6    41.6   45.3    48.6   51.5    54.1    56.3
          60.5   59.6   60.6   64.6   61.7   63.5   62.4                        OASPL =  71.0 PNL =  83.7 PNLT =   84.9
CORE   :  44.9   47.5   50.1   52.1   54.1   56.0   57.1   58.1   58.7   58.9   58.6    58.3   57.6    56.7   55.7    54.7    53.4
          52.0   50.5   49.1   47.4   45.8   44.1   42.4                        OASPL =  68.8 PNL =  77.6 PNLT =   77.7
TURB   :  41.6   42.6   43.6   44.6   45.6   46.6   47.6   48.7   49.7   50.7   51.7    52.7   53.8    54.8   55.9    57.0    58.1
          59.2   60.4   61.8   63.0   64.6   66.5   70.6                        OASPL □  74.3 PNL =  85.5 PNLT =   85.5
FLAP   :  61.3   62.7   63.8   64.5   64.8   64.2   63.4   62.3   61.3   60.2   58.9    57.7   56.4    55.1   53.7    52.3    50.9
          49.5   48.1   46.7   45.2   43.7   42.2   40.7                        OASPL □  73.7 PNL =  78.2 PNLT =   78.2
TOTALS:   64.3   65.8   66.8   67.6   68.0   67.6   67.0   66.4   65.8   65.1   64.3    63.4   62.6    61.7   61.1    60.8    60.5
          61.4   59.9   59.2   59.1   54.7   51.2   46.1                        OASPL =  77.9 PNL =  86.6 PNLT =   87.1

*****
 GEOM:  7  -865.8     0.0   114.0  1015.4    97.4  138.2   97.5   83.3   35.28   36.17        55.0    118.2
          SOURCES WHEN   XO=-1000.0 FT,  YO= 1000.0 FT,  TAU =    36.2 SEC,  R □ 1015.4 FT,  THETA =  97.4 DEG
FAN    : -21.9  -14.1   -6.8    0.2    6.9   13.1   19.0   24.6   29.7   34.5   38.9    42.9   46.6    49.9   52.8    55.4    57.6
          61.8   60.9   61.9   65.8   63.0   64.7   63.6                        OASPL □  72.2 PNL =  85.0 PNLT =   86.1
CORE   :  45.8   48.4   51.0   52.9   54.9   56.9   58.0   59.0   59.5   59.7   59.5    59.1   58.5    57.5   56.5    55.6    54.2
          52.8   51.4   50.0   48.3   46.6   44.9   43.2                        OASPL □  69.6 PNL =  78.5 PNLT □   78.6
TURB   :  43.3   44.3   45.3   46.3   47.3   48.3   49.3   50.4   51.4   52.4   53.4    54.4   55.5    56.5   57.6    58.7    59.8
          60.9   62.1   63.5   64.7   66.3   68.2   72.5                        OASPL =  76.1 PNL =  87.3 PNLT =   87.3
FLAP   :  64.4   65.9   67.0   67.8   68.1   67.5   66.7   65.7   64.6   63.5   62.2    60.9   59.7    58.3   57.0    55.6    54.2
          52.8   51.4   50.0   48.5   47.0   45.5   44.0                        OASPL □  76.9 PNL □  81.6 PNLT =   81.6
TOTALS:   67.4   68.9   70.0   70.8   71.1   70.6   69.9   69.1   68.4   67.5   66.5    65.5   64.5    63.6   62.9    62.4    62.1
          62.8   61.4   60.7   60.5   56.2   52.6   47.7                        OASPL =  80.6 PNL □  88.6 PNLT =   89.0

 GEOM:  8  -748.6     0.0    98.6  1035.8   103.9  157.1  104.0   84.0   36.28   37.18        55.0    118.2
```

TABLE V. - Continued.

```
         SOURCES WHEN   XO=-1000.0 FT,  YO= 1000.0 FT,  TAU =   37.2 SEC,  R ■ 1035.8 FT,  THETA ■ 103.9 DEG
FAN   :  -20.9  -13.2   -5.8    1.2    7.8   14.1   20.0   25.5   30.6   35.4   39.8   43.9   47.6   50.9   53.8   56.3   58.5
          62.8   61.8   62.9   66.8   63.9   65.7   64.6                        OASPL =   73.2 PNL ■   85.9 PNLT =   87.1
CORE  :   46.3   48.9   51.5   53.4   55.4   57.4   58.5   59.4   60.0   60.2   60.0   59.6   59.0   58.0   57.0   56.1   54.7
          53.3   51.9   50.5   48.8   47.1   45.4   43.7                        OASPL ■   70.1 PNL =   79.0 PNLT =   79.1
TURB  :   44.4   45.4   46.4   47.4   48.4   49.4   50.4   51.5   52.5   53.5   54.5   55.5   56.6   57.6   58.7   59.8   60.9
          62.0   63.2   64.6   65.8   67.4   69.3   73.8                        OASPL =   77.3 PNL ■   88.4 PNLT =   88.4
FLAP  :   68.9   70.3   71.4   72.3   72.7   72.1   71.3   70.2   69.2   68.1   66.8   65.5   64.2   62.9   61.5   60.1   58.7
          57.3   55.9   54.5   53.0   51.6   50.1   48.6                        OASPL ■   81.5 PNL =   86.4 PNLT ■   86.4
TOTALS:   71.8   73.3   74.4   75.2   75.5   75.0   74.1   73.2   72.2   71.1   69.9   68.6   67.4   66.2   65.1   64.3   63.6
          64.0   62.5   61.6   61.3   57.0   53.2   48.4                        OASPL =   84.5 PNL =   91.0 PNLT =   91.4

  GEOM:  9  -631.4      0.0     83.1  1069.0     110.0  165.8  110.1   84.7    37.28   38.21      55.0    118.2
         SOURCES WHEN   XO=-1000.0 FT,  YO= 1000.0 FT,  TAU ■   38.2 SEC,  R ■ 1069.0 FT,  THETA ■ 110.0 DEG
FAN   :  -20.3  -12.6   -5.2    1.8    8.4   14.7   20.6   26.1   31.3   36.1   40.5   44.5   48.2   51.5   54.4   57.0   59.2
          63.5   62.4   63.5   67.6   64.6   66.5   65.3                        OASPL ■   73.9 PNL =   86.7 PNLT =   87.9
CORE  :   46.5   49.1   51.7   53.6   55.6   57.6   58.7   59.7   60.2   60.4   60.2   59.8   59.2   58.2   57.3   56.3   54.9
          53.5   52.1   50.7   49.0   47.3   45.6   43.9                        OASPL =   70.3 PNL =   79.2 PNLT =   79.3
TURB  :   44.9   45.9   46.9   47.9   48.9   49.9   50.9   52.0   53.0   54.0   55.0   56.0   57.1   58.1   59.2   60.3   61.4
          62.5   63.7   65.1   66.3   67.9   69.8   74.6                        OASPL =   77.9 PNL =   89.1 PNLT =   89.1
FLAP  :   69.2   70.7   71.8   72.8   73.1   72.6   71.8   70.7   69.7   68.6   67.3   66.0   64.7   63.4   62.0   60.6   59.2
          57.8   56.4   55.0   53.5   52.0   50.5   49.0                        OASPL =   81.9 PNL ■   86.9 PNLT =   86.9
TOTALS:   72.2   73.6   74.7   75.7   76.0   75.5   74.6   73.6   72.6   71.5   70.3   69.0   67.8   66.5   65.5   64.6   64.0
          64.5   62.8   61.9   61.6   57.0   53.2   48.3                        OASPL =   84.9 PNL ■   91.4 PNLT =   91.8

  GEOM: 10  -514.2      0.0     67.7  1113.8     115.7  170.6  115.8   85.4    38.28   39.25      55.0    118.2
         SOURCES WHEN   XO=-1000.0 FT,  YO= 1000.0 FT,  TAU =   39.3 SEC,  R = 1113.8 FT,  THETA ■ 115.7 DEG
FAN   :  -20.2  -12.4   -5.0    2.0    8.6   14.9   20.7   26.3   31.4   36.2   40.6   44.7   48.3   51.6   54.6   57.1   59.3
          63.7   62.6   63.7   67.8   64.7   66.6   65.5                        OASPL =   74.1 PNL =   86.8 PNLT =   88.0
CORE  :   46.3   48.9   51.5   53.5   55.4   57.4   58.5   59.5   60.0   60.3   60.0   59.6   59.0   58.0   57.1   56.1   54.7
          53.3   51.9   50.5   48.8   47.1   45.4   43.7                        OASPL =   70.1 PNL ■   79.0 PNLT =   79.1
TURB  :   43.8   44.8   45.8   46.8   47.8   48.8   49.8   50.9   51.9   52.9   53.9   54.9   56.0   57.0   58.1   59.2   60.3
          61.4   62.6   64.0   65.2   66.8   68.7   73.3                        OASPL =   76.7 PNL ■   87.9 PNLT =   87.9
FLAP  :   69.0   70.5   71.7   72.7   73.1   72.6   71.7   70.7   69.7   68.5   67.2   65.9   64.6   63.3   61.9   60.5   59.1
          57.7   56.3   54.9   53.4   52.0   50.5   49.0                        OASPL =   81.9 PNL =   86.8 PNLT =   86.8
TOTALS:   72.0   73.4   74.6   75.5   75.9   75.4   74.5   73.5   72.5   71.4   70.1   68.8   67.5   66.2   65.0   64.1   63.4
          63.9   62.1   61.0   60.8   55.7   51.6   45.9                        OASPL =   84.8 PNL ■   90.9 PNLT ■   91.4

  GEOM: 11  -397.0      0.0     52.3  1168.9     121.0  173.5  121.0   86.1    39.28   40.30      55.0    118.2
         SOURCES WHEN   XO=-1000.0 FT,  YO= 1000.0 FT,  TAU ■   40.3 SEC,  R = 1168.9 FT,  THETA ■ 121.0 DEG
FAN   :  -20.2  -12.4   -5.1    1.9    8.6   14.8   20.7   26.3   31.4   36.2   40.6   44.6   48.3   51.6   54.5   57.1   59.3
          63.7   62.6   63.7   67.8   64.7   66.6   65.4                        OASPL ■   74.1 PNL =   86.8 PNLT ■   88.0
CORE  :   46.0   48.6   51.2   53.2   55.1   57.1   58.2   59.2   59.7   60.0   59.7   59.3   58.7   57.7   56.8   55.8   54.4
          53.0   51.6   50.2   48.5   46.8   45.1   43.4                        OASPL =   69.8 PNL =   78.7 PNLT =   78.8
TURB  :   42.4   43.4   44.4   45.4   46.4   47.4   48.4   49.5   50.5   51.5   52.5   53.5   54.6   55.6   56.7   57.8   58.9
          60.0   61.2   62.6   63.8   65.4   67.3   71.7                        OASPL =   75.3 PNL =   86.4 PNLT =   86.4
FLAP  :   68.6   70.1   71.3   72.3   72.8   72.3   71.4   70.4   69.4   68.2   66.9   65.6   64.3   63.0   61.6   60.2   58.7
          57.3   56.0   54.5   53.1   51.6   50.2   48.7                        OASPL ■   81.5 PNL =   86.4 PNLT =   86.5
TOTALS:   71.5   73.0   74.2   75.2   75.6   75.1   74.2   73.2   72.2   71.1   69.7   68.4   67.0   65.7   64.4   63.4   62.6
          63.2   61.1   59.9   59.8   54.1   49.8   43.1                        OASPL ■   84.4 PNL =   90.2 PNLT =   90.8

  GEOM:  1  -585.9      0.0     77.1   774.1      40.6    6.0   40.4   83.0    37.67   38.34      55.0    118.2
         SOURCES WHEN   XO=     0.0 FT,  YO=  500.0 FT,  TAU =   38.3 SEC,  R =  774.1 FT,  THETA =  40.6 DEG
FAN   :  -17.9  -10.2   -2.8    4.2   10.8   17.1   23.0   28.5   33.7   38.4   42.9   46.9   50.6   53.9   56.8   59.4   61.6
          65.4   64.8   65.9   69.4   67.0   68.5   67.4                        OASPL =   76.0 PNL =   88.7 PNLT =   89.7
CORE  :   41.6   44.2   46.8   48.7   50.7   52.7   53.8   54.8   55.3   55.5   55.3   54.9   54.3   53.3   52.3   51.4   50.0
          48.6   47.2   45.8   44.1   42.4   40.7   39.0                        OASPL =   65.4 PNL =   74.2 PNLT ■   74.2
TURB  :   26.9   27.9   28.9   29.9   30.9   31.9   32.9   34.0   35.0   36.0   37.0   38.0   39.1   40.1   41.2   42.3   43.4
          44.5   45.7   47.1   48.3   49.9   51.8   54.8                        OASPL =   59.2 PNL =   70.6 PNLT ■   70.6
FLAP  :   65.1   66.5   67.6   68.4   68.7   68.1   67.3   66.2   65.2   64.1   62.8   61.5   60.3   58.9   57.5   56.2   54.8
          53.4   52.0   50.6   49.1   47.6   46.1   44.6                        OASPL =   77.5 PNL =   82.2 PNLT ■   82.3
```

TABLE V. - Continued.

```
TOTALS:   68.0   69.5   70.5   71.3   71.6   71.0   70.2   69.2   68.2   67.1   65.8   64.6   63.4   62.5   62.0   62.2   62.6
          64.9   63.2   62.7   64.2   58.8   56.2   49.1                        OASPL □   80.9 PNL =   89.8 PNLT =   90.9

  GEOM:  2  -468.8      0.0    61.7   688.1     46.9    6.0   46.8   84.4    38.67   39.27      55.0   118.2
           SOURCES WHEN    XO=     0.0 FT,   YO=   500.0 FT,   TAU □   39.3 SEC,   R =  688.1 FT,   THETA =   46.9 DEG
FAN    :  -18.1  -10.4   -3.0    4.0   10.6   16.9   22.8   28.3   33.5   38.2   42.7   46.7   50.4   53.7   56.6   59.2   61.4
           65.4   64.6   65.7   69.5   66.8   68.4   67.3                        OASPL =   75.9 PNL =   88.6 PNLT =   89.7
CORE   :   43.6   46.2   48.8   50.8   52.7   54.7   55.8   56.8   57.3   57.6   57.3   56.9   56.3   55.3   54.4   53.4   52.0
           50.6   49.2   47.8   46.1   44.4   42.7   41.0                        OASPL =   67.4 PNL =   76.3 PNLT □   76.3
TURB   :   30.5   31.5   32.5   33.5   34.5   35.5   36.5   37.6   38.6   39.6   40.6   41.6   42.7   43.7   44.8   45.9   47.0
           48.1   49.3   50.7   51.9   53.5   55.4   58.4                        OASPL □   62.8 PNL =   74.2 PNLT =   74.2
FLAP   :   66.0   67.5   68.6   69.5   69.9   69.3   68.5   67.5   66.4   65.3   64.0   62.7   61.5   60.1   58.7   57.3   55.9
           54.5   53.1   51.7   50.2   48.8   47.3   45.8                        OASPL =   78.7 PNL =   83.5 PNLT =   83.5
TOTALS:    69.0   70.4   71.6   72.5   72.8   72.3   71.5   70.5   69.6   68.5   67.3   66.0   64.9   63.8   63.1   63.0   63.2
           65.5   63.7   63.4   65.2   60.0   58.0   51.7                        OASPL =   82.1 PNL =   90.8 PNLT =   91.9

  GEOM:  3  -351.6      0.0    46.3   613.0     54.9    6.0   54.8   85.8    39.67   40.20      55.0   118.2
           SOURCES WHEN    XO=     0.0 FT,   YO=   500.0 FT,   TAU =   40.2 SEC,   R □  613.0 FT,   THETA □   54.9 DEG
FAN    :  -18.8  -11.1   -3.7    3.3    9.9   16.2   22.1   27.6   32.8   37.5   42.0   46.0   49.7   53.0   55.9   58.5   60.7
           64.9   63.9   65.0   69.0   66.1   67.9   66.7                        OASPL =   75.3 PNL =   88.1 PNLT =   89.2
CORE   :   45.6   48.2   50.8   52.8   54.7   56.7   57.8   58.8   59.3   59.6   59.3   58.9   58.3   57.3   56.4   55.4   54.0
           52.6   51.2   49.8   48.1   46.4   44.7   43.0                        OASPL =   69.4 PNL =   78.3 PNLT =   78.4
TURB   :   34.7   35.7   36.7   37.7   38.7   39.7   40.7   41.8   42.8   43.8   44.8   45.8   46.9   47.9   49.0   50.1   51.2
           52.3   53.5   54.9   56.1   57.7   59.6   62.7                        OASPL =   67.0 PNL =   78.4 PNLT =   78.4
FLAP   :   67.0   68.4   69.6   70.7   71.1   70.6   69.7   68.7   67.7   66.6   65.2   63.9   62.7   61.3   59.9   58.5   57.1
           55.7   54.3   52.9   51.4   50.0   48.5   47.0                        OASPL □   79.9 PNL □   84.7 PNLT =   84.7
TOTALS:    69.9   71.4   72.6   73.6   74.0   73.6   72.8   71.9   70.9   69.9   68.7   67.5   66.3   65.2   64.2   63.8   63.7
           65.7   64.0   63.7   65.7   60.8   59.3   54.2                        OASPL =   83.3 PNL □   91.5 PNLT. =   92.7

  GEOM:  4  -234.4      0.0    30.9   553.1     64.8    6.0   64.8   87.2    40.67   41.15      55.0   118.2
           SOURCES WHEN    XO=     0.0 FT,   YO=   500.0 FT,   TAU =   41.1 SEC,   R =  553.1 FT,   THETA =   64.8 DEG
FAN    :  -19.9  -12.2   -4.8    2.2    8.8   15.1   21.0   26.5   31.6   36.4   40.8   44.9   48.6   51.9   54.8   57.3   59.5
           63.8   62.8   63.9   67.9   64.9   66.8   65.6                        OASPL =   74.2 PNL =   87.0 PNLT =   88.1
CORE   :   47.4   50.0   52.6   54.6   56.5   58.5   59.6   60.6   61.1   61.4   61.1   60.7   60.1   59.1   58.2   57.2   55.8
           54.4   53.0   51.6   49.9   48.2   46.5   44.8                        OASPL =   71.2 PNL =   80.2 PNLT =   80.2
TURB   :   39.1   40.1   41.1   42.1   43.1   44.1   45.1   46.2   47.2   48.2   49.2   50.2   51.3   52.3   53.4   54.5   55.6
           56.7   57.9   59.3   60.5   62.1   64.0   67.3                        OASPL =   71.5 PNL =   82.9 PNLT □   82.9
FLAP   :   67.8   69.3   70.6   71.7   72.2   71.7   70.9   69.9   68.8   67.7   66.4   65.1   63.8   62.4   61.0   59.6   58.1
           56.8   55.4   53.9   52.5   51.0   49.6   48.1                        OASPL =   80.9 PNL =   85.9 PNLT =   85.9
TOTALS:    70.8   72.3   73.6   74.7   75.2   74.8   74.0   73.1   72.2   71.2   70.1   68.9   67.7   66.5   65.5   64.8   64.4
           65.8   64.3   64.1   65.8   61.8   60.7   57.2                        OASPL □   84.4 PNL □   92.3 PNLT =   93.3

  GEOM:  5  -117.2      0.0    15.4   513.8     76.8    6.0   76.8   88.6    41.67   42.12      55.0   118.2
           SOURCES WHEN    XO=     0.0 FT,   YO=   500.0 FT,   TAU =   42.1 SEC,   R □  513.8 FT,   THETA =   76.8 DEG
FAN    :  -19.9  -12.1   -4.7    2.3    8.9   15.2   21.0   26.6   31.7   36.5   40.9   45.0   48.6   51.9   54.9   57.4   59.6
           63.9   62.9   64.0   67.9   65.0   66.8   65.7                        OASPL □   74.3 PNL □   87.0 PNLT =   88.2
CORE   :   49.1   51.7   54.2   56.2   58.2   60.1   61.3   62.2   62.8   63.0   62.7   62.4   61.7   60.8   59.8   58.9   57.5
           56.1   54.7   53.3   51.6   49.9   48.2   46.5                        OASPL =   72.9 PNL □   81.9 PNLT =   81.9
TURB   :   43.3   44.3   45.3   46.3   47.3   48.3   49.3   50.4   51.4   52.4   53.4   54.4   55.5   56.5   57.6   58.7   59.8
           60.9   62.1   63.5   64.7   66.3   68.2   71.8                        OASPL □   75.8 PNL =   87.1 PNLT =   87.1
FLAP   :   68.5   70.0   71.3   72.6   73.1   72.7   71.9   70.8   69.8   68.7   67.3   66.0   64.7   63.3   61.9   60.4   59.0
           57.6   56.2   54.8   53.4   51.9   50.5   49.0                        OASPL =   81.8 PNL □   86.8 PNLT =   86.9
TOTALS:    71.5   73.0   74.4   75.6   76.2   75.8   75.1   74.2   73.3   72.4   71.3   70.2   69.1   68.0   67.0   66.4   66.1
           67.1   66.0   66.0   67.3   64.3   63.4   61.5                        OASPL □   85.5 PNL □   93.8 PNLT =   94.3

*****  CLOSEST POINT OF APPROACH
  GEOM:  6      0.0      0.0     0.0   500.0     90.0   90.0   90.0   90.0    42.67   43.10      20.0   118.2
           SOURCES WHEN    XO=     0.0 FT,   YO=   500.0 FT,   TAU =   43.1 SEC,   R =  500.0 FT,   THETA =   90.0 DEG
FAN    :  -13.4   -7.3   -1.6    3.8    8.8   13.5   17.7   21.6   25.2   28.3   31.1   33.5   35.6   39.4   38.5   39.5   43.2
           40.2   41.9   40.7   39.4   37.3   35.7   33.6                        OASPL □   50.5 PNL =   63.3 PNLT □   64.5
```

TABLE V. - Continued.

```
CORE  :  40.3   42.9   45.5   47.4   49.4   51.4   52.5   53.4   54.0   54.2   54.0   53.6   53.0   52.0   51.0   50.1   48.7
         47.3   45.9   44.5   42.8   41.1   39.4   37.7                       OASPL =   64.1 PNL =   72.8 PNLT =   72.9
TURB  :  37.4   38.4   39.4   40.4   41.4   42.4   43.4   44.5   45.5   46.5   47.5   48.5   49.6   50.6   51.7   52.8   53.9
         55.0   64.4   54.6   52.8   56.5   50.3   51.5                       OASPL =   67.3 PNL =   82.7 PNLT =   85.9
FLAP  :  45.1   44.4   43.4   42.4   41.3   40.0   38.6   37.3   36.0   34.6   33.1   31.6   30.2   28.8   27.5   26.0   24.6
         23.2   21.7   20.3   18.8   17.3   15.9   14.4                       OASPL =   51.7 PNL =   50.0 PNLT =   50.0
TOTALS:  49.8   50.3   51.1   52.1   53.5   55.0   56.0   56.8   57.4   57.6   57.4   57.2   56.9   56.6   56.3   56.3   56.4
         56.3   64.3   54.1   51.0   52.4   43.8   40.8                       OASPL =   70.0 PNL =   84.1 PNLT =   87.1

*****
 GEOM:  7   115.9     0.0     0.0   513.3    102.8  190.0  102.9   92.3    43.67   44.11     20.0   113.5
         SOURCES WHEN   XO=    0.0 FT,  YO=  500.0 FT,  TAU =   44.1 SEC,  R =  513.3 FT,  THETA = 102.8 DEG
FAN   : -11.2   -5.1    0.7    6.1   11.1   15.7   20.0   23.9   27.4   30.6   33.3   35.8   37.8   41.6   40.8   41.7   45.4
         42.5   44.1   42.9   41.6   39.6   37.9   35.9                       OASPL =   52.7 PNL =   65.6 PNLT =   66.7
CORE  :  41.6   44.2   46.8   48.8   50.7   52.7   53.8   54.8   55.4   55.6   55.3   54.9   54.3   53.4   52.4   51.4   50.0
         48.6   47.2   45.8   44.1   42.4   40.7   39.0                       OASPL =   65.4 PNL =   74.2 PNLT =   74.3
TURB  :  40.3   41.3   42.3   43.3   44.3   45.3   46.3   47.4   48.4   49.4   50.4   51.4   52.5   53.5   54.6   55.7   56.8
         57.9   68.3   57.5   55.6   60.2   53.1   54.8                       OASPL =   70.8 PNL =   86.3 PNLT =   89.8
FLAP  :  54.9   54.2   53.1   52.1   51.1   49.7   48.4   47.1   45.8   44.3   42.9   41.4   40.0   38.6   37.2   35.8   34.3
         32.9   31.5   30.0   28.5   27.1   25.6   24.2                       OASPL =   61.5 PNL =   61.9 PNLT =   61.9
TOTALS:  58.2   57.7   57.3   57.1   57.3   57.8   58.3   58.9   59.2   59.4   59.2   59.1   58.9   58.7   58.5   58.6   58.9
         58.9   68.1   56.7   53.6   55.8   46.3   43.7                       OASPL =   73.1 PNL =   87.4 PNLT =   90.8

 GEOM:  8   227.1     0.0     0.0   549.2    114.0  190.0  114.1   94.5    44.67   45.15     20.0   108.9
         SOURCES WHEN   XO=    0.0 FT,  YO=  500.0 FT,  TAU =   45.1 SEC,  R =  549.2 FT,  THETA = 114.0 DEG
FAN   : -10.4   -4.2    1.5    6.9   11.9   16.5   20.8   24.7   28.2   31.4   34.2   36.6   38.6   42.6   41.6   42.5   46.4
         43.3   45.1   43.8   42.5   40.4   38.7   36.7                       OASPL =   53.6 PNL =   66.5 PNLT =   67.7
CORE  :  41.7   44.3   46.9   48.9   50.9   52.8   53.9   54.9   55.5   55.7   55.4   55.1   54.4   53.5   52.5   51.5   50.1
         48.7   47.3   45.9   44.2   42.5   40.8   39.2                       OASPL =   65.5 PNL =   74.3 PNLT =   74.4
TURB  :  40.1   41.1   42.1   43.1   44.1   45.1   46.1   47.2   48.2   49.2   50.2   51.2   52.3   53.3   54.4   55.5   56.6
         57.7   68.5   57.3   55.5   60.3   52.9   54.8                       OASPL =   70.9 PNL =   86.3 PNLT =   90.0
FLAP  :  54.5   53.8   52.8   51.7   50.7   49.4   48.0   46.7   45.4   43.9   42.5   41.0   39.6   38.2   36.8   35.4   34.0
         32.5   31.1   29.6   28.2   26.7   25.3   23.8                       OASPL =   61.1 PNL =   61.4 PNLT =   61.5
TOTALS:  57.8   57.4   57.0   56.8   57.1   57.8   58.3   58.9   59.2   59.4   59.2   59.1   58.8   58.6   58.4   58.4   58.7
         58.6   68.0   56.3   53.1   55.4   45.4   42.7                       OASPL =   73.0 PNL =   87.3 PNLT =   90.8

 GEOM:  9   333.6     0.0     0.0   601.1    123.1  190.0  123.3   96.6    45.67   46.19     20.0   104.2
         SOURCES WHEN   XO=    0.0 FT,  YO=  500.0 FT,  TAU =   46.2 SEC,  R =  601.1 FT,  THETA = 123.1 DEG
FAN   : -10.5   -4.4    1.3    6.7   11.7   16.4   20.6   24.5   28.1   31.2   34.0   36.4   38.5   42.4   41.4   42.4   46.3
         43.1   44.9   43.6   42.3   40.2   38.6   36.5                       OASPL =   53.4 PNL =   66.4 PNLT =   67.5
CORE  :  41.1   43.7   46.3   48.3   50.2   52.2   53.3   54.3   54.9   55.1   54.8   54.4   53.8   52.9   51.9   50.9   49.5
         48.1   46.7   45.3   43.6   41.9   40.2   38.5                       OASPL =   64.9 PNL =   73.7 PNLT =   73.7
TURB  :  37.4   38.4   39.4   40.4   41.4   42.4   43.4   44.5   45.5   46.5   47.5   48.5   49.6   50.6   51.7   52.8   53.9
         55.0   64.7   54.6   52.7   56.7   50.2   51.6                       OASPL =   67.5 PNL =   82.9 PNLT =   86.2
FLAP  :  53.9   53.2   52.2   51.1   50.1   48.8   47.4   46.1   44.8   43.3   41.9   40.4   39.0   37.6   36.2   34.8   33.4
         31.9   30.5   29.0   27.6   26.1   24.7   23.2                       OASPL =   60.5 PNL =   60.8 PNLT =   60.8
TOTALS:  57.2   56.7   56.3   56.1   56.3   57.0   57.4   58.0   58.4   58.5   58.2   57.9   57.5   57.0   56.6   56.4   56.4
         56.0   64.0   53.4   50.1   51.2   41.9   38.2                       OASPL =   70.9 PNL =   84.2 PNLT =   87.2

 GEOM: 10   435.5     0.0     0.0   663.1    130.3  190.0  130.6   98.6    46.67   47.25     20.0    99.6
         SOURCES WHEN   XO=    0.0 FT,  YO=  500.0 FT,  TAU =   47.2 SEC,  R =  663.1 FT,  THETA = 130.3 DEG
FAN   : -11.2   -5.1    0.6    6.0   11.0   15.7   19.9   23.8   27.3   30.5   33.3   35.7   37.8   41.6   40.7   41.7   45.4
         42.4   44.1   42.9   41.6   39.5   37.8   35.8                       OASPL =   52.7 PNL =   65.6 PNLT =   66.7
CORE  :  40.3   42.9   45.5   47.4   49.4   51.4   52.5   53.4   54.0   54.2   54.0   53.6   53.0   52.0   51.0   50.1   48.7
         47.3   45.9   44.5   42.8   41.1   39.4   37.7                       OASPL =   64.1 PNL =   72.8 PNLT =   72.9
TURB  :  33.9   34.9   35.9   36.9   37.9   38.9   39.9   41.0   42.0   43.0   44.0   45.0   46.1   47.1   48.2   49.3   50.4
         51.5   59.9   51.1   49.2   52.2   46.7   47.5                       OASPL =   63.2 PNL =   78.5 PNLT =   81.4
FLAP  :  53.2   52.5   51.5   50.4   49.4   48.1   46.7   45.4   44.1   42.6   41.2   39.7   38.3   36.9   35.5   34.1   32.7
         31.2   29.8   28.3   26.9   25.4   24.0   22.5                       OASPL =   59.8 PNL =   60.0 PNLT =   60.0
```

TABLE V. - Continued.

```
TOTALS:  56.4   55.9   55.4   55.2   55.4   56.0   56.4   57.0   57.3   57.3   57.0   56.6   56.0   55.3   54.6   54.0   53.8
         52.9   58.9   50.0   46.6   46.0   37.7   32.8                        OASPL =     69.0 PNL =   80.5 PNLT =   83.0

  GEOM: 11   532.8     0.0     0.0   730.7    135.9  190.0  136.4  100.5    47.67   48.31     20.0     94.9
         SOURCES WHEN   XO=     0.0 FT,  YO=  500.0 FT,  TAU =   48.3 SEC,  R =  730.7 FT,  THETA = 135.9 DEG
FAN   : -13.2   -7.1   -1.3    4.0    9.1   13.7   18.0   21.9   25.4   28.5   31.3   33.7   35.8   39.7   38.8   39.7   43.5
         40.5   42.2   40.9   39.6   37.5   35.9   33.9                        OASPL =     50.7 PNL =   63.6 PNLT =   64.7
CORE  :  39.4   42.0   44.6   46.5   48.5   50.5   51.6   52.5   53.1   53.3   53.1   52.7   52.1   51.1   50.1   49.2   47.8
         46.4   45.0   43.6   41.9   40.2   38.5   36.8                        OASPL =     63.2 PNL =   71.9 PNLT =   71.9
TURB  :  31.0   32.0   33.0   34.0   35.0   36.0   37.0   38.1   39.1   40.1   41.1   42.1   43.2   44.2   45.3   46.4   47.5
         48.6   56.0   48.1   46.3   48.5   43.8   44.3                        OASPL =     59.8 PNL =   75.0 PNLT =   77.5
FLAP  :  52.5   51.8   50.7   49.7   48.7   47.3   46.0   44.7   43.4   41.9   40.5   39.0   37.6   36.2   34.8   33.4   31.9
         30.5   29.1   27.6   26.2   24.7   23.2   21.8                        OASPL =     59.1 PNL =   59.2 PNLT =   59.2
TOTALS:  55.6   55.2   54.6   54.4   54.5   55.1   55.5   56.0   56.3   56.3   55.9   55.4   54.7   53.9   52.9   52.1   51.6
         50.4   54.8   47.0   43.4   41.7   33.9   28.0                        OASPL =     67.6 PNL =   77.6 PNLT =   79.6

  GEOM:  1  -585.9     0.0    77.1  1161.6     59.6    6.0   59.6   86.5    37.67   38.68     55.0    118.2
         SOURCES WHEN   XO=     0.0 FT,  YO= 1000.0 FT,  TAU =   38.7 SEC,  R = 1161.6 FT,  THETA =  59.6 DEG
FAN   : -25.3  -17.6  -10.2   -3.2    3.4    9.7   15.6   21.1   26.2   31.0   35.4   39.5   43.1   46.4   49.4   51.9   54.1
         58.4   57.4   58.5   62.5   59.5   61.4   60.2                        OASPL =     68.8 PNL =   81.6 PNLT =   82.8
CORE  :  40.5   43.1   45.7   47.7   49.6   51.6   52.7   53.7   54.3   54.5   54.2   53.8   53.2   52.3   51.3   50.3   48.9
         47.5   46.1   44.7   43.0   41.3   39.6   37.9                        OASPL =     64.3 PNL =   73.1 PNLT =   73.1
TURB  :  31.0   32.0   33.0   34.0   35.0   36.0   37.0   38.1   39.1   40.1   41.1   42.1   43.2   44.2   45.3   46.4   47.5
         48.6   49.8   51.2   52.4   54.0   55.9   59.1                        OASPL =     63.4 PNL =   74.7 PNLT =   74.8
FLAP  :  61.4   62.9   64.1   65.2   65.6   65.2   64.3   63.3   62.3   61.1   59.8   58.5   57.2   55.9   54.4   53.0   51.6
         50.2   48.8   47.4   45.9   44.5   43.0   41.5                        OASPL =     74.4 PNL =   79.0 PNLT =   79.1
TOTALS:  64.3   65.8   67.0   68.1   68.5   68.0   67.2   66.2   65.2   64.1   62.8   61.5   60.1   58.7   57.4   56.5   55.7
         56.9   54.4   53.1   53.6   46.8   42.4   33.4                        OASPL =     77.4 PNL =   83.2 PNLT =   84.4

  GEOM:  2  -468.8     0.0    61.7  1106.1     64.8    6.0   64.8   87.2    38.67   39.63     55.0    118.2
         SOURCES WHEN   XO=     0.0 FT,  YO= 1000.0 FT,  TAU =   39.6 SEC,  R = 1106.1 FT,  THETA =  64.8 DEG
FAN   : -26.0  -18.2  -10.8   -3.8    2.8    9.1   15.0   20.5   25.6   30.4   34.8   38.9   42.5   45.8   48.8   51.3   53.5
         57.8   56.8   57.9   61.9   58.9   60.7   59.6                        OASPL =     68.2 PNL =   81.0 PNLT =   82.1
CORE  :  41.4   44.0   46.6   48.5   50.5   52.5   53.6   54.6   55.1   55.3   55.1   54.7   54.1   53.1   52.1   51.2   49.8
         48.4   47.0   45.6   43.9   42.2   40.5   38.8                        OASPL =     65.2 PNL =   74.0 PNLT =   74.0
TURB  :  33.0   34.0   35.0   36.0   37.0   38.0   39.0   40.1   41.1   42.1   43.1   44.1   45.2   46.2   47.3   48.4   49.5
         50.6   51.8   53.2   54.4   56.0   57.9   61.3                        OASPL =     65.5 PNL =   76.8 PNLT =   76.8
FLAP  :  61.8   63.3   64.6   65.7   66.2   65.7   64.9   63.9   62.8   61.7   60.4   59.0   57.8   56.4   55.0   53.5   52.1
         50.7   49.3   47.9   46.5   45.0   43.6   42.1                        OASPL =     74.9 PNL =   79.6 PNLT =   79.6
TOTALS:  64.7   66.2   67.5   68.6   69.1   68.6   67.8   66.8   65.9   64.8   63.5   62.2   60.9   59.5   58.1   57.1   56.2
         57.0   54.7   53.5   53.9   47.7   43.6   35.8                        OASPL =     77.9 PNL =   83.7 PNLT =   84.7

  GEOM:  3  -351.6     0.0    46.3  1061.0     70.6    6.0   70.6   87.9    39.67   40.59     55.0    118.2
         SOURCES WHEN   XO=     0.0 FT,  YO= 1000.0 FT,  TAU =   40.6 SEC,  R = 1061.0 FT,  THETA =  70.6 DEG
FAN   : -26.2  -18.4  -11.1   -4.1    2.6    8.8   14.7   20.3   25.4   30.2   34.6   38.6   42.3   45.6   48.5   51.1   53.3
         57.6   56.6   57.6   61.7   58.7   60.5   59.4                        OASPL =     68.0 PNL =   80.7 PNLT =   81.9
CORE  :  42.2   44.8   47.4   49.4   51.3   53.3   54.4   55.4   55.9   56.2   55.9   55.5   54.9   53.9   53.0   52.0   50.6
         49.2   47.8   46.4   44.7   43.0   41.3   39.6                        OASPL =     66.0 PNL =   74.8 PNLT =   74.9
TURB  :  35.1   36.1   37.1   38.1   39.1   40.1   41.1   42.2   43.2   44.2   45.2   46.2   47.3   48.3   49.4   50.5   51.6
         52.7   53.9   55.3   56.5   58.1   60.0   63.5                        OASPL =     67.6 PNL =   78.9 PNLT =   78.9
FLAP  :  62.1   63.7   65.0   66.2   66.7   66.2   65.4   64.4   63.3   62.2   60.9   59.5   58.2   56.9   55.5   54.0   52.6
         51.2   49.8   48.4   47.0   45.5   44.1   42.6                        OASPL =     75.4 PNL =   80.1 PNLT =   80.1
TOTALS:  65.1   66.6   67.9   69.1   69.6   69.1   68.4   67.4   66.5   65.4   64.2   62.9   61.6   60.2   58.9   57.9   57.0
         57.6   55.5   54.4   54.6   49.1   45.2   38.4                        OASPL =     78.5 PNL =   84.3 PNLT =   85.3

  GEOM:  4  -234.4     0.0    30.9  1027.6     76.8    6.0   76.8   88.6    40.67   41.56     55.0    118.2
         SOURCES WHEN   XO=     0.0 FT,  YO= 1000.0 FT,  TAU =   41.6 SEC,  R = 1027.6 FT,  THETA =  76.8 DEG
FAN   : -25.9  -18.1  -10.8   -3.8    2.9    9.1   15.0   20.6   25.7   30.5   34.9   38.9   42.6   45.9   48.8   51.4   53.6
         57.8   56.9   57.9   61.9   59.0   60.8   59.7                        OASPL =     68.3 PNL =   81.0 PNLT =   82.2
CORE  :  43.0   45.6   48.2   50.2   52.2   54.1   55.2   56.2   56.8   57.0   56.7   56.4   55.7   54.8   53.8   52.8   51.5
         50.0   48.6   47.2   45.5   43.8   42.2   40.5                        OASPL =     66.8 PNL =   75.7 PNLT =   75.7
```

TABLE V. - Continued.

```
TURB   :   37.3   38.3   39.3   40.3   41.3   42.3   43.3   44.4   45.4   46.4   47.4   48.4   49.5   50.5   51.6   52.7   53.8
           54.9   56.1   57.5   58.7   60.3   62.2   65.8                         OASPL =   69.8 PNL =   81.1 PNLT =   81.1
FLAP   :   62.4   64.0   65.3   66.6   67.1   66.7   65.8   64.8   63.8   62.6   61.3   60.0   58.7   57.3   55.9   54.4   53.0
           51.6   50.2   48.8   47.4   45.9   44.5   43.0                         OASPL =   75.8 PNL =   80.5 PNLT =   80.6
TOTALS:    65.4   66.9   68.3   69.5   70.0   69.6   68.8   67.9   67.0   66.0   64.8   63.5   62.3   61.0   59.8   58.8   58.0
           58.5   56.7   55.7   55.7   50.8   47.1   41.1                         OASPL =   79.0 PNL =   85.2 PNLT =   85.8

  GEOM:  5  -117.2     0.0    15.4  1007.0    83.3    6.0   83.3   89.3   41.67   42.55       55.0   118.2
           SOURCES WHEN   XO=    0.0 FT,  YO= 1000.0 FT,  TAU =    42.5 SEC,  R = 1007.0 FT,  THETA =  83.3 DEG
FAN    :  -24.8  -17.1   -9.7   -2.7    4.0   10.2   16.1   21.6   26.8   31.6   36.0   40.0   43.7   47.0   49.9   52.5   54.7
           58.9   57.9   59.0   63.0   60.1   61.9   60.7                         OASPL =   69.3 PNL =   82.1 PNLT =   83.2
CORE   :   43.9   46.5   49.1   51.1   53.1   55.0   56.1   57.1   57.7   57.9   57.6   57.3   56.6   55.7   54.7   53.8   52.4
           51.0   49.5   48.1   46.5   44.8   43.1   41.4                         OASPL =   67.8 PNL =   76.6 PNLT =   76.7
TURB   :   39.4   40.4   41.4   42.4   43.4   44.4   45.4   46.5   47.5   48.5   49.5   50.5   51.6   52.6   53.7   54.8   55.9
           57.0   58.2   59.6   60.8   62.4   64.3   68.1                         OASPL =   72.0 PNL =   83.2 PNLT =   83.2
FLAP   :   62.6   64.2   65.6   66.9   67.5   67.0   66.2   65.2   64.1   63.0   61.6   60.3   59.0   57.7   56.2   54.7   53.3
           51.9   50.5   49.1   47.7   46.2   44.8   43.3                         OASPL =   76.1 PNL =   80.9 PNLT =   80.9
TOTALS:    65.6   67.2   68.5   69.8   70.4   70.0   69.3   68.4   67.5   66.5   65.3   64.2   63.0   61.8   60.7   59.9   59.3
           59.9   58.2   57.4   57.3   52.8   49.2   43.8                         OASPL =   79.4 PNL =   86.3 PNLT =   86.8

*****  CLOSEST POINT OF APPROACH
  GEOM:  6     0.0     0.0     0.0  1000.0    90.0   90.0   90.0   90.0   42.67   43.54       20.0   118.2
           SOURCES WHEN   XO=    0.0 FT,  YO= 1000.0 FT,  TAU =    43.5 SEC,  R = 1000.0 FT,  THETA =  90.0 DEG
FAN    :  -19.4  -13.3   -7.6   -2.2    2.8    7.4   11.7   15.6   19.1   22.3   25.1   27.5   29.5   33.4   32.5   33.5   37.2
           34.2   35.9   34.7   33.3   31.3   29.6   27.6                         OASPL =   44.5 PNL =   57.1 PNLT =   58.2
CORE   :   34.3   36.8   39.4   41.4   43.4   45.3   46.5   47.4   48.0   48.2   47.9   47.6   46.9   46.0   45.0   44.1   42.7
           41.3   39.9   38.4   36.8   35.1   33.4   31.7                         OASPL =   58.1 PNL =   66.6 PNLT =   66.6
TURB   :   31.4   32.4   33.4   34.4   35.4   36.4   37.4   38.5   39.5   40.5   41.5   42.5   43.6   44.6   45.7   46.8   47.9
           49.0   58.4   48.6   46.8   50.5   44.2   45.5                         OASPL =   61.3 PNL =   76.6 PNLT =   79.8
FLAP   :   39.1   38.4   37.4   36.3   35.3   34.0   32.6   31.3   30.0   28.5   27.1   25.6   24.2   22.8   21.4   20.0   18.6
           17.1   15.7   14.2   12.8   11.3    9.9    8.4                         OASPL =   45.7 PNL =   42.2 PNLT =   42.2
TOTALS:    43.8   44.2   45.0   46.0   47.3   48.8   49.8   50.6   51.0   51.2   50.9   50.6   50.1   49.6   49.1   48.7   48.4
           47.8   55.0   43.9   39.6   39.0   27.8   20.9                         OASPL =   62.6 PNL =   75.2 PNLT =   78.3

*****
  GEOM:  7   115.9     0.0     0.0  1006.7    96.5  190.0   96.5   91.2   43.67   44.55       20.0   113.5
           SOURCES WHEN   XO=    0.0 FT,  YO= 1000.0 FT,  TAU =    44.5 SEC,  R = 1006.7 FT,  THETA =  96.5 DEG
FAN    :  -18.2  -12.1   -6.3   -0.9    4.1    8.7   13.0   16.9   20.4   23.5   26.3   28.7   30.8   34.6   33.8   34.7   38.4
           35.5   37.1   35.9   34.6   32.5   30.9   28.9                         OASPL =   45.7 PNL =   58.3 PNLT =   59.4
CORE   :   35.1   37.7   40.3   42.2   44.2   46.2   47.3   48.2   48.8   49.0   48.8   48.4   47.8   46.8   45.8   44.9   43.5
           42.1   40.7   39.3   37.6   35.9   34.2   32.5                         OASPL =   58.9 PNL =   67.4 PNLT =   67.5
TURB   :   33.1   34.1   35.1   36.1   37.1   38.1   39.1   40.2   41.2   42.2   43.2   44.2   45.3   46.3   47.4   48.5   49.6
           50.7   60.6   50.3   48.5   52.6   45.9   47.4                         OASPL =   63.3 PNL =   78.7 PNLT =   82.0
FLAP   :   48.9   48.2   47.2   46.1   45.1   43.8   42.4   41.1   39.8   38.3   36.9   35.4   34.0   32.6   31.2   29.8   28.4
           27.0   25.5   24.0   22.6   21.1   19.7   18.2                         OASPL =   55.5 PNL =   54.8 PNLT =   54.8
TOTALS:    52.1   51.6   51.1   50.7   50.8   51.3   51.6   52.1   52.4   52.4   52.1   51.8   51.4   50.9   50.4   50.1   49.9
           49.3   57.2   45.5   41.2   41.0   29.3   22.6                         OASPL =   64.8 PNL =   77.2 PNLT =   80.5

  GEOM:  8   227.1     0.0     0.0  1025.5   102.6  190.0  102.6   92.3   44.67   45.56       20.0   108.9
           SOURCES WHEN   XO=    0.0 FT,  YO= 1000.0 FT,  TAU =    45.6 SEC,  R = 1025.5 FT,  THETA = 102.6 DEG
FAN    :  -17.2  -11.1   -5.4    0.0    5.0    9.7   13.9   17.8   21.4   24.5   27.3   29.7   31.8   35.6   34.7   35.7   39.4
           36.4   38.1   36.8   35.5   33.5   31.9   29.8                         OASPL =   46.7 PNL =   59.4 PNLT =   60.5
CORE   :   35.6   38.2   40.8   42.8   44.7   46.7   47.8   48.8   49.3   49.6   49.3   48.9   48.3   47.3   46.4   45.4   44.0
           42.6   41.2   39.8   38.1   36.4   34.7   33.0                         OASPL =   59.4 PNL =   68.0 PNLT =   68.0
TURB   :   34.2   35.2   36.2   37.2   38.2   39.2   40.2   41.3   42.3   43.3   44.3   45.3   46.4   47.4   48.5   49.6   50.7
           51.8   62.2   51.4   49.6   54.1   47.1   48.8                         OASPL =   64.7 PNL =   80.2 PNLT =   83.7
FLAP   :   48.8   48.1   47.1   46.1   45.1   43.7   42.4   41.1   39.8   38.3   36.8   35.4   34.0   32.6   31.2   29.8   28.3
           26.9   25.4   24.0   22.5   21.1   19.6   18.2                         OASPL =   55.5 PNL =   54.7 PNLT =   54.7
TOTALS:    52.1   51.6   51.2   50.9   51.1   51.6   52.1   52.6   52.9   53.0   52.7   52.4   52.1   51.6   51.3   51.0   50.8
           50.3   58.7   46.4   42.0   42.3   30.0   23.4                         OASPL =   65.5 PNL =   78.4 PNLT =   81.8
```

TABLE V. - Concluded.

```
 GEOM:  9   333.6       0.0       0.0  1054.2     108.2  190.0  108.2    93.3     45.67   46.59        20.0    104.2
            SOURCES WHEN   XO=      0.0 FT,   YO= 1000.0 FT,   TAU □    46.6 SEC,   R = 1054.2 FT,   THETA = 108.2 DEG
FAN    :  -16.7   -10.5    -4.8     0.6      5.6    10.2    14.5    18.4    21.9    25.1    27.9    30.3    32.3    36.2    35.3    36.2    40.1
           37.0    38.8    37.5    36.1     34.1    32.4    30.4                            OASPL =    47.3 PNL =     60.0 PNLT =     61.2
CORE   :   35.8    38.4    41.0    43.0     44.9    46.9    48.0    49.0    49.5    49.8    49.5    49.1    48.5    47.5    46.6    45.6    44.2
           42.8    41.4    40.0    38.3     36.6    34.9    33.2                            OASPL =    59.6 PNL =     68.2 PNLT =     68.2
TURB   :   34.7    35.7    36.7    37.7     38.7    39.7    40.7    41.8    42.8    43.8    44.8    45.8    46.9    47.9    49.0    50.1    51.2
           52.3    63.3    51.9    50.1     55.1    47.5    49.5                            OASPL =    65.6 PNL =     81.0 PNLT =     84.7
FLAP   :   48.7    48.0    47.0    46.0     44.9    43.6    42.2    40.9    39.6    38.2    36.7    35.2    33.8    32.4    31.1    29.6    28.2
           26.8    25.3    23.9    22.4     20.9    19.5    18.0                            OASPL □    55.3 PNL =     54.5 PNLT =     54.5
TOTALS:    52.0    51.6    51.1    51.0     51.2    51.8    52.2    52.8    53.1    53.2    52.9    52.7    52.3    51.9    51.6    51.3    51.1
           50.6    59.5    46.6    42.2     42.8    29.9    23.3                            OASPL =    65.8 PNL =     78.9 PNLT □     82.6

 GEOM: 10   435.5       0.0       0.0  1090.7     113.2  190.0  113.2    94.3     46.67   47.62        20.0     99.6
            SOURCES WHEN   XO=      0.0 FT,   YO= 1000.0 FT,   TAU =    47.6 SEC,   R = 1090.7 FT,   THETA = 113.2 DEG
FAN    :  -16.4   -10.3    -4.5     0.8      5.8    10.5    14.8    18.6    22.2    25.3    28.1    30.5    32.6    36.5    35.6    36.5    40.4
           37.3    39.1    37.8    36.4     34.3    32.7    30.7                            OASPL =    47.6 PNL =     60.3 PNLT =     61.5
CORE   :   35.7    38.3    40.9    42.9     44.9    46.8    47.9    48.9    49.5    49.7    49.4    49.1    48.4    47.5    46.5    45.5    44.2
           42.7    41.3    39.9    38.2     36.6    34.9    33.2                            OASPL =    59.6 PNL =     68.1 PNLT □     68.2
TURB   :   34.3    35.3    36.3    37.3     38.3    39.3    40.3    41.4    42.4    43.4    44.4    45.4    46.5    47.5    48.6    49.7    50.8
           51.9    62.7    51.4    49.6     54.6    47.1    49.0                            OASPL =    65.1 PNL =     80.5 PNLT =     84.2
FLAP   :   48.5    47.8    46.8    45.8     44.7    43.4    42.0    40.7    39.4    38.0    36.5    35.0    33.6    32.2    30.9    29.4    28.0
           26.6    25.1    23.7    22.2     20.7    19.3    17.8                            OASPL □    55.1 PNL =     54.3 PNLT =     54.3
TOTALS:    51.8    51.4    50.9    50.8     51.0    51.6    52.1    52.6    53.0    53.0    52.8    52.5    52.1    51.6    51.2    50.9    50.6
           50.0    58.8    45.9    41.4     41.7    28.7    21.8                            OASPL □    65.4 PNL =     78.3 PNLT =     81.9

 GEOM: 11   532.8       0.0       0.0  1133.1     117.6  190.0  117.7    95.3     47.67   48.66        20.0     94.9
            SOURCES WHEN   XO=      0.0 FT,   YO= 1000.0 FT,   TAU =    48.7 SEC,   R □ 1133.1 FT,   THETA = 117.6 DEG
FAN    :  -16.3   -10.2    -4.5     0.9      5.9    10.5    14.8    18.7    22.2    25.4    28.2    30.6    32.6    36.6    35.6    36.6    40.5
           37.3    39.1    37.8    36.5     34.4    32.7    30.7                            OASPL □    47.6 PNL =     60.4 PNLT =     61.6
CORE   :   35.5    38.1    40.7    42.7     44.7    46.6    47.7    48.7    49.3    49.5    49.2    48.9    48.2    47.3    46.3    45.3    44.0
           42.6    41.1    39.7    38.0     36.4    34.7    33.0                            OASPL =    59.4 PNL =     67.9 PNLT =     68.0
TURB   :   33.3    34.3    35.3    36.3     37.3    38.3    39.3    40.4    41.4    42.4    43.4    44.4    45.5    46.5    47.6    48.7    49.8
           50.9    61.5    50.5    48.7     53.4    46.2    47.9                            OASPL =    63.9 PNL =     79.3 PNLT =     82.9
FLAP   :   48.3    47.6    46.6    45.5     44.5    43.1    41.8    40.5    39.2    37.7    36.3    34.8    33.4    32.0    30.6    29.2    27.8
           26.3    24.9    23.4    22.0     20.5    19.0    17.6                            OASPL =    54.9 PNL =     54.0 PNLT =     54.0
TOTALS:    51.5    51.1    50.7    50.5     50.7    51.3    51.8    52.3    52.6    52.7    52.4    52.0    51.5    51.0    50.5    50.1    49.8
           49.0    57.2    44.8    40.1     39.9    27.1    19.6                            OASPL =    64.8 PNL =     77.2 PNLT =     80.6
```

```
              VALUES OF PNL-MAX
 XO ,                      YO POSITION
 POS            500.   1000.
-2000. LEVEL    95.9    89.7
        THETA   115.4   110.3
         TIME    28.43   29.85
-1000. LEVEL    98.5    91.4
        THETA   116.0   110.0
         TIME    36.78   38.21
    0. LEVEL    93.8    86.3
        THETA    76.8    83.3
         TIME    42.12   42.55
```

TABLE VI. - OUTPUT FROM EXAMPLE TWO

This output is discussed in the text of the report.

```
                    QSRA TAKEOFF CALCULATION, ENGINE MAP FROM TEST DATA

 GEOMETRIC RELATIONS OF AIRCRAFT/OBSERVER
          KI    XI       YI        ZI       R       THETA  THETAF THETAH   PHI      TI       TAU        EPPI      VI
  GEOM:  1    382.0      0.0       0.0   1224.7      26.0   10.0   24.4    68.8    10.19    11.26       85.0     75.0
                   NOISE CONTRIBUTIONS FOR EACH NOISE SOURCE
 SOURCE      XO        YO       TAU     OASPL     PNL      PNLT
FAN     :  1500.0    500.0  11.259     81.8     95.6     98.8
CORE    :  1500.0    500.0  11.259     68.2     77.0     77.1
TURB    :  1500.0    500.0  11.259     53.6     65.0     65.0
FLAP    :  1500.0    500.0  11.259     84.0     88.5     88.5
TOTAL   :  1500.0    500.0  11.259     86.8     94.4     97.6
  GEOM:  2    460.7      0.0       0.0   1153.3      27.4   10.0   26.0    70.2    11.19    12.20       85.0     82.4
FAN     :  1500.0    500.0  12.197     82.4     96.2     99.3
CORE    :  1500.0    500.0  12.197     68.9     77.8     77.8
TURB    :  1500.0    500.0  12.197     54.7     66.1     66.2
FLAP    :  1500.0    500.0  12.197     84.5     89.2     89.2
TOTAL   :  1500.0    500.0  12.197     87.3     95.4     98.6
  GEOM:  3    546.7      0.0       0.0   1076.4      29.3   10.0   28.0    71.7    12.19    13.13       85.0     89.7
FAN     :  1500.0    500.0  13.130     83.0     96.8     99.9
CORE    :  1500.0    500.0  13.130     69.7     78.7     78.7
TURB    :  1500.0    500.0  13.130     56.0     67.5     67.5
FLAP    :  1500.0    500.0  13.130     85.1     90.1     90.1
TOTAL   :  1500.0    500.0  13.130     88.0     96.5     99.7
  GEOM:  4    640.1      0.0       0.0    994.7      31.6   10.0   30.6    73.4    13.19    14.06       85.0     97.1
FAN     :  1500.0    500.0  14.058     83.7     97.6    100.7
CORE    :  1500.0    500.0  14.058     70.8     79.7     79.7
TURB    :  1500.0    500.0  14.058     57.7     69.2     69.2
FLAP    :  1500.0    500.0  14.058     85.8     91.0     91.1
TOTAL   :  1500.0    500.0  14.058     88.8     97.8    100.9
  GEOM:  5    740.9      0.0       0.0    909.0      34.7   10.0   33.8    75.2    14.19    14.98       85.0    104.4
FAN     :  1500.0    500.0  14.983     84.6     98.5    101.6
CORE    :  1500.0    500.0  14.983     72.0     80.9     81.0
TURB    :  1500.0    500.0  14.983     59.6     71.2     71.2
FLAP    :  1500.0    500.0  14.983     86.6     92.1     92.2
TOTAL   :  1500.0    500.0  14.983     89.7     99.2    102.3
  GEOM:  6    849.0      0.0       0.0    820.8      38.6   10.0   38.0    77.3    15.19    15.91       85.0    111.8
FAN     :  1500.0    500.0  15.906     85.6     99.5    102.6
CORE    :  1500.0    500.0  15.906     73.4     82.4     82.4
TURB    :  1500.0    500.0  15.906     62.1     73.7     73.7
FLAP    :  1500.0    500.0  15.906     87.6     93.4     93.4
TOTAL   :  1500.0    500.0  15.906     90.7    100.8    103.8
  GEOM:  7    964.5      0.0       0.0    732.7      44.0   10.0   43.5    79.5    16.19    16.83       85.0    119.2
FAN     :  1500.0    500.0  16.829     86.2    100.2    103.3
CORE    :  1500.0    500.0  16.829     75.2     84.3     84.3
TURB    :  1500.0    500.0  16.829     65.2     76.9     76.9
FLAP    :  1500.0    500.0  16.829     88.7     94.7     94.8
TOTAL   :  1500.0    500.0  16.829     91.9    102.2    105.1
  GEOM:  8   1087.3      0.0       0.0    648.3      51.2   10.0   50.9    81.8    17.19    17.76       85.0    126.5
FAN     :  1500.0    500.0  17.755     86.5    100.7    103.7
CORE    :  1500.0    500.0  17.755     77.4     86.5     86.5
TURB    :  1500.0    500.0  17.755     69.2     80.8     80.9
FLAP    :  1500.0    500.0  17.755     90.0     96.3     96.3
TOTAL   :  1500.0    500.0  17.755     93.3    103.5    106.3
  GEOM:  9   1217.5      0.0       0.0    574.3      61.0   10.0   60.9    84.4    18.19    18.69       85.0    133.9
FAN     :  1500.0    500.0  18.690     86.0    100.1    102.9
CORE    :  1500.0    500.0  18.690     79.4     88.5     88.6
TURB    :  1500.0    500.0  18.690     74.1     85.8     85.8
```

TABLE VI. - Continued.

FLAP :	1500.0	500.0	18.690	91.4	98.0	98.0						
TOTAL :	1500.0	500.0	18.690	94.7	104.3	106.7						
GEOM: 10	1355.1	0.0	0.0	520.6	74.1	10.0	74.1	87.1	19.19	19.64	85.0	141.2
FAN :	1500.0	500.0	19.644	84.3	98.3	101.0						
CORE :	1500.0	500.0	19.644	81.3	90.5	90.5						
TURB :	1500.0	500.0	19.644	78.8	90.6	90.6						
FLAP :	1500.0	500.0	19.644	92.8	99.6	99.6						
TOTAL :	1500.0	500.0	19.644	95.9	104.7	106.6						
***** CLOSEST POINT OF APPROACH												
GEOM: 11	1500.0	0.0	0.0	500.0	90.0	90.0	90.0	90.0	20.19	20.63	85.0	148.6
FAN :	1500.0	500.0	20.626	86.2	99.7	102.3						
CORE :	1500.0	500.0	20.626	83.5	92.7	92.8						
TURB :	1500.0	500.0	20.626	84.0	95.7	95.7						
FLAP :	1500.0	500.0	20.626	94.9	101.8	101.9						
TOTAL :	1500.0	500.0	20.626	98.0	107.0	108.7						
*****												
GEOM: 12	1647.8	0.0	15.8	521.6	106.3	190.0	106.3	93.0	21.19	21.64	85.0	148.6
FAN :	1500.0	500.0	21.644	88.6	102.0	104.5						
CORE :	1500.0	500.0	21.644	85.0	94.3	94.3						
TURB :	1500.0	500.0	21.644	87.1	98.9	98.9						
FLAP :	1500.0	500.0	21.644	104.5	111.6	111.7						
TOTAL :	1500.0	500.0	21.644	107.2	114.0	115.0						
GEOM: 13	1795.5	0.0	31.6	581.7	120.2	190.0	120.3	95.9	22.19	22.70	85.0	148.6
FAN :	1500.0	500.0	22.697	89.2	102.5	105.1						
CORE :	1500.0	500.0	22.697	84.7	93.9	93.9						
TURB :	1500.0	500.0	22.697	85.3	97.0	97.0						
FLAP :	1500.0	500.0	22.697	103.9	110.9	111.0						
TOTAL :	1500.0	500.0	22.697	106.5	113.2	114.5						
GEOM: 14	1943.3	0.0	47.4	669.9	130.9	190.0	131.3	98.8	23.19	23.77	85.0	148.6
FAN :	1500.0	500.0	23.774	88.0	101.2	103.7						
CORE :	1500.0	500.0	23.774	83.4	92.6	92.7						
TURB :	1500.0	500.0	23.774	80.1	91.8	91.8						
FLAP :	1500.0	500.0	23.774	102.9	109.9	110.0						
TOTAL :	1500.0	500.0	23.774	105.4	111.9	113.2						
GEOM: 15	2091.0	0.0	63.2	776.7	138.9	190.0	139.5	101.7	24.19	24.87	85.0	148.6
FAN :	1500.0	500.0	24.867	85.1	98.4	100.9						
CORE :	1500.0	500.0	24.867	82.1	91.3	91.3						
TURB :	1500.0	500.0	24.867	75.8	87.5	87.6						
FLAP :	1500.0	500.0	24.867	101.7	108.8	108.9						
TOTAL :	1500.0	500.0	24.867	104.2	110.3	111.4						
GEOM: 16	2238.8	0.0	78.9	895.6	144.8	190.0	145.7	104.5	25.19	25.97	85.0	148.6
FAN :	1500.0	500.0	25.971	81.9	95.2	97.8						
CORE :	1500.0	500.0	25.971	80.8	89.9	90.0						
TURB :	1500.0	500.0	25.971	71.7	83.4	83.4						
FLAP :	1500.0	500.0	25.971	100.6	107.7	107.7						
TOTAL :	1500.0	500.0	25.971	103.0	108.8	109.4						
GEOM: 17	2386.6	0.0	94.7	1022.2	149.2	190.0	150.3	107.2	26.19	27.08	85.0	148.6
FAN :	1500.0	500.0	27.082	79.1	92.5	95.2						
CORE :	1500.0	500.0	27.082	79.5	88.7	88.7						
TURB :	1500.0	500.0	27.082	68.3	80.0	80.0						
FLAP :	1500.0	500.0	27.082	99.6	106.6	106.7						
TOTAL :	1500.0	500.0	27.082	101.9	107.4	107.9						
GEOM: 18	2534.3	0.0	110.5	1154.1	152.6	190.0	154.0	109.9	27.19	28.20	85.0	148.6
FAN :	1500.0	500.0	28.197	76.8	90.3	93.0						
CORE :	1500.0	500.0	28.197	78.4	87.6	87.6						
TURB :	1500.0	500.0	28.197	65.5	77.2	77.2						
FLAP :	1500.0	500.0	28.197	98.6	105.6	105.7						
TOTAL :	1500.0	500.0	28.197	100.8	106.1	106.5						
GEOM: 19	2682.1	0.0	126.3	1289.7	155.2	190.0	156.9	112.4	28.19	29.32	85.0	148.6
FAN :	1500.0	500.0	29.316	74.9	88.5	91.2						

TABLE VI. - Continued.

CORE :		1500.0	500.0	29.316	77.4	86.5	86.6						
TURB :		1500.0	500.0	29.316	63.2	74.8	74.8						
FLAP :		1500.0	500.0	29.316	97.7	104.7	104.7						
TOTAL :		1500.0	500.0	29.316	99.8	104.9	105.3						
GEOM:	20	2829.8	0.0	142.1	1427.8	157.3	190.0	159.2	114.9	29.19	30.44	85.0	148.6
FAN :		1500.0	500.0	30.437	73.2	86.9	89.6						
CORE :		1500.0	500.0	30.437	76.5	85.6	85.6						
TURB :		1500.0	500.0	30.437	61.3	72.8	72.9						
FLAP :		1500.0	500.0	30.437	96.8	103.8	103.9						
TOTAL :		1500.0	500.0	30.437	98.9	103.8	104.1						
GEOM:	21	2977.6	0.0	157.9	1567.9	159.0	190.0	161.1	117.3	30.19	31.56	85.0	148.6
FAN :		1500.0	500.0	31.559	71.8	85.5	88.2						
CORE :		1500.0	500.0	31.559	75.7	84.7	84.8						
TURB :		1500.0	500.0	31.559	59.6	71.1	71.2						
FLAP :		1500.0	500.0	31.559	96.1	103.1	103.1						
TOTAL :		1500.0	500.0	31.559	98.0	102.8	103.1						
GEOM:	1	382.0	0.0	0.0	1500.0	42.8	10.0	42.2	79.0	10.19	11.50	85.0	75.0
FAN :		1500.0	1000.0	11.500	80.1	94.1	97.2						
CORE :		1500.0	1000.0	11.500	68.8	77.7	77.7						
TURB :		1500.0	1000.0	11.500	58.5	70.1	70.1						
FLAP :		1500.0	1000.0	11.500	82.4	88.2	88.3						
TOTAL :		1500.0	1000.0	11.500	85.0	91.9	94.9						
GEOM:	2	460.7	0.0	0.0	1442.3	44.8	10.0	44.3	79.8	11.19	12.45	85.0	82.4
FAN :		1500.0	1000.0	12.449	80.2	94.3	97.4						
CORE :		1500.0	1000.0	12.449	69.5	78.4	78.4						
TURB :		1500.0	1000.0	12.449	59.7	71.3	71.3						
FLAP :		1500.0	1000.0	12.449	82.8	88.7	88.7						
TOTAL :		1500.0	1000.0	12.449	85.4	92.5	95.5						
GEOM:	3	546.7	0.0	0.0	1381.6	47.2	10.0	46.8	80.6	12.19	13.40	85.0	89.7
FAN :		1500.0	1000.0	13.396	80.4	94.5	97.5						
CORE :		1500.0	1000.0	13.396	70.2	79.1	79.2						
TURB :		1500.0	1000.0	13.396	61.0	72.6	72.6						
FLAP :		1500.0	1000.0	13.396	83.3	89.3	89.3						
TOTAL :		1500.0	1000.0	13.396	85.9	93.1	96.1						
GEOM:	4	640.1	0.0	0.0	1318.9	50.1	10.0	49.7	81.5	13.19	14.34	85.0	97.1
FAN :		1500.0	1000.0	14.341	80.6	94.7	97.7						
CORE :		1500.0	1000.0	14.341	71.1	80.0	80.1						
TURB :		1500.0	1000.0	14.341	62.6	74.2	74.2						
FLAP :		1500.0	1000.0	14.341	83.8	89.9	89.9						
TOTAL :		1500.0	1000.0	14.341	86.5	93.8	96.7						
GEOM:	5	740.9	0.0	0.0	1255.5	53.5	10.0	53.2	82.5	14.19	15.29	85.0	104.4
FAN :		1500.0	1000.0	15.286	80.4	94.6	97.5						
CORE :		1500.0	1000.0	15.286	71.8	80.8	80.9						
TURB :		1500.0	1000.0	15.286	64.4	76.0	76.0						
FLAP :		1500.0	1000.0	15.286	84.3	90.6	90.6						
TOTAL :		1500.0	1000.0	15.286	87.0	94.3	97.2						
GEOM:	6	849.0	0.0	0.0	1193.2	57.5	10.0	57.3	83.6	15.19	16.23	85.0	111.8
FAN :		1500.0	1000.0	16.232	80.2	94.4	97.3						
CORE :		1500.0	1000.0	16.232	72.7	81.7	81.7						
TURB :		1500.0	1000.0	16.232	66.4	78.1	78.1						
FLAP :		1500.0	1000.0	16.232	84.9	91.3	91.3						
TOTAL :		1500.0	1000.0	16.232	87.7	94.9	97.5						
GEOM:	7	964.5	0.0	0.0	1134.4	62.3	10.0	62.2	84.7	16.19	17.18	85.0	119.2
FAN :		1500.0	1000.0	17.180	79.7	93.8	96.6						
CORE :		1500.0	1000.0	17.180	73.6	82.6	82.6						
TURB :		1500.0	1000.0	17.180	68.5	80.2	80.2						
FLAP :		1500.0	1000.0	17.180	85.5	92.0	92.0						
TOTAL :		1500.0	1000.0	17.180	88.3	95.3	97.7						
GEOM:	8	1087.3	0.0	0.0	1081.8	67.9	10.0	67.9	85.9	17.19	18.13	85.0	126.5
FAN :		1500.0	1000.0	18.134	78.8	92.9	95.7						

TABLE VI. - Continued.

CORE :	1500.0	1000.0	18.134	74.4	83.5	83.5						
TURB :	1500.0	1000.0	18.134	70.6	82.3	82.3						
FLAP :	1500.0	1000.0	18.134	86.2	92.7	92.8						
TOTAL :	1500.0	1000.0	18.134	88.9	95.5	97.8						
GEOM: 9	1217.5	0.0	0.0	1039.1	74.5	10.0	74.5	87.2	18.19	19.10	85.0	133.9
FAN :	1500.0	1000.0	19.097	78.2	92.2	94.9						
CORE :	1500.0	1000.0	19.097	75.3	84.4	84.4						
TURB :	1500.0	1000.0	19.097	73.0	84.6	84.7						
FLAP :	1500.0	1000.0	19.097	86.8	93.5	93.5						
TOTAL :	1500.0	1000.0	19.097	89.5	96.0	98.0						
GEOM: 10	1355.1	0.0	0.0	1010.4	81.9	10.0	81.9	88.6	19.19	20.07	85.0	141.2
FAN :	1500.0	1000.0	20.072	78.7	92.4	95.0						
CORE :	1500.0	1000.0	20.072	76.3	85.4	85.5						
TURB :	1500.0	1000.0	20.072	75.4	87.1	87.1						
FLAP :	1500.0	1000.0	20.072	87.4	94.2	94.2						
TOTAL :	1500.0	1000.0	20.072	90.1	96.8	98.5						
***** CLOSEST POINT OF APPROACH												
GEOM: 11	1500.0	0.0	0.0	1000.0	90.0	90.0	90.0	90.0	20.19	21.06	85.0	148.6
FAN :	1500.0	1000.0	21.063	80.2	93.7	96.2						
CORE :	1500.0	1000.0	21.063	77.5	86.6	86.7						
TURB :	1500.0	1000.0	21.063	77.9	89.7	89.7						
FLAP :	1500.0	1000.0	21.063	88.8	95.7	95.8						
TOTAL :	1500.0	1000.0	21.063	91.5	98.4	100.1						
*****												
GEOM: 12	1647.8	0.0	15.8	1011.0	98.3	190.0	98.3	91.5	21.19	22.07	85.0	148.6
FAN :	1500.0	1000.0	22.072	81.6	95.0	97.4						
CORE :	1500.0	1000.0	22.072	78.6	87.7	87.7						
TURB :	1500.0	1000.0	22.072	80.1	91.8	91.8						
FLAP :	1500.0	1000.0	22.072	98.6	105.7	105.7						
TOTAL :	1500.0	1000.0	22.072	101.0	106.7	107.7						
GEOM: 13	1795.5	0.0	31.6	1043.2	106.3	190.0	106.3	93.0	22.19	23.10	85.0	148.6
FAN :	1500.0	1000.0	23.100	82.6	96.0	98.5						
CORE :	1500.0	1000.0	23.100	79.0	88.1	88.2						
TURB :	1500.0	1000.0	23.100	81.1	92.8	92.8						
FLAP :	1500.0	1000.0	23.100	98.5	105.5	105.6						
TOTAL :	1500.0	1000.0	23.100	100.8	106.6	107.7						
GEOM: 14	1943.3	0.0	47.4	1094.9	113.6	190.0	113.7	94.4	23.19	24.15	85.0	148.6
FAN :	1500.0	1000.0	24.146	83.1	96.4	99.0						
CORE :	1500.0	1000.0	24.146	79.0	88.1	88.2						
TURB :	1500.0	1000.0	24.146	80.7	92.4	92.4						
FLAP :	1500.0	1000.0	24.146	98.2	105.3	105.3						
TOTAL :	1500.0	1000.0	24.146	100.5	106.3	107.5						
GEOM: 15	2091.0	0.0	63.2	1163.3	120.2	190.0	120.3	95.9	24.19	25.21	85.0	148.6
FAN :	1500.0	1000.0	25.205	83.2	96.5	99.1						
CORE :	1500.0	1000.0	25.205	78.7	87.8	87.8						
TURB :	1500.0	1000.0	25.205	79.3	91.0	91.0						
FLAP :	1500.0	1000.0	25.205	97.8	104.9	104.9						
TOTAL :	1500.0	1000.0	25.205	100.1	105.7	107.1						
GEOM: 16	2238.8	0.0	78.9	1245.8	126.0	190.0	126.2	97.4	25.19	26.28	85.0	148.6
FAN :	1500.0	1000.0	26.278	82.7	95.9	98.5						
CORE :	1500.0	1000.0	26.278	78.1	87.2	87.2						
TURB :	1500.0	1000.0	26.278	76.5	88.2	88.3						
FLAP :	1500.0	1000.0	26.278	97.4	104.4	104.4						
TOTAL :	1500.0	1000.0	26.278	99.6	105.0	106.4						
GEOM: 17	2386.6	0.0	94.7	1339.8	130.9	190.0	131.3	98.8	26.19	27.36	85.0	148.6
FAN :	1500.0	1000.0	27.360	81.9	95.2	97.7						
CORE :	1500.0	1000.0	27.360	77.4	86.5	86.6						
TURB :	1500.0	1000.0	27.360	74.1	85.7	85.8						
FLAP :	1500.0	1000.0	27.360	96.8	103.8	103.9						
TOTAL :	1500.0	1000.0	27.360	99.0	104.3	105.6						

TABLE VI. - Continued.

GEOM: 18	2534.3	0.0	110.5	1442.9	135.2	190.0	135.7	100.2	27.19	28.45	85.0	148.6
FAN :	1500.0	1000.0	28.450	80.4	93.7	96.2						
CORE :	1500.0	1000.0	28.450	76.7	85.8	85.9						
TURB :	1500.0	1000.0	28.450	71.8	83.5	83.5						
FLAP :	1500.0	1000.0	28.450	96.3	103.3	103.3						
TOTAL :	1500.0	1000.0	28.450	98.4	103.4	104.7						
GEOM: 19	2682.1	0.0	126.3	1553.5	138.9	190.0	139.5	101.7	28.19	29.55	85.0	148.6
FAN :	1500.0	1000.0	29.547	79.1	92.4	94.9						
CORE :	1500.0	1000.0	29.547	76.1	85.1	85.2						
TURB :	1500.0	1000.0	29.547	69.8	81.5	81.5						
FLAP :	1500.0	1000.0	29.547	95.7	102.7	102.8						
TOTAL :	1500.0	1000.0	29.547	97.7	102.6	103.4						
GEOM: 20	2829.8	0.0	142.1	1669.9	142.1	190.0	142.8	103.1	29.19	30.65	85.0	148.6
FAN :	1500.0	1000.0	30.648	77.5	90.8	93.3						
CORE :	1500.0	1000.0	30.648	75.4	84.4	84.5						
TURB :	1500.0	1000.0	30.648	67.7	79.4	79.4						
FLAP :	1500.0	1000.0	30.648	95.2	102.1	102.2						
TOTAL :	1500.0	1000.0	30.648	97.1	101.8	102.5						
GEOM: 21	2977.6	0.0	157.9	1791.1	144.8	190.0	145.7	104.5	30.19	31.75	85.0	148.6
FAN :	1500.0	1000.0	31.754	75.8	89.2	91.8						
CORE :	1500.0	1000.0	31.754	74.7	83.8	83.8						
TURB :	1500.0	1000.0	31.754	65.7	77.4	77.4						
FLAP :	1500.0	1000.0	31.754	94.6	101.6	101.6						
TOTAL :	1500.0	1000.0	31.754	96.5	101.0	101.7						
GEOM: 1	1048.6	0.0	0.0	1535.1	21.4	10.0	19.3	63.2	16.88	18.22	85.0	124.2
FAN :	2500.0	500.0	18.222	79.8	93.6	96.7						
CORE :	2500.0	500.0	18.222	65.5	74.3	74.4						
TURB :	2500.0	500.0	18.222	49.8	60.9	61.0						
FLAP :	2500.0	500.0	18.222	82.3	85.9	86.0						
TOTAL :	2500.0	500.0	18.222	84.9	90.7	93.9						
GEOM: 2	1176.6	0.0	0.0	1414.7	22.9	10.0	21.0	65.3	17.88	19.12	85.0	131.6
FAN :	2500.0	500.0	19.117	80.6	94.3	97.5						
CORE :	2500.0	500.0	19.117	66.5	75.3	75.3						
TURB :	2500.0	500.0	19.117	51.1	62.4	62.4						
FLAP :	2500.0	500.0	19.117	82.9	86.7	86.7						
TOTAL :	2500.0	500.0	19.117	85.7	92.0	95.3						
GEOM: 3	1311.8	0.0	0.0	1289.1	24.8	10.0	23.1	67.6	18.88	20.01	85.0	139.0
FAN :	2500.0	500.0	20.007	81.4	95.1	98.3						
CORE :	2500.0	500.0	20.007	67.5	76.4	76.4						
TURB :	2500.0	500.0	20.007	52.7	64.0	64.0						
FLAP :	2500.0	500.0	20.007	83.6	87.8	87.9						
TOTAL :	2500.0	500.0	20.007	86.4	93.6	96.8						
GEOM: 4	1454.5	0.0	0.0	1158.9	27.3	10.0	25.9	70.0	19.88	20.89	85.0	146.3
FAN :	2500.0	500.0	20.893	82.3	96.1	99.3						
CORE :	2500.0	500.0	20.893	68.8	77.7	77.8						
TURB :	2500.0	500.0	20.893	54.6	66.0	66.1						
FLAP :	2500.0	500.0	20.893	84.4	89.1	89.2						
TOTAL :	2500.0	500.0	20.893	87.3	95.3	98.5						
GEOM: 5	1602.2	0.0	10.9	1027.7	33.2	16.8	30.2	62.6	20.88	21.78	85.0	148.6
FAN :	2500.0	500.0	21.778	83.5	97.3	100.5						
CORE :	2500.0	500.0	21.778	70.7	79.6	79.7						
TURB :	2500.0	500.0	21.778	58.0	69.5	69.6						
FLAP :	2500.0	500.0	21.778	86.1	90.1	90.1						
TOTAL :	2500.0	500.0	21.778	89.1	97.3	100.4						
GEOM: 6	1749.9	0.0	26.7	901.9	37.7	18.1	35.0	65.0	21.88	22.67	85.0	148.6
FAN :	2500.0	500.0	22.668	84.7	98.7	101.7						
CORE :	2500.0	500.0	22.668	72.5	81.4	81.5						
TURB :	2500.0	500.0	22.668	60.9	72.5	72.5						
FLAP :	2500.0	500.0	22.668	87.3	91.2	91.3						
TOTAL :	2500.0	500.0	22.668	90.4	99.2	102.3						

TABLE VI. - Continued.

GEOM:	7	1897.7	0.0	42.5	784.0	43.7	20.1	41.4	67.4	22.88	23.57	85.0	148.6
FAN	:	2500.0	500.0	23.565	85.6	99.7	102.7						
CORE	:	2500.0	500.0	23.565	74.6	83.6	83.7						
TURB	:	2500.0	500.0	23.565	64.5	76.2	76.2						
FLAP	:	2500.0	500.0	23.565	88.5	92.9	93.0						
TOTAL	:	2500.0	500.0	23.565	91.8	101.1	104.1						
GEOM:	8	2045.4	0.0	58.3	678.3	51.7	23.4	49.9	70.0	23.88	24.47	85.0	148.6
FAN	:	2500.0	500.0	24.473	86.1	100.2	103.2						
CORE	:	2500.0	500.0	24.473	77.0	86.1	86.1						
TURB	:	2500.0	500.0	24.473	69.0	80.6	80.7						
FLAP	:	2500.0	500.0	24.473	89.7	94.6	94.6						
TOTAL	:	2500.0	500.0	24.473	93.1	102.6	105.5						
GEOM:	9	2193.2	0.0	74.1	591.3	62.4	29.7	61.3	72.6	24.88	25.40	85.0	148.6
FAN	:	2500.0	500.0	25.397	85.4	99.5	102.3						
CORE	:	2500.0	500.0	25.397	79.2	88.4	88.4						
TURB	:	2500.0	500.0	25.397	74.2	85.9	85.9						
FLAP	:	2500.0	500.0	25.397	91.2	96.5	96.5						
TOTAL	:	2500.0	500.0	25.397	94.5	103.5	106.0						
GEOM:	10	2341.0	0.0	89.9	532.3	76.1	45.6	75.7	75.4	25.88	26.35	85.0	148.6
FAN	:	2500.0	500.0	26.345	84.0	97.9	100.6						
CORE	:	2500.0	500.0	26.345	81.3	90.5	90.5						
TURB	:	2500.0	500.0	26.345	79.3	91.0	91.0						
FLAP	:	2500.0	500.0	26.345	92.0	97.7	97.7						
TOTAL	:	2500.0	500.0	26.345	95.3	103.8	105.8						
***** CLOSEST POINT OF APPROACH													
GEOM:	11	2488.7	0.0	105.7	511.2	92.1	100.0	92.1	78.2	26.88	27.33	85.0	148.6
FAN	:	2500.0	500.0	27.327	86.3	99.8	102.3						
CORE	:	2500.0	500.0	27.327	83.6	92.8	92.9						
TURB	:	2500.0	500.0	27.327	84.3	96.1	96.1						
FLAP	:	2500.0	500.0	27.327	92.4	98.5	98.5						
TOTAL	:	2500.0	500.0	27.327	96.0	105.8	107.6						
*****													
GEOM:	12	2636.5	0.0	121.4	532.3	108.0	154.4	108.2	81.0	27.88	28.35	85.0	148.6
FAN	:	2500.0	500.0	28.345	88.7	102.1	104.6						
CORE	:	2500.0	500.0	28.345	85.0	94.2	94.3						
TURB	:	2500.0	500.0	28.345	87.2	98.9	98.9						
FLAP	:	2500.0	500.0	28.345	82.4	88.4	88.5						
TOTAL	:	2500.0	500.0	28.345	91.7	105.3	107.2						
GEOM:	13	2784.2	0.0	137.2	591.3	121.7	170.3	121.9	83.9	28.88	29.40	85.0	148.6
FAN	:	2500.0	500.0	29.397	89.1	102.4	105.0						
CORE	:	2500.0	500.0	29.397	84.5	93.8	93.8						
TURB	:	2500.0	500.0	29.397	84.6	96.3	96.3						
FLAP	:	2500.0	500.0	29.397	93.3	99.8	99.9						
TOTAL	:	2500.0	500.0	29.397	96.8	107.1	109.2						
GEOM:	14	2932.0	0.0	153.0	678.3	132.4	176.6	132.5	86.9	29.88	30.47	85.0	148.6
FAN	:	2500.0	500.0	30.473	87.6	100.8	103.3						
CORE	:	2500.0	500.0	30.473	83.3	92.5	92.6						
TURB	:	2500.0	500.0	30.473	79.4	91.1	91.2						
FLAP	:	2500.0	500.0	30.473	98.3	105.2	105.2						
TOTAL	:	2500.0	500.0	30.473	101.1	108.2	110.0						
GEOM:	15	3079.7	0.0	168.8	784.0	140.4	179.9	140.4	89.8	30.88	31.57	85.0	148.6
FAN	:	2500.0	500.0	31.565	84.7	97.9	100.5						
CORE	:	2500.0	500.0	31.565	82.0	91.2	91.2						
TURB	:	2500.0	500.0	31.565	75.2	86.9	86.9						
FLAP	:	2500.0	500.0	31.565	101.2	108.3	108.3						
TOTAL	:	2500.0	500.0	31.565	103.7	109.8	110.9						
GEOM:	16	3227.5	0.0	184.6	901.9	146.3	181.9	146.3	92.8	31.88	32.67	85.0	148.6
FAN	:	2500.0	500.0	32.668	81.2	94.6	97.2						
CORE	:	2500.0	500.0	32.668	80.7	89.8	89.9						
TURB	:	2500.0	500.0	32.668	70.9	82.6	82.6						

TABLE VI. - Continued.

FLAP :		2500.0	500.0	32.668	100.4	107.5	107.6						
TOTAL :		2500.0	500.0	32.668	102.9	108.6	109.2						
GEOM:	17	3375.3	0.0	200.4	1027.7	150.7	183.2	150.9	95.7	32.88	33.78	85.0	148.6
FAN :		2500.0	500.0	33.778	78.5	92.0	94.6						
CORE :		2500.0	500.0	33.778	79.5	88.6	88.7						
TURB :		2500.0	500.0	33.778	67.5	79.1	79.2						
FLAP :		2500.0	500.0	33.778	99.5	106.6	106.6						
TOTAL :		2500.0	500.0	33.778	101.8	107.3	107.8						
GEOM:	18	3523.0	0.0	216.2	1159.0	154.1	184.2	154.4	98.6	33.88	34.89	85.0	148.6
FAN :		2500.0	500.0	34.893	76.2	89.8	92.4						
CORE :		2500.0	500.0	34.893	78.4	87.5	87.5						
TURB :		2500.0	500.0	34.893	64.7	76.3	76.3						
FLAP :		2500.0	500.0	34.893	98.6	105.6	105.7						
TOTAL :		2500.0	500.0	34.893	100.9	106.1	106.5						
GEOM:	19	3670.8	0.0	232.0	1294.0	156.8	184.9	157.2	101.5	34.88	36.01	85.0	148.6
FAN :		2500.0	500.0	36.011	74.3	87.9	90.6						
CORE :		2500.0	500.0	36.011	77.4	86.5	86.5						
TURB :		2500.0	500.0	36.011	62.4	74.0	74.0						
FLAP :		2500.0	500.0	36.011	97.8	104.8	104.8						
TOTAL :		2500.0	500.0	36.011	99.9	105.0	105.3						
GEOM:	20	3818.5	0.0	247.8	1431.8	158.9	185.5	159.5	104.3	35.88	37.13	85.0	148.6
FAN :		2500.0	500.0	37.132	72.6	86.3	89.0						
CORE :		2500.0	500.0	37.132	76.5	85.5	85.6						
TURB :		2500.0	500.0	37.132	60.4	72.0	72.0						
FLAP :		2500.0	500.0	37.132	96.9	103.9	104.0						
TOTAL :		2500.0	500.0	37.132	99.0	103.9	104.2						
GEOM:	21	3966.3	0.0	263.5	1571.5	160.6	185.9	161.4	107.1	36.88	38.25	85.0	148.6
FAN :		2500.0	500.0	38.254	71.2	84.9	87.7						
CORE :		2500.0	500.0	38.254	75.6	84.7	84.7						
TURB :		2500.0	500.0	38.254	58.7	70.3	70.3						
FLAP :		2500.0	500.0	38.254	96.1	103.1	103.2						
TOTAL :		2500.0	500.0	38.254	98.1	102.8	103.2						
GEOM:	1	1048.6	0.0	0.0	1762.5	35.8	10.0	35.0	75.9	16.88	18.42	85.0	124.2
FAN :		2500.0	1000.0	18.421	78.9	92.8	95.9						
CORE :		2500.0	1000.0	18.421	66.4	75.2	75.2						
TURB :		2500.0	1000.0	18.421	54.3	65.8	65.8						
FLAP :		2500.0	1000.0	18.421	80.9	86.2	86.3						
TOTAL :		2500.0	1000.0	18.421	83.3	89.0	92.2						
GEOM:	2	1176.6	0.0	0.0	1658.8	38.2	10.0	37.5	77.1	17.88	19.33	85.0	131.6
FAN :		2500.0	1000.0	19.330	79.5	93.4	96.5						
CORE :		2500.0	1000.0	19.330	67.2	76.1	76.1						
TURB :		2500.0	1000.0	19.330	55.8	67.3	67.4						
FLAP :		2500.0	1000.0	19.330	81.4	87.0	87.0						
TOTAL :		2500.0	1000.0	19.330	83.9	90.2	93.3						
GEOM:	3	1311.8	0.0	0.0	1553.0	41.1	10.0	40.5	78.3	18.88	20.24	85.0	139.0
FAN :		2500.0	1000.0	20.237	80.0	94.0	97.0						
CORE :		2500.0	1000.0	20.237	68.2	77.1	77.1						
TURB :		2500.0	1000.0	20.237	57.6	69.1	69.1						
FLAP :		2500.0	1000.0	20.237	82.1	87.8	87.8						
TOTAL :		2500.0	1000.0	20.237	84.6	91.3	94.4						
GEOM:	4	1454.5	0.0	0.0	1446.8	44.6	10.0	44.2	79.7	19.88	21.14	85.0	146.3
FAN :		2500.0	1000.0	21.145	80.2	94.3	97.3						
CORE :		2500.0	1000.0	21.145	69.4	78.3	78.4						
TURB :		2500.0	1000.0	21.145	59.6	71.2	71.2						
FLAP :		2500.0	1000.0	21.145	82.8	88.7	88.7						
TOTAL :		2500.0	1000.0	21.145	85.4	92.4	95.4						
GEOM:	5	1602.2	0.0	10.9	1344.0	50.2	16.8	49.3	75.5	20.88	22.05	85.0	148.6
FAN :		2500.0	1000.0	22.055	80.4	94.5	97.5						
CORE :		2500.0	1000.0	22.055	70.9	79.9	79.9						
TURB :		2500.0	1000.0	22.055	62.5	74.1	74.1						

TABLE VI. - Continued.

FLAP :		2500.0	1000.0	22.055	83.7	89.1	89.1						
TOTAL :		2500.0	1000.0	22.055	86.4	93.4	96.3						
GEOM:	6	1749.9	0.0	26.7	1250.3	55.2	18.1	54.5	76.8	21.88	22.97	85.0	148.6
FAN :		2500.0	1000.0	22.973	80.2	94.3	97.3						
CORE :		2500.0	1000.0	22.973	72.1	81.0	81.1						
TURB :		2500.0	1000.0	22.973	65.1	76.7	76.7						
FLAP :		2500.0	1000.0	22.973	84.5	90.2	90.2						
TOTAL :		2500.0	1000.0	22.973	87.3	94.2	97.0						
GEOM:	7	1897.7	0.0	42.5	1168.2	61.0	20.1	60.5	78.3	22.88	23.90	85.0	148.6
FAN :		2500.0	1000.0	23.901	79.8	93.9	96.8						
CORE :		2500.0	1000.0	23.901	73.2	82.2	82.2						
TURB :		2500.0	1000.0	23.901	67.9	79.5	79.6						
FLAP :		2500.0	1000.0	23.901	85.4	91.3	91.3						
TOTAL :		2500.0	1000.0	23.901	88.2	94.9	97.5						
GEOM:	8	2045.4	0.0	58.3	1100.0	67.5	23.4	67.2	79.7	23.88	24.84	85.0	148.6
FAN :		2500.0	1000.0	24.841	78.8	92.9	95.6						
CORE :		2500.0	1000.0	24.841	74.2	83.3	83.3						
TURB :		2500.0	1000.0	24.841	70.4	82.0	82.1						
FLAP :		2500.0	1000.0	24.841	86.2	92.2	92.3						
TOTAL :		2500.0	1000.0	24.841	89.0	95.3	97.6						
GEOM:	9	2193.2	0.0	74.1	1048.6	74.8	29.7	74.7	81.1	24.88	25.80	85.0	148.6
FAN :		2500.0	1000.0	25.797	78.1	92.1	94.8						
CORE :		2500.0	1000.0	25.797	75.3	84.3	84.4						
TURB :		2500.0	1000.0	25.797	73.0	84.7	84.7						
FLAP :		2500.0	1000.0	25.797	87.2	93.4	93.4						
TOTAL :		2500.0	1000.0	25.797	89.9	96.0	98.0						
GEOM:	10	2341.0	0.0	89.9	1016.5	82.8	45.6	82.7	82.6	25.88	26.77	85.0	148.6
FAN :		2500.0	1000.0	26.769	78.7	92.4	95.0						
CORE :		2500.0	1000.0	26.769	76.4	85.5	85.5						
TURB :		2500.0	1000.0	26.769	75.6	87.3	87.4						
FLAP :		2500.0	1000.0	26.769	87.5	93.9	93.9						
TOTAL :		2500.0	1000.0	26.769	90.3	96.8	98.6						
***** CLOSEST POINT OF APPROACH													
GEOM:	11	2488.7	0.0	105.7	1005.6	91.1	100.0	91.1	84.0	26.88	27.76	85.0	148.6
FAN :		2500.0	1000.0	27.759	80.3	93.8	96.3						
CORE :		2500.0	1000.0	27.759	77.6	86.7	86.8						
TURB :		2500.0	1000.0	27.759	78.2	89.9	89.9						
FLAP :		2500.0	1000.0	27.759	87.8	94.2	94.2						
TOTAL :		2500.0	1000.0	27.759	90.6	97.8	99.5						
*****													
GEOM:	12	2636.5	0.0	121.4	1016.5	99.3	154.4	99.4	85.5	27.88	28.77	85.0	148.6
FAN :		2500.0	1000.0	28.769	81.7	95.1	97.5						
CORE :		2500.0	1000.0	28.769	78.6	87.8	87.8						
TURB :		2500.0	1000.0	28.769	80.3	92.0	92.1						
FLAP :		2500.0	1000.0	28.769	77.7	84.0	84.1						
TOTAL :		2500.0	1000.0	28.769	84.3	95.6	97.4						
GEOM:	13	2784.2	0.0	137.2	1048.6	107.3	170.3	107.3	87.0	28.88	29.80	85.0	148.6
FAN :		2500.0	1000.0	29.797	82.7	96.1	98.6						
CORE :		2500.0	1000.0	29.797	79.0	88.2	88.2						
TURB :		2500.0	1000.0	29.797	81.2	92.9	92.9						
FLAP :		2500.0	1000.0	29.797	88.9	95.6	95.6						
TOTAL :		2500.0	1000.0	29.797	91.8	99.4	101.2						
GEOM:	14	2932.0	0.0	153.0	1100.0	114.6	176.6	114.6	88.4	29.88	30.84	85.0	148.6
FAN :		2500.0	1000.0	30.841	83.2	96.5	99.1						
CORE :		2500.0	1000.0	30.841	79.0	88.1	88.2						
TURB :		2500.0	1000.0	30.841	80.5	92.2	92.3						
FLAP :		2500.0	1000.0	30.841	94.3	101.2	101.2						
TOTAL :		2500.0	1000.0	30.841	96.7	102.7	104.3						
GEOM:	15	3079.7	0.0	168.8	1168.2	121.1	179.9	121.1	89.9	30.88	31.90	85.0	148.6
FAN :		2500.0	1000.0	31.901	83.2	96.5	99.1						

TABLE VI. - Continued.

CORE :	2500.0	1000.0	31.901	78.6	87.7	87.8						
TURB :	2500.0	1000.0	31.901	78.9	90.6	90.6						
FLAP :	2500.0	1000.0	31.901	97.6	104.6	104.7						
TOTAL :	2500.0	1000.0	31.901	99.9	105.5	106.9						
GEOM: 16	3227.5	0.0	184.6	1250.3	126.9	181.9	126.9	91.4	31.88	32.97	85.0	148.6
FAN :	2500.0	1000.0	32.973	82.7	95.9	98.5						
CORE :	2500.0	1000.0	32.973	78.0	87.1	87.2						
TURB :	2500.0	1000.0	32.973	76.2	87.9	87.9						
FLAP :	2500.0	1000.0	32.973	97.4	104.4	104.5						
TOTAL :	2500.0	1000.0	32.973	99.6	105.0	106.4						
GEOM: 17	3375.3	0.0	200.4	1344.0	131.8	183.2	131.9	92.9	32.88	34.05	85.0	148.6
FAN :	2500.0	1000.0	34.055	81.7	95.0	97.5						
CORE :	2500.0	1000.0	34.055	77.4	86.5	86.5						
TURB :	2500.0	1000.0	34.055	73.7	85.4	85.4						
FLAP :	2500.0	1000.0	34.055	96.9	103.9	104.0						
TOTAL :	2500.0	1000.0	34.055	99.1	104.3	105.7						
GEOM: 18	3523.0	0.0	216.2	1446.8	136.1	184.2	136.2	94.3	33.88	35.14	85.0	148.6
FAN :	2500.0	1000.0	35.145	80.2	93.5	96.0						
CORE :	2500.0	1000.0	35.145	76.7	85.8	85.8						
TURB :	2500.0	1000.0	35.145	71.5	83.1	83.2						
FLAP :	2500.0	1000.0	35.145	96.4	103.4	103.5						
TOTAL :	2500.0	1000.0	35.145	98.5	103.6	104.8						
GEOM: 19	3670.8	0.0	232.0	1557.1	139.8	184.9	139.9	95.8	34.88	36.24	85.0	148.6
FAN :	2500.0	1000.0	36.241	78.9	92.2	94.7						
CORE :	2500.0	1000.0	36.241	76.0	85.1	85.1						
TURB :	2500.0	1000.0	36.241	69.5	81.1	81.2						
FLAP :	2500.0	1000.0	36.241	95.9	102.9	103.0						
TOTAL :	2500.0	1000.0	36.241	97.9	102.8	103.6						
GEOM: 20	3818.5	0.0	247.8	1673.3	143.0	185.5	143.2	97.3	35.88	37.34	85.0	148.6
FAN :	2500.0	1000.0	37.343	77.1	90.5	93.0						
CORE :	2500.0	1000.0	37.343	75.4	84.4	84.5						
TURB :	2500.0	1000.0	37.343	67.3	78.9	78.9						
FLAP :	2500.0	1000.0	37.343	95.3	102.3	102.4						
TOTAL :	2500.0	1000.0	37.343	97.3	102.0	102.7						
GEOM: 21	3966.3	0.0	263.5	1794.3	145.7	185.9	146.0	98.7	36.88	38.45	85.0	148.6
FAN :	2500.0	1000.0	38.448	75.5	88.9	91.5						
CORE :	2500.0	1000.0	38.448	74.7	83.7	83.8						
TURB :	2500.0	1000.0	38.448	65.2	76.9	76.9						
FLAP :	2500.0	1000.0	38.448	94.7	101.7	101.8						
TOTAL :	2500.0	1000.0	38.448	96.6	101.1	101.8						
GEOM: 1	1999.8	0.0	53.4	1582.2	25.6	18.1	19.3	46.9	23.57	24.95	85.0	148.6
FAN :	3500.0	500.0	24.954	79.6	93.4	96.5						
CORE :	3500.0	500.0	24.954	65.9	74.7	74.7						
TURB :	3500.0	500.0	24.954	51.2	62.5	62.5						
FLAP :	3500.0	500.0	24.954	83.3	87.1	87.1						
TOTAL :	3500.0	500.0	24.954	86.0	90.9	94.1						
GEOM: 2	2147.6	0.0	69.2	1443.5	27.5	19.0	21.3	48.6	24.57	25.83	85.0	148.6
FAN :	3500.0	500.0	25.833	80.4	94.2	97.4						
CORE :	3500.0	500.0	25.833	66.9	75.8	75.8						
TURB :	3500.0	500.0	25.833	52.8	64.1	64.1						
FLAP :	3500.0	500.0	25.833	84.1	87.9	88.0						
TOTAL :	3500.0	500.0	25.833	86.8	92.4	95.6						
GEOM: 3	2295.3	0.0	85.0	1307.1	29.8	20.1	23.8	50.3	25.57	26.71	85.0	148.6
FAN :	3500.0	500.0	26.714	81.3	95.1	98.3						
CORE :	3500.0	500.0	26.714	68.1	77.0	77.0						
TURB :	3500.0	500.0	26.714	54.6	66.0	66.0						
FLAP :	3500.0	500.0	26.714	85.0	88.8	88.9						
TOTAL :	3500.0	500.0	26.714	87.7	94.0	97.1						
GEOM: 4	2443.1	0.0	100.8	1173.5	32.7	21.5	26.9	52.1	26.57	27.60	85.0	148.6
FAN :	3500.0	500.0	27.597	82.3	96.2	99.3						

TABLE VI. - Continued.

CORE :	3500.0	500.0	27.597	69.5	78.4	78.4						
TURB :	3500.0	500.0	27.597	56.6	68.1	68.2						
FLAP :	3500.0	500.0	27.597	85.8	89.7	89.8						
TOTAL :	3500.0	500.0	27.597	88.7	95.6	98.8						
GEOM: 5	2590.9	0.0	116.6	1044.1	36.3	23.4	30.7	53.9	27.57	28.48	85.0	148.6
FAN :	3500.0	500.0	28.484	83.4	97.3	100.4						
CORE :	3500.0	500.0	28.484	71.0	79.9	80.0						
TURB :	3500.0	500.0	28.484	59.1	70.7	70.7						
FLAP :	3500.0	500.0	28.484	86.7	90.7	90.7						
TOTAL :	3500.0	500.0	28.484	89.7	97.4	100.5						
GEOM: 6	2738.6	0.0	132.4	920.4	41.0	26.0	35.7	55.9	28.57	29.38	85.0	148.6
FAN :	3500.0	500.0	29.376	84.5	98.5	101.5						
CORE :	3500.0	500.0	29.376	72.8	81.7	81.8						
TURB :	3500.0	500.0	29.376	62.1	73.7	73.7						
FLAP :	3500.0	500.0	29.376	87.7	91.7	91.8						
TOTAL :	3500.0	500.0	29.376	90.8	99.2	102.2						
GEOM: 7	2886.4	0.0	148.1	805.3	47.1	29.7	42.4	58.0	29.57	30.28	85.0	148.6
FAN :	3500.0	500.0	30.275	85.1	99.2	102.2						
CORE :	3500.0	500.0	30.275	74.9	83.9	84.0						
TURB :	3500.0	500.0	30.275	65.7	77.3	77.3						
FLAP :	3500.0	500.0	30.275	88.7	92.8	92.9						
TOTAL :	3500.0	500.0	30.275	92.0	100.7	103.7						
GEOM: 8	3034.1	0.0	163.9	702.8	55.1	35.5	51.2	60.2	30.57	31.19	85.0	148.6
FAN :	3500.0	500.0	31.186	85.2	99.3	102.3						
CORE :	3500.0	500.0	31.186	77.0	86.1	86.2						
TURB :	3500.0	500.0	31.186	70.1	81.7	81.7						
FLAP :	3500.0	500.0	31.186	89.6	93.6	93.7						
TOTAL :	3500.0	500.0	31.186	92.9	101.7	104.6						
GEOM: 9	3181.9	0.0	179.7	619.3	65.6	45.6	62.9	62.4	31.57	32.11	85.0	148.6
FAN :	3500.0	500.0	32.113	84.2	98.3	101.0						
CORE :	3500.0	500.0	32.113	79.1	88.2	88.3						
TURB :	3500.0	500.0	32.113	74.8	86.5	86.5						
FLAP :	3500.0	500.0	32.113	90.2	94.3	94.4						
TOTAL :	3500.0	500.0	32.113	93.6	102.0	104.5						
GEOM: 10	3329.7	0.0	195.5	563.2	78.8	65.0	77.7	64.8	32.57	33.06	85.0	148.6
FAN :	3500.0	500.0	33.064	83.5	97.3	99.9						
CORE :	3500.0	500.0	33.064	81.1	90.2	90.3						
TURB :	3500.0	500.0	33.064	79.6	91.3	91.3						
FLAP :	3500.0	500.0	33.064	89.9	94.0	94.1						
TOTAL :	3500.0	500.0	33.064	93.5	102.3	104.3						
***** CLOSEST POINT OF APPROACH												
GEOM: 11	3477.4	0.0	211.3	543.3	93.9	100.0	94.2	67.3	33.57	34.05	85.0	148.6
FAN :	3500.0	500.0	34.046	86.1	99.6	102.1						
CORE :	3500.0	500.0	34.046	83.4	92.5	92.6						
TURB :	3500.0	500.0	34.046	84.3	96.0	96.1						
FLAP :	3500.0	500.0	34.046	90.9	95.4	95.5						
TOTAL :	3500.0	500.0	34.046	94.8	104.7	106.5						
*****												
GEOM: 12	3625.2	0.0	227.1	563.2	109.0	135.0	110.1	69.8	34.57	35.06	85.0	148.6
FAN :	3500.0	500.0	35.064	88.4	101.7	104.3						
CORE :	3500.0	500.0	35.064	84.6	93.8	93.8						
TURB :	3500.0	500.0	35.064	86.8	98.5	98.6						
FLAP :	3500.0	500.0	35.064	85.2	89.9	90.0						
TOTAL :	3500.0	500.0	35.064	92.1	105.1	107.1						
GEOM: 13	3772.9	0.0	242.9	619.3	122.2	154.4	123.4	72.5	35.57	36.11	85.0	148.6
FAN :	3500.0	500.0	36.113	88.7	102.0	104.6						
CORE :	3500.0	500.0	36.113	84.1	93.3	93.4						
TURB :	3500.0	500.0	36.113	84.0	95.7	95.8						
FLAP :	3500.0	500.0	36.113	80.2	85.0	85.1						
TOTAL :	3500.0	500.0	36.113	90.1	103.9	106.1						

TABLE VI. - Continued.

GEOM:	14	3920.7	0.0	258.7	702.8	132.6	164.5	133.6	75.2	36.57	37.19	85.0	148.6
FAN :		3500.0	500.0	37.186	87.2	100.4	103.0						
CORE :		3500.0	500.0	37.186	83.0	92.2	92.3						
TURB :		3500.0	500.0	37.186	79.0	90.8	90.8						
FLAP :		3500.0	500.0	37.186	85.7	91.2	91.2						
TOTAL :		3500.0	500.0	37.186	90.8	102.6	104.9						
GEOM:	15	4068.5	0.0	274.5	805.3	140.6	170.3	141.2	78.0	37.57	38.28	85.0	148.6
FAN :		3500.0	500.0	38.275	84.3	97.6	100.2						
CORE :		3500.0	500.0	38.275	81.7	90.9	91.0						
TURB :		3500.0	500.0	38.275	74.8	86.5	86.5						
FLAP :		3500.0	500.0	38.275	90.0	96.0	96.0						
TOTAL :		3500.0	500.0	38.275	93.3	101.5	103.7						
GEOM:	16	4216.2	0.0	290.3	920.4	146.6	174.0	147.0	80.9	38.57	39.38	85.0	148.6
FAN :		3500.0	500.0	39.376	80.9	94.3	97.0						
CORE :		3500.0	500.0	39.376	80.5	89.6	89.7						
TURB :		3500.0	500.0	39.376	70.6	82.2	82.2						
FLAP :		3500.0	500.0	39.376	92.4	98.7	98.7						
TOTAL :		3500.0	500.0	39.376	95.1	100.8	102.6						
GEOM:	17	4364.0	0.0	306.0	1044.1	151.2	176.6	151.3	83.8	39.57	40.48	85.0	148.6
FAN :		3500.0	500.0	40.484	78.2	91.7	94.3						
CORE :		3500.0	500.0	40.484	79.3	88.5	88.5						
TURB :		3500.0	500.0	40.484	67.1	78.7	78.8						
FLAP :		3500.0	500.0	40.484	94.3	100.9	100.9						
TOTAL :		3500.0	500.0	40.484	96.8	102.0	103.3						
GEOM:	18	4511.7	0.0	321.8	1173.5	154.7	178.5	154.8	86.7	40.57	41.60	85.0	148.6
FAN :		3500.0	500.0	41.597	75.9	89.4	92.1						
CORE :		3500.0	500.0	41.597	78.3	87.4	87.4						
TURB :		3500.0	500.0	41.597	64.3	75.9	75.9						
FLAP :		3500.0	500.0	41.597	95.8	102.6	102.7						
TOTAL :		3500.0	500.0	41.597	98.1	103.2	103.8						
GEOM:	19	4659.5	0.0	337.6	1307.1	157.5	179.9	157.5	89.7	41.57	42.71	85.0	148.6
FAN :		3500.0	500.0	42.714	73.9	87.6	90.3						
CORE :		3500.0	500.0	42.714	77.3	86.4	86.4						
TURB :		3500.0	500.0	42.714	61.9	73.5	73.5						
FLAP :		3500.0	500.0	42.714	97.0	104.0	104.0						
TOTAL :		3500.0	500.0	42.714	99.1	104.1	104.5						
GEOM:	20	4807.2	0.0	353.4	1443.5	159.7	181.0	159.7	92.6	42.57	43.83	85.0	148.6
FAN :		3500.0	500.0	43.833	72.3	86.0	88.7						
CORE :		3500.0	500.0	43.833	76.4	85.5	85.5						
TURB :		3500.0	500.0	43.833	59.9	71.5	71.5						
FLAP :		3500.0	500.0	43.833	96.4	103.4	103.5						
TOTAL :		3500.0	500.0	43.833	98.5	103.4	103.7						
GEOM:	21	4955.0	0.0	369.2	1582.2	161.5	181.9	161.6	95.6	43.57	44.95	85.0	148.6
FAN :		3500.0	500.0	44.954	70.8	84.5	87.3						
CORE :		3500.0	500.0	44.954	75.6	84.6	84.7						
TURB :		3500.0	500.0	44.954	58.2	69.7	69.8						
FLAP :		3500.0	500.0	44.954	95.8	102.8	102.8						
TOTAL :		3500.0	500.0	44.954	97.8	102.4	102.8						
GEOM:	1	1999.8	0.0	53.4	1803.7	37.7	18.1	35.0	65.0	23.57	25.15	85.0	148.6
FAN :		3500.0	1000.0	25.148	78.7	92.6	95.7						
CORE :		3500.0	1000.0	25.148	66.4	75.2	75.3						
TURB :		3500.0	1000.0	25.148	54.9	66.4	66.4						
FLAP :		3500.0	1000.0	25.148	81.3	84.8	84.9						
TOTAL :		3500.0	1000.0	25.148	83.9	88.5	91.6						
GEOM:	2	2147.6	0.0	69.2	1683.4	40.5	19.0	38.0	66.2	24.57	26.04	85.0	148.6
FAN :		3500.0	1000.0	26.043	79.3	93.3	96.4						
CORE :		3500.0	1000.0	26.043	67.4	76.3	76.3						
TURB :		3500.0	1000.0	26.043	56.6	68.1	68.2						
FLAP :		3500.0	1000.0	26.043	81.8	85.7	85.8						
TOTAL :		3500.0	1000.0	26.043	84.5	89.8	92.9						

TABLE VI. - Continued.

GEOM:	3	2295.3	0.0	85.0	1567.9	43.7	20.1	41.4	67.4	25.57	26.94	85.0	148.6
FAN	:	3500.0	1000.0	26.942	79.6	93.7	96.7						
CORE	:	3500.0	1000.0	26.942	68.6	77.4	77.5						
TURB	:	3500.0	1000.0	26.942	58.5	70.1	70.1						
FLAP	:	3500.0	1000.0	26.942	82.5	86.6	86.7						
TOTAL	:	3500.0	1000.0	26.942	85.2	90.9	94.0						
GEOM:	4	2443.1	0.0	100.8	1458.5	47.4	21.5	45.4	68.7	26.57	27.85	85.0	148.6
FAN	:	3500.0	1000.0	27.846	79.9	94.0	97.1						
CORE	:	3500.0	1000.0	27.846	69.8	78.7	78.7						
TURB	:	3500.0	1000.0	27.846	60.6	72.2	72.2						
FLAP	:	3500.0	1000.0	27.846	83.0	87.4	87.5						
TOTAL	:	3500.0	1000.0	27.846	85.8	92.0	95.0						
GEOM:	5	2590.9	0.0	116.6	1356.5	51.7	23.4	49.9	70.0	27.57	28.76	85.0	148.6
FAN	:	3500.0	1000.0	28.757	80.0	94.2	97.2						
CORE	:	3500.0	1000.0	28.757	71.0	79.9	80.0						
TURB	:	3500.0	1000.0	28.757	63.0	74.6	74.6						
FLAP	:	3500.0	1000.0	28.757	83.7	88.3	88.4						
TOTAL	:	3500.0	1000.0	28.757	86.5	93.0	95.9						
GEOM:	6	2738.6	0.0	132.4	1263.8	56.6	26.0	55.2	71.3	28.57	29.68	85.0	148.6
FAN	:	3500.0	1000.0	29.676	79.9	94.0	96.9						
CORE	:	3500.0	1000.0	29.676	72.1	81.1	81.1						
TURB	:	3500.0	1000.0	29.676	65.6	77.2	77.2						
FLAP	:	3500.0	1000.0	29.676	84.4	89.3	89.3						
TOTAL	:	3500.0	1000.0	29.676	87.3	93.7	96.5						
GEOM:	7	2886.4	0.0	148.1	1182.6	62.4	29.7	61.3	72.6	29.57	30.61	85.0	148.6
FAN	:	3500.0	1000.0	30.605	79.3	93.4	96.3						
CORE	:	3500.0	1000.0	30.605	73.2	82.2	82.3						
TURB	:	3500.0	1000.0	30.605	68.2	79.9	79.9						
FLAP	:	3500.0	1000.0	30.605	85.1	90.3	90.3						
TOTAL	:	3500.0	1000.0	30.605	88.0	94.3	96.9						
GEOM:	8	3034.1	0.0	163.9	1115.3	68.9	35.5	68.1	74.0	30.57	31.55	85.0	148.6
FAN	:	3500.0	1000.0	31.546	78.4	92.5	95.3						
CORE	:	3500.0	1000.0	31.546	74.2	83.3	83.3						
TURB	:	3500.0	1000.0	31.546	70.7	82.3	82.3						
FLAP	:	3500.0	1000.0	31.546	85.7	91.0	91.1						
TOTAL	:	3500.0	1000.0	31.546	88.5	94.6	97.0						
GEOM:	9	3181.9	0.0	179.7	1064.7	76.1	45.6	75.7	75.4	31.57	32.50	85.0	148.6
FAN	:	3500.0	1000.0	32.502	77.9	91.9	94.6						
CORE	:	3500.0	1000.0	32.502	75.3	84.3	84.4						
TURB	:	3500.0	1000.0	32.502	73.2	84.9	84.9						
FLAP	:	3500.0	1000.0	32.502	86.0	91.5	91.6						
TOTAL	:	3500.0	1000.0	32.502	88.9	95.0	97.1						
GEOM:	10	3329.7	0.0	195.5	1033.1	83.9	65.0	83.8	76.8	32.57	33.47	85.0	148.6
FAN	:	3500.0	1000.0	33.474	78.7	92.4	95.0						
CORE	:	3500.0	1000.0	33.474	76.4	85.5	85.5						
TURB	:	3500.0	1000.0	33.474	75.8	87.5	87.6						
FLAP	:	3500.0	1000.0	33.474	85.4	91.1	91.2						
TOTAL	:	3500.0	1000.0	33.474	88.5	95.5	97.4						
***** CLOSEST POINT OF APPROACH													
GEOM:	11	3477.4	0.0	211.3	1022.3	92.1	100.0	92.1	78.2	33.57	34.46	85.0	148.6
FAN	:	3500.0	1000.0	34.465	80.3	93.8	96.3						
CORE	:	3500.0	1000.0	34.465	77.6	86.7	86.8						
TURB	:	3500.0	1000.0	34.465	78.3	90.0	90.0						
FLAP	:	3500.0	1000.0	34.465	86.4	92.3	92.3						
TOTAL	:	3500.0	1000.0	34.465	89.5	97.0	98.8						
*****													
GEOM:	12	3625.2	0.0	227.1	1033.1	100.2	135.0	100.4	79.6	34.57	35.47	85.0	148.6
FAN	:	3500.0	1000.0	35.474	81.7	95.1	97.5						
CORE	:	3500.0	1000.0	35.474	78.6	87.7	87.8						
TURB	:	3500.0	1000.0	35.474	80.4	92.1	92.1						

TABLE VI. - Continued.

FLAP :	3500.0	1000.0	35.474	81.0	86.9	86.9						
TOTAL :	3500.0	1000.0	35.474	85.8	96.1	98.0						
GEOM: 13	3772.9	0.0	242.9	1064.7	108.0	154.4	108.2	81.0	35.57	36.50	85.0	148.6
FAN :	3500.0	1000.0	36.502	82.7	96.1	98.6						
CORE :	3500.0	1000.0	36.502	79.0	88.1	88.1						
TURB :	3500.0	1000.0	36.502	81.1	92.9	92.9						
FLAP :	3500.0	1000.0	36.502	76.4	82.2	82.2						
TOTAL :	3500.0	1000.0	36.502	84.1	95.8	97.8						
GEOM: 14	3920.7	0.0	258.7	1115.3	115.3	164.5	115.5	82.5	36.57	37.55	85.0	148.6
FAN :	3500.0	1000.0	37.546	83.1	96.4	99.0						
CORE :	3500.0	1000.0	37.546	78.9	88.0	88.1						
TURB :	3500.0	1000.0	37.546	80.3	92.0	92.1						
FLAP :	3500.0	1000.0	37.546	82.4	88.6	88.6						
TOTAL :	3500.0	1000.0	37.546	86.7	96.7	98.8						
GEOM: 15	4068.5	0.0	274.5	1182.6	121.7	170.3	121.9	83.9	37.57	38.61	85.0	148.6
FAN :	3500.0	1000.0	38.605	83.1	96.4	99.0						
CORE :	3500.0	1000.0	38.605	78.5	87.6	87.7						
TURB :	3500.0	1000.0	38.605	78.5	90.3	90.3						
FLAP :	3500.0	1000.0	38.605	87.3	93.7	93.8						
TOTAL :	3500.0	1000.0	38.605	90.2	97.9	100.0						
GEOM: 16	4216.2	0.0	290.3	1263.8	127.5	174.0	127.5	85.4	38.57	39.68	85.0	148.6
FAN :	3500.0	1000.0	39.676	82.6	95.8	98.4						
CORE :	3500.0	1000.0	39.676	77.9	87.0	87.1						
TURB :	3500.0	1000.0	39.676	75.9	87.6	87.6						
FLAP :	3500.0	1000.0	39.676	90.1	96.7	96.7						
TOTAL :	3500.0	1000.0	39.676	92.6	98.5	100.6						
GEOM: 17	4364.0	0.0	306.0	1356.5	132.4	176.6	132.5	86.9	39.57	40.76	85.0	148.6
FAN :	3500.0	1000.0	40.757	81.5	94.8	97.3						
CORE :	3500.0	1000.0	40.757	77.3	86.4	86.4						
TURB :	3500.0	1000.0	40.757	73.4	85.1	85.1						
FLAP :	3500.0	1000.0	40.757	92.3	99.1	99.1						
TOTAL :	3500.0	1000.0	40.757	94.6	99.9	101.8						
GEOM: 18	4511.7	0.0	321.8	1458.5	136.7	178.5	136.7	88.4	40.57	41.85	85.0	148.6
FAN :	3500.0	1000.0	41.846	80.1	93.3	95.9						
CORE :	3500.0	1000.0	41.846	76.6	85.7	85.8						
TURB :	3500.0	1000.0	41.846	71.2	82.9	82.9						
FLAP :	3500.0	1000.0	41.846	94.0	100.9	100.9						
TOTAL :	3500.0	1000.0	41.846	96.1	101.2	102.7						
GEOM: 19	4659.5	0.0	337.6	1567.9	140.4	179.9	140.4	89.8	41.57	42.94	85.0	148.6
FAN :	3500.0	1000.0	42.942	78.6	91.9	94.5						
CORE :	3500.0	1000.0	42.942	76.0	85.0	85.1						
TURB :	3500.0	1000.0	42.942	69.1	80.8	80.8						
FLAP :	3500.0	1000.0	42.942	95.2	102.2	102.3						
TOTAL :	3500.0	1000.0	42.942	97.2	102.1	102.9						
GEOM: 20	4807.2	0.0	353.4	1683.4	143.5	181.0	143.6	91.3	42.57	44.04	85.0	148.6
FAN :	3500.0	1000.0	44.043	76.8	90.2	92.8						
CORE :	3500.0	1000.0	44.043	75.3	84.3	84.4						
TURB :	3500.0	1000.0	44.043	66.9	78.5	78.6						
FLAP :	3500.0	1000.0	44.043	94.9	101.9	101.9						
TOTAL :	3500.0	1000.0	44.043	96.8	101.5	102.2						
GEOM: 21	4955.0	0.0	369.2	1803.7	146.3	181.9	146.3	92.8	43.57	45.15	85.0	148.6
FAN :	3500.0	1000.0	45.148	75.2	88.6	91.2						
CORE :	3500.0	1000.0	45.148	74.7	83.7	83.7						
TURB :	3500.0	1000.0	45.148	64.9	76.5	76.5						
FLAP :	3500.0	1000.0	45.148	94.4	101.4	101.5						
TOTAL :	3500.0	1000.0	45.148	96.3	100.8	101.5						

TABLE VI. - Concluded.

VALUES OF PNLT-MAX

XO , POS		YO POSITION 500.	1000.
1500.	LEVEL	115.0	107.7
	THETA	106.3	106.3
	TIME	21.64	23.10
2500.	LEVEL	110.9	106.9
	THETA	140.4	121.1
	TIME	31.57	31.90
3500.	LEVEL	107.1	102.9
	THETA	109.0	140.4
	TIME	35.06	42.94

TABLE VII. - OUTPUT FROM EXAMPLE THREE

This output is discussed in the text. It is included to illustrate a caution to the user when large changes in engine power settings occur.

```
                 QSRA LANDING AND TAKEOFF, ENGINE MAP FROM TEST DATA

 GEOMETRIC RELATIONS OF AIRCRAFT/OBSERVER
      KI    XI       YI       ZI       R        THETA  THETAF THETAH   PHI      TI      TAU     EPPI     VI
  GEOM:  1 -4309.7    0.0   567.4  2430.4      17.0   12.3   12.1   44.6     5.89    8.02     55.0   118.2
               TOTAL NOISE HISTORY AT EACH POINT
 SOURCE    XO       YO      TAU     OASPL     PNL     PNLT
TOTAL  : -2000.0  500.0  8.015    69.4     72.1    73.1
  GEOM:  2 -4192.5    0.0   552.0  2315.5      17.7   12.6   12.8   45.3     6.89    8.91     55.0   118.2
TOTAL  : -2000.0  500.0  8.915    69.9     73.0    74.0
  GEOM:  3 -4075.3    0.0   536.6  2201.1      18.4   13.0   13.5   46.0     7.89    9.81     55.0   118.2
TOTAL  : -2000.0  500.0  9.815    70.3     73.9    74.8
  GEOM:  4 -3958.1    0.0   521.1  2087.1      19.2   13.4   14.2   46.8     8.89   10.72     55.0   118.2
TOTAL  : -2000.0  500.0 10.715    70.8     74.8    75.7
  GEOM:  5 -3840.9    0.0   505.7  1973.5      20.1   13.9   15.1   47.6     9.89   11.62     55.0   118.2
TOTAL  : -2000.0  500.0 11.616    71.3     75.7    76.7
  GEOM:  6 -3723.8    0.0   490.3  1860.6      21.1   14.4   16.1   48.3    10.89   12.52     55.0   118.2
TOTAL  : -2000.0  500.0 12.517    71.8     76.7    77.6
  GEOM:  7 -3606.6    0.0   474.8  1748.3      22.2   15.0   17.2   49.1    11.89   13.42     55.0   118.2
TOTAL  : -2000.0  500.0 13.419    72.4     77.7    78.6
  GEOM:  8 -3489.4    0.0   459.4  1636.9      23.5   15.6   18.4   50.0    12.89   14.32     55.0   118.2
TOTAL  : -2000.0  500.0 14.322    73.0     78.7    79.6
  GEOM:  9 -3372.2    0.0   444.0  1526.4      25.0   16.4   19.9   50.8    13.89   15.23     55.0   118.2
TOTAL  : -2000.0  500.0 15.225    73.6     79.7    80.6
  GEOM: 10 -3255.0    0.0   428.6  1417.3      26.7   17.4   21.6   51.7    14.89   16.13     55.0   118.2
TOTAL  : -2000.0  500.0 16.130    74.3     80.8    81.7
  GEOM: 11 -3137.8    0.0   413.1  1309.7      28.8   18.5   23.5   52.5    15.89   17.04     55.0   118.2
TOTAL  : -2000.0  500.0 17.036    75.0     82.0    83.3
  GEOM: 12 -3020.6    0.0   397.7  1204.1      31.1   19.8   25.9   53.4    16.89   17.94     55.0   118.2
TOTAL  : -2000.0  500.0 17.943    75.7     83.2    84.4
  GEOM: 13 -2903.4    0.0   382.3  1101.1      34.0   21.4   28.7   54.4    17.89   18.85     55.0   118.2
TOTAL  : -2000.0  500.0 18.853    76.5     84.5    85.7
  GEOM: 14 -2786.2    0.0   366.8  1001.4      37.4   23.5   32.1   55.3    18.89   19.77     55.0   118.2
TOTAL  : -2000.0  500.0 19.766    77.4     85.8    87.0
  GEOM: 15 -2669.1    0.0   351.4   906.2      41.6   26.2   36.4   56.3    19.89   20.68     55.0   118.2
TOTAL  : -2000.0  500.0 20.683    78.3     87.0    88.2
  GEOM: 16 -2551.9    0.0   336.0   817.0      46.7   29.8   41.7   57.3    20.89   21.60     55.0   118.2
TOTAL  : -2000.0  500.0 21.605    79.2     87.9    89.1
  GEOM: 17 -2434.7    0.0   320.5   736.0      53.0   34.9   48.5   58.3    21.89   22.53     55.0   118.2
TOTAL  : -2000.0  500.0 22.534    80.0     88.6    89.8
  GEOM: 18 -2317.5    0.0   305.1   666.3      60.8   42.4   56.9   59.3    22.89   23.47     55.0   118.2
TOTAL  : -2000.0  500.0 23.473    80.7     89.2    90.3
  GEOM: 19 -2200.3    0.0   289.7   611.6      70.1   53.8   67.4   60.4    23.89   24.43     55.0   118.2
TOTAL  : -2000.0  500.0 24.425    81.4     90.0    90.9
  GEOM: 20 -2083.1    0.0   274.3   576.3      81.0   71.6   79.8   61.5    24.89   25.39     55.0   118.2
TOTAL  : -2000.0  500.0 25.394    82.1     91.7    92.2
***** CLOSEST POINT OF APPROACH
  GEOM: 21 -1965.9    0.0   258.8   564.1      92.8   96.0   93.1   62.6    25.89   26.38     55.0   118.2
TOTAL  : -2000.0  500.0 26.384    82.6     93.9    94.3
*****
  GEOM: 22 -1848.7    0.0   243.4   576.3     104.6  120.4  106.2   63.7    26.89   27.39     55.0   118.2
TOTAL  : -2000.0  500.0 27.394    83.1     95.3    95.7
  GEOM: 23 -1731.5    0.0   228.0   611.6     115.4  138.2  117.7   64.8    27.89   28.43     55.0   118.2
TOTAL  : -2000.0  500.0 28.425    84.7     95.9    96.3
  GEOM: 24 -1614.4    0.0   212.5   666.3     124.8  149.6  127.2   66.0    28.89   29.47     55.0   118.2
TOTAL  : -2000.0  500.0 29.473    85.9     95.2    96.2
  GEOM: 25 -1497.2    0.0   197.1   736.0     132.5  157.1  134.9   67.2    29.89   30.53     55.0   118.2
TOTAL  : -2000.0  500.0 30.534    86.0     94.0    95.0
```

TABLE VII. - Concluded.

GEOM:	26	-1380.0	0.0	181.7	817.0	138.8	162.2	140.9	68.4	30.89	31.60	55.0	118.2
TOTAL :		-2000.0	500.0	31.605	85.6	92.3	93.3						
GEOM:	27	-1262.8	0.0	166.3	906.2	143.9	165.8	145.7	69.6	31.89	32.68	55.0	118.2
TOTAL :		-2000.0	500.0	32.683	84.9	90.4	91.5						
GEOM:	28	-1145.6	0.0	150.8	1001.4	148.1	168.5	149.5	70.9	32.89	33.77	55.0	118.2
TOTAL :		-2000.0	500.0	33.766	84.3	88.7	89.9						
GEOM:	29	-1028.4	0.0	135.4	1101.1	151.5	170.6	152.7	72.2	33.89	34.85	55.0	118.2
TOTAL :		-2000.0	500.0	34.853	83.6	87.6	88.7						
GEOM:	30	-911.2	0.0	120.0	1204.1	154.3	172.2	155.3	73.5	34.89	35.94	55.0	118.2
TOTAL :		-2000.0	500.0	35.943	83.0	86.6	87.3						
GEOM:	31	-794.0	0.0	104.5	1309.7	156.7	173.5	157.4	74.8	35.89	37.04	55.0	118.2
TOTAL :		-2000.0	500.0	37.036	82.4	85.7	86.4						
GEOM:	32	-676.8	0.0	89.1	1417.3	158.7	174.6	159.3	76.1	36.89	38.13	55.0	118.2
TOTAL :		-2000.0	500.0	38.130	81.8	84.9	85.6						
GEOM:	33	-559.7	0.0	73.7	1526.4	160.4	175.6	160.8	77.4	37.89	39.23	55.0	118.2
TOTAL :		-2000.0	500.0	39.225	81.2	84.1	84.8						
GEOM:	34	-442.5	0.0	58.3	1636.9	161.9	176.4	162.2	78.8	38.89	40.32	55.0	118.2
TOTAL :		-2000.0	500.0	40.322	80.7	83.3	84.0						
GEOM:	35	-325.3	0.0	42.8	1748.3	163.1	177.0	163.4	80.2	39.89	41.42	55.0	118.2
TOTAL :		-2000.0	500.0	41.419	80.2	82.6	83.3						
GEOM:	36	-208.1	0.0	27.4	1860.6	164.2	177.6	164.4	81.5	40.89	42.52	55.0	118.2
TOTAL :		-2000.0	500.0	42.517	79.7	82.0	82.7						
GEOM:	37	-90.9	0.0	12.0	1973.5	165.2	178.1	165.3	82.9	41.89	43.62	55.0	118.2
TOTAL :		-2000.0	500.0	43.616	79.3	81.4	82.1						
GEOM:	38	26.6	0.0	0.0	2087.3	163.0	190.0	165.9	125.1	42.89	44.72	85.0	118.8
TOTAL :		-2000.0	500.0	44.715	95.3	99.4	99.8						
GEOM:	39	146.7	0.0	0.0	2204.2	163.6	190.0	166.7	126.7	43.89	45.82	85.0	121.5
TOTAL :		-2000.0	500.0	45.818	94.7	98.8	99.2						
GEOM:	40	269.6	0.0	0.0	2324.0	164.1	190.0	167.4	128.2	44.89	46.92	85.0	124.2
TOTAL :		-2000.0	500.0	46.922	94.2	98.1	98.5						
GEOM:	41	395.2	0.0	0.0	2446.8	164.6	190.0	168.0	129.8	45.89	48.03	85.0	126.9
TOTAL :		-2000.0	500.0	48.030	93.6	97.5	97.9						

TABLE VIII. - OUTPUT FROM EXAMPLE FOUR

QSRA (YF102) NOISE: SINGLE ENGINE, NO FLAPS, NO ATTENUATION

ENGINE PERFORMANCE PARAMETER = 37.78

FAN NOISE SPECTRA
1 ENGINE(S) AT A CONSTANT RADIUS OF 100.0 FEET, IN THE PLANE OF PHI = 0.0 DEGREES

INPUT PARAMETERS: FAN SPEED = 2796. RPM; FAN MASS FLOW (WAFAN) □ 97.4 LB/S; FAN DIAMETER (FANDIA) □ 3.392 FT;
TIP REL MACH NO.(TIPM) = 0.473; DESIGN REL TIP MACH (TIPMD) = 1.240; TEMP RISE (DELT) = 9.4 DEG R;
PRESS RATIO(1 STAGE)(FPR) = 1.054; NO. BLADES(NBL) □ 40; NO. VANES(NVAN) □ 85; ROTOR/STATOR SPACING (RSS) □ 275. %;
NO. STAGES(NSTG) = 1; STAGE EFF (FANEFF) =0.840; INLET GUIDE VANES (IGV) =0; INLET FLOW DISTOR (IFD) =1;
EXHAUST NOISE OPTION (IEXH) =2; NO. OF TONE HARM CALC (NH) □ 5; AIR GAMMAF = 1.40; FAN HUB DIAM(FANHUB) = 1.450 FT.

	POLAR ANGLE, THETA, DEGREES																			POWER LEVEL
FREQ	0.0	10.0	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	170.0	180.0	
50	-1.3	-0.3	0.7	0.7	0.7	-1.2	-3.4	-4.8	-4.5	-2.5	-0.4	1.0	1.9	2.2	0.2	-3.8	-7.8	-12.8	-17.8	50.3
63	5.8	6.8	7.8	7.8	7.8	5.9	3.7	2.3	2.6	4.6	6.7	8.1	9.0	9.3	7.3	3.3	-0.7	-5.7	-10.7	57.4
79	12.5	13.5	14.5	14.6	14.6	12.6	10.5	9.0	9.4	11.3	13.4	14.9	15.7	16.0	14.0	10.0	6.0	1.0	-4.0	64.1
99	18.9	19.9	20.9	20.9	20.9	19.0	16.8	15.3	15.7	17.7	19.8	21.2	22.1	22.4	20.4	16.4	12.4	7.4	2.4	70.5
125	24.9	25.9	26.9	26.9	26.9	25.0	22.8	21.3	21.7	23.7	25.8	27.2	28.1	28.4	26.4	22.4	18.4	13.4	8.4	76.5
158	30.5	31.5	32.5	32.5	32.5	30.6	28.5	27.0	27.3	29.3	31.4	32.8	33.7	34.0	32.0	28.0	24.0	19.0	14.0	82.1
199	35.8	36.8	37.8	37.8	37.8	35.9	33.7	32.2	32.6	34.6	36.6	38.1	39.0	39.3	37.3	33.3	29.3	24.3	19.3	87.4
251	40.6	41.7	42.7	42.7	42.7	40.7	38.6	37.1	37.5	39.4	41.5	43.0	43.9	44.1	42.1	38.1	34.1	29.1	24.1	92.2
316	45.2	46.2	47.2	47.2	47.2	45.3	43.1	41.6	42.0	44.0	46.0	47.5	48.4	48.7	46.7	42.7	38.7	33.7	28.7	96.8
398	49.3	50.3	51.3	51.3	51.3	49.4	47.2	45.7	46.1	48.1	50.2	51.6	52.5	52.8	50.8	46.8	42.8	37.8	32.8	100.9
501	53.1	54.1	55.1	55.1	55.1	53.2	51.0	49.5	49.9	51.9	53.9	55.4	56.3	56.6	54.6	50.6	46.6	41.6	36.6	104.7
630	56.5	57.5	58.5	58.5	58.5	56.6	54.4	52.9	53.3	55.3	57.3	58.8	59.7	60.0	58.0	54.0	50.0	45.0	40.0	108.1
794	59.5	60.5	61.5	61.5	61.5	59.6	57.4	55.9	56.3	58.3	60.4	61.8	62.7	63.0	61.0	57.0	53.0	48.0	43.0	111.1
999	62.2	63.2	64.2	64.2	64.2	62.3	60.1	58.6	59.0	61.0	63.0	64.5	65.4	65.7	63.7	59.7	55.7	50.7	45.7	113.7
1258	64.4	65.4	66.4	66.5	66.5	64.5	62.4	60.9	61.3	63.2	65.3	66.8	67.6	67.9	65.9	61.9	57.9	52.9	47.9	116.0
1584	66.4	67.4	68.4	68.4	68.4	66.5	64.3	62.8	63.2	65.2	67.2	68.7	69.6	69.9	67.9	63.9	59.9	54.9	49.9	118.0
1995	75.3	76.7	78.2	78.2	78.2	76.9	74.6	71.9	70.0	70.4	71.8	73.3	74.2	74.4	72.4	68.6	64.9	60.5	55.5	125.2
2511	69.1	70.1	71.1	71.1	71.1	69.2	67.0	65.5	65.9	67.9	70.0	71.4	72.3	72.6	70.6	66.6	62.6	57.6	52.6	120.7
3162	69.9	70.9	71.9	71.9	71.9	70.0	67.8	66.3	66.7	68.7	70.8	72.2	73.1	73.4	71.4	67.4	63.4	58.4	53.4	121.5
3981	74.0	75.3	76.6	76.6	76.7	75.2	73.2	71.5	71.6	73.6	75.4	77.2	78.2	78.3	76.3	72.6	68.9	64.6	59.6	126.4
5011	72.4	73.6	74.8	74.8	74.8	73.2	71.2	69.6	69.9	71.9	73.9	75.5	76.5	76.6	74.6	70.9	67.1	62.7	57.7	124.7
6309	70.1	71.1	72.1	72.1	72.1	70.2	68.0	66.5	66.9	68.9	71.0	72.4	73.3	73.6	71.6	67.6	63.6	58.6	53.6	121.7
7943	70.7	71.9	73.0	73.0	73.0	71.4	69.3	67.8	68.1	70.1	72.1	73.7	74.6	74.8	72.8	69.0	65.2	60.6	55.6	122.9
9999	69.3	70.4	71.5	71.5	71.5	69.7	67.6	66.1	66.5	68.5	70.5	72.1	73.0	73.2	71.2	67.3	63.5	58.8	53.8	121.2
OSPL	81.3	82.5	83.7	83.7	83.8	82.2	80.1	78.2	78.1	79.8	81.7	83.3	84.2	84.4	82.4	78.6	74.8	70.2	65.2	132.9
PNL	94.4	95.6	96.8	96.8	96.9	95.3	93.2	91.5	91.6	93.5	95.4	97.0	98.0	98.1	96.1	92.4	88.6	84.1	79.1	
PNLT	97.0	98.3	99.6	99.6	99.7	98.3	96.2	94.1	93.4	94.8	96.4	98.1	99.1	99.2	97.2	93.5	89.8	85.5	80.5	

TABLE VIII. - Continued.

QSRA (YF102) NOISE: SINGLE ENGINE, NO FLAPS, NO ATTENUATION

ENGINE PERFORMANCE PARAMETER = 37.78

JET NOISE SPECTRA
1 ENGINE(S) AT A CONSTANT RADIUS OF 100.0 FEET, IN THE PLANE OF PHI = 0.0 DEGREES

INPUT PARAMETERS: NOZZLE TYPE(SIMPLE=0,COAX=1)(INOZ) =1; IPLUG=0; ISLOT=0; FWD VEL EFFECTS(IFWD)=0;

	AREA(SQ FT)	VEL(FPS)	TEMP(R)	GAMMA	GAS CONST	DES MACH #	HYD DIA(FT)	ANNUL HT(FT)	FUEL (#/S)
CORE:	1.215	357.9	1212.2	1.360	53.380	1.000	0.000	0.000	0.000
FAN :	3.951	302.7	540.1	1.400	53.350	1.000	1.321	0.660	

POLAR ANGLE, THETA, DEGREES

FREQ	0.0	10.0	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	170.0	180.0	POWER LEVEL
50	58.2	58.2	58.2	58.3	58.5	58.7	58.8	59.1	59.3	59.6	59.8	60.1	60.3	60.7	62.1	64.1	66.0	66.8	64.4	111.6
63	58.8	58.8	58.9	59.0	59.2	59.4	59.6	59.8	60.1	60.4	60.7	60.9	61.2	61.8	63.0	64.8	66.3	66.7	63.4	112.3
79	59.2	59.2	59.3	59.4	59.6	59.9	60.1	60.4	60.7	61.0	61.4	61.7	61.9	62.6	63.8	65.1	66.1	65.9	61.8	112.8
99	59.4	59.5	59.6	59.7	59.9	60.2	60.4	60.8	61.1	61.5	61.9	62.2	62.5	63.2	64.2	65.1	65.4	64.5	60.1	113.0
125	59.6	59.6	59.7	59.9	60.1	60.4	60.7	61.0	61.4	61.8	62.2	62.6	62.9	63.6	64.5	64.9	64.5	63.0	58.3	113.2
158	59.5	59.5	59.6	59.8	60.1	60.4	60.7	61.1	61.5	61.9	62.4	62.8	63.2	63.8	64.5	64.4	63.4	61.5	56.8	113.2
199	59.2	59.2	59.4	59.6	59.8	60.2	60.5	60.9	61.4	61.9	62.4	62.8	63.3	63.9	64.3	63.8	62.2	59.8	54.8	113.0
251	58.8	58.8	58.9	59.1	59.4	59.8	60.2	60.6	61.1	61.7	62.2	62.7	63.2	63.7	63.9	62.9	60.8	58.0	52.5	112.7
316	58.2	58.2	58.4	58.6	58.9	59.3	59.7	60.2	60.7	61.2	61.8	62.4	62.9	63.3	63.3	61.9	59.3	56.3	50.5	112.2
398	57.5	57.5	57.7	57.9	58.2	58.6	59.0	59.5	60.1	60.7	61.3	61.9	62.4	62.8	62.5	60.8	57.9	54.6	48.6	111.6
501	56.6	56.7	56.9	57.1	57.4	57.9	58.3	58.8	59.4	60.0	60.6	61.2	61.8	62.1	61.5	59.6	56.5	53.0	46.7	110.8
630	55.6	55.7	55.9	56.1	56.4	56.9	57.4	57.9	58.6	59.2	59.9	60.5	61.1	61.3	60.5	58.2	54.9	51.3	44.8	110.0
794	54.6	54.7	54.8	55.1	55.4	55.9	56.4	56.9	57.6	58.2	58.9	59.6	60.3	60.4	59.4	56.9	53.5	49.5	42.8	109.0
999	53.5	53.6	53.7	54.0	54.3	54.8	55.3	55.9	56.5	57.2	57.9	58.6	59.3	59.3	58.2	55.6	52.0	47.8	40.9	107.9
1258	52.4	52.5	52.6	52.9	53.2	53.7	54.2	54.8	55.4	56.1	56.8	57.5	58.2	58.2	57.0	54.3	50.5	46.1	38.9	106.8
1584	51.3	51.4	51.5	51.8	52.1	52.6	53.1	53.7	54.3	55.0	55.7	56.4	57.1	57.0	55.8	53.0	49.1	44.4	37.0	105.7
1995	50.2	50.2	50.4	50.7	51.0	51.5	52.0	52.6	53.2	53.9	54.6	55.3	56.0	55.9	54.6	51.7	47.6	42.7	35.2	104.5
2511	49.0	49.0	49.2	49.5	49.8	50.3	50.8	51.4	52.1	52.8	53.5	54.2	54.9	54.8	53.4	50.4	46.1	41.0	33.3	103.4
3162	47.8	47.9	48.0	48.3	48.6	49.1	49.6	50.2	50.9	51.6	52.3	53.1	53.8	53.6	52.2	49.1	44.6	39.3	31.4	102.2
3981	46.6	46.7	46.8	47.1	47.5	47.9	48.5	49.1	49.7	50.4	51.2	51.9	52.6	52.4	51.0	47.8	43.1	37.6	29.5	101.0
5011	45.4	45.5	45.7	45.9	46.3	46.7	47.3	47.9	48.5	49.3	50.0	50.7	51.4	51.2	49.8	46.6	41.7	35.9	27.5	99.8
6309	44.3	44.3	44.5	44.7	45.1	45.6	46.1	46.7	47.4	48.1	48.8	49.5	50.2	50.1	48.6	45.3	40.2	34.2	25.6	98.7
7943	43.1	43.1	43.3	43.6	43.9	44.4	44.9	45.5	46.2	46.9	47.6	48.3	49.1	48.9	47.4	44.0	38.8	32.5	23.7	97.5
9999	41.9	41.9	42.1	42.4	42.7	43.2	43.7	44.3	45.0	45.7	46.4	47.2	47.9	47.7	46.2	42.7	37.4	30.9	21.8	96.3
OSPL	69.9	69.9	70.0	70.2	70.5	70.8	71.2	71.6	72.0	72.5	73.0	73.5	74.0	74.4	74.7	74.5	74.3	73.5	69.7	123.7
PNL	76.2	76.3	76.4	76.7	77.0	77.4	77.9	78.5	79.1	79.8	80.4	81.1	81.7	81.8	81.0	79.0	76.1	72.9	66.7	
PNLT	76.2	76.3	76.4	76.7	77.0	77.5	78.0	78.5	79.1	79.8	80.5	81.1	81.7	81.8	81.0	79.0	76.1	72.9	66.7	

TABLE VIII. - Continued.

QSRA (YF102) NOISE: SINGLE ENGINE, NO FLAPS, NO ATTENUATION

ENGINF PERFORMANCE PARAMETER = 37.78

CORE NOISE SPECTRA

1 ENGINE(S) AT A CONSTANT RADIUS OF 100.0 FEET, IN THE PLANE OF PHI = 0.0 DEGREES

MODIFIED NOISE LEVEL PREDICTION

INPUT PARAMETERS: COMBUSTOR INLET TEMP (T3) = 783.2 DEG R; EXHAUST TEMP (T4) =1616.5 DEG R;
INLET PRESS (P3) = 6518.7 PSF; CORE MASS FLOW (WCORE) = 16.3 LB/S; DESIGN TURBINE DELTA T (DTEMD) = 900.0 DEG R

	POLAR ANGLE, THETA, DEGREES																			POWER LEVEL
FREQ	0.0	10.0	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	170.0	180.0	
50	43.4	44.9	46.4	47.8	49.2	50.8	51.8	52.6	53.5	54.9	56.2	57.0	57.3	57.3	57.2	57.1	56.9	56.8	56.7	106.0
63	46.0	47.5	49.0	50.4	51.8	53.4	54.4	55.2	56.1	57.4	58.8	59.6	59.9	59.9	59.8	59.6	59.5	59.4	59.3	108.6
79	48.6	50.1	51.6	53.0	54.4	56.0	57.0	57.8	58.7	60.0	61.4	62.2	62.5	62.5	62.4	62.2	62.1	62.0	61.9	111.2
99	50.6	52.1	53.6	55.0	56.4	58.0	59.0	59.8	60.7	62.0	63.4	64.2	64.5	64.5	64.4	64.2	64.1	64.0	63.9	113.2
125	52.5	54.0	55.5	56.9	58.3	59.9	60.9	61.7	62.6	64.0	65.3	66.1	66.4	66.4	66.3	66.2	66.0	65.9	65.8	115.1
158	54.5	56.0	57.5	58.9	60.3	61.9	62.9	63.7	64.6	65.9	67.3	68.1	68.4	68.4	68.3	68.1	68.0	67.9	67.8	117.1
199	55.6	57.1	58.6	60.0	61.4	63.0	64.0	64.8	65.7	67.1	68.4	69.2	69.5	69.5	69.4	69.3	69.1	69.0	68.9	118.2
251	56.6	58.1	59.6	61.0	62.4	64.0	65.0	65.8	66.7	68.0	69.4	70.2	70.5	70.5	70.4	70.2	70.1	70.0	69.9	119.2
316	57.1	58.6	60.1	61.5	62.9	64.5	65.5	66.3	67.2	68.6	69.9	70.7	71.0	71.0	70.9	70.8	70.6	70.5	70.4	119.7
398	57.4	58.9	60.4	61.8	63.2	64.8	65.8	66.6	67.5	68.8	70.2	71.0	71.3	71.3	71.2	71.0	70.9	70.8	70.7	120.0
501	57.1	58.6	60.1	61.5	62.9	64.5	65.5	66.3	67.2	68.5	69.9	70.7	71.0	71.0	70.9	70.7	70.6	70.5	70.4	119.7
630	56.7	58.2	59.7	61.1	62.5	64.1	65.1	65.9	66.8	68.2	69.5	70.3	70.6	70.6	70.5	70.4	70.2	70.1	70.0	119.3
794	56.1	57.6	59.1	60.5	61.9	63.5	64.5	65.3	66.2	67.5	68.9	69.7	70.0	70.0	69.9	69.7	69.6	69.5	69.4	118.7
999	55.1	56.6	58.1	59.5	60.9	62.5	63.5	64.3	65.2	66.6	67.9	68.7	69.0	69.0	68.9	68.8	68.6	68.5	68.4	117.7
1258	54.2	55.7	57.2	58.6	60.0	61.6	62.6	63.4	64.3	65.6	67.0	67.8	68.1	68.1	68.0	67.8	67.7	67.6	67.5	116.8
1584	53.2	54.7	56.2	57.6	59.0	60.6	61.6	62.4	63.3	64.7	66.0	66.8	67.1	67.1	67.0	66.9	66.7	66.6	66.5	115.8
1995	51.8	53.3	54.8	56.2	57.6	59.2	60.2	61.0	61.9	63.3	64.6	65.4	65.7	65.7	65.6	65.5	65.3	65.2	65.1	114.4
2511	50.4	51.9	53.4	54.8	56.2	57.8	58.8	59.6	60.5	61.9	63.2	64.0	64.3	64.3	64.2	64.1	63.9	63.8	63.7	113.0
3162	49.0	50.5	52.0	53.4	54.8	56.4	57.4	58.2	59.1	60.5	61.8	62.6	62.9	62.9	62.8	62.7	62.5	62.4	62.3	111.6
3981	47.6	49.1	50.6	52.0	53.4	55.0	56.0	56.8	57.7	59.0	60.4	61.2	61.5	61.5	61.4	61.2	61.1	61.0	60.9	110.2
5011	45.9	47.4	48.9	50.3	51.7	53.3	54.3	55.1	56.0	57.4	58.7	59.5	59.8	59.8	59.7	59.6	59.4	59.3	59.2	108.5
6309	44.2	45.7	47.2	48.6	50.0	51.6	52.6	53.4	54.3	55.7	57.0	57.8	58.1	58.1	58.0	57.9	57.7	57.6	57.5	106.8
7943	42.5	44.0	45.5	46.9	48.3	49.9	50.9	51.7	52.6	54.0	55.3	56.1	56.4	56.4	56.3	56.2	56.0	55.9	55.8	105.1
9999	40.8	42.3	43.8	45.2	46.6	48.2	49.2	50.0	50.9	52.3	53.6	54.4	54.7	54.7	54.6	54.5	54.3	54.2	54.1	103.4
OSPL	67.2	68.7	70.2	71.6	73.0	74.6	75.6	76.4	77.3	78.7	80.0	80.8	81.1	81.1	81.0	80.9	80.7	80.6	80.5	129.8
PNL	76.0	77.6	79.1	80.6	82.0	83.6	84.7	85.5	86.4	87.8	89.2	90.0	90.3	90.3	90.2	90.0	89.9	89.8	89.7	
PNLT	76.1	77.6	79.2	80.6	82.1	83.7	84.7	85.5	86.5	87.8	89.2	90.0	90.3	90.3	90.2	90.1	89.9	89.8	89.7	

TABLE VIII. - Continued.

QSRA (YF102) NOISE: SINGLE ENGINE, NO FLAPS, NO ATTENUATION

ENGINE PERFORMANCE PARAMETER = 37.78

TURBINE NOISE SPECTRA
1 ENGINE(S) AT A CONSTANT RADIUS OF 100.0 FEET, IN THE PLANE OF PHI = 0.0 DEGREES

INPUT PARAMETERS: EXIT TEMP (TCTUR) =1212.2 DEG R; ROTOR TIP SPEED (TURTS) = 360.9 FPS; MASS FLOW (WCORE) = 16.250 LB/S;
FAN SPEED (RPM) = 2796. RPM; TURBINE/FAN SPEED (GEAR) = 2.30; DIAMETER (TBNDIA) = 1.530 FT; NO. BLADES (NBLR) = 60;
STATOR CHORD/ROTOR SPACING (CS) =700.0%; TYPE (SHORT CORE DUCT=1,COPLANAR OR TURBOJET=0)(TYPTB) =1

FREQ	POLAR ANGLE, THETA, DEGREES 0.0	10.0	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	170.0	180.0	POWER LEVEL
50	19.0	23.0	27.0	31.0	35.0	39.0	43.0	46.0	49.0	52.0	54.7	56.0	54.7	51.0	47.3	42.1	37.0	31.8	26.7	101.7
63	20.0	24.0	28.0	32.0	36.0	40.0	44.0	47.0	50.0	53.0	55.7	57.0	55.7	52.0	48.3	43.1	38.0	32.8	27.7	102.7
79	21.0	25.0	29.0	33.0	37.0	41.0	45.0	48.0	51.0	54.0	56.7	58.0	56.7	53.0	49.3	44.1	39.0	33.8	28.7	103.7
99	22.0	26.0	30.0	34.0	38.0	42.0	46.0	49.0	52.0	55.0	57.7	59.0	57.7	54.0	50.3	45.1	40.0	34.8	29.7	104.7
125	23.0	27.0	31.0	35.0	39.0	43.0	47.0	50.0	53.0	56.0	58.7	60.0	58.7	55.0	51.3	46.1	41.0	35.8	30.7	105.7
158	24.0	28.0	32.0	36.0	40.0	44.0	48.0	51.0	54.0	57.0	59.7	61.0	59.7	56.0	52.3	47.1	42.0	36.8	31.7	106.7
199	25.0	29.0	33.0	37.0	41.0	45.0	49.0	52.0	55.0	58.0	60.7	62.0	60.7	57.0	53.3	48.1	43.0	37.8	32.7	107.7
251	26.1	30.1	34.1	38.1	42.1	46.1	50.1	53.1	56.1	59.1	61.8	63.1	61.8	58.1	54.4	49.2	44.1	38.9	33.8	108.8
316	27.1	31.1	35.1	39.1	43.1	47.1	51.1	54.1	57.1	60.1	62.8	64.1	62.8	59.1	55.4	50.2	45.1	39.9	34.8	109.8
398	28.1	32.1	36.1	40.1	44.1	48.1	52.1	55.1	58.1	61.1	63.8	65.1	63.8	60.1	56.4	51.2	46.1	40.9	35.8	110.8
501	29.1	33.1	37.1	41.1	45.1	49.1	53.1	56.1	59.1	62.1	64.8	66.1	64.8	61.1	57.4	52.2	47.1	41.9	36.8	111.8
630	30.1	34.1	38.1	42.1	46.1	50.1	54.1	57.1	60.1	63.1	65.8	67.1	65.8	62.1	58.4	53.2	48.1	42.9	37.8	112.8
794	31.2	35.2	39.2	43.2	47.2	51.2	55.2	58.2	61.2	64.2	66.9	68.2	66.9	63.2	59.5	54.3	49.2	44.0	38.9	113.9
999	32.2	36.2	40.2	44.2	48.2	52.2	56.2	59.2	62.2	65.2	67.9	69.2	67.9	64.2	60.5	55.3	50.2	45.0	39.9	114.9
1258	33.3	37.3	41.3	45.3	49.3	53.3	57.3	60.3	63.3	66.3	69.0	70.3	69.0	65.3	61.6	56.4	51.3	46.1	41.0	116.0
1584	34.4	38.4	42.4	46.4	50.4	54.4	58.4	61.4	64.4	67.4	70.1	71.4	70.1	66.4	62.7	57.5	52.4	47.2	42.1	117.1
1995	35.5	39.5	43.5	47.5	51.5	55.5	59.5	62.5	65.5	68.5	71.2	72.5	71.2	67.5	63.8	58.6	53.5	48.3	43.2	118.2
2511	36.6	40.6	44.6	48.6	52.6	56.6	60.6	63.6	66.6	69.6	72.3	73.6	72.3	68.6	64.9	59.7	54.6	49.4	44.3	119.3
3162	37.8	41.8	45.8	49.8	53.8	57.8	61.8	64.8	67.8	70.8	73.5	74.8	73.5	69.8	66.1	60.9	55.8	50.6	45.5	120.5
3981	39.2	43.2	47.2	51.2	55.2	59.2	63.2	66.2	69.2	72.2	74.9	76.2	74.9	71.2	67.5	62.3	57.2	52.0	46.9	121.9
5011	40.4	44.4	48.4	52.4	56.4	60.4	64.4	67.4	70.4	73.4	76.1	77.4	76.1	72.4	68.7	63.5	58.4	53.2	48.1	123.1
6309	42.8	47.0	51.2	55.4	59.6	63.8	68.1	71.5	75.0	78.5	81.8	83.8	81.9	77.0	72.3	66.8	61.4	56.1	50.7	128.7
7943	40.8	44.8	48.8	52.8	56.8	60.8	64.8	67.8	70.8	73.8	76.5	77.8	76.5	72.8	69.1	64.0	58.8	53.7	48.5	123.6
9999	40.1	44.1	48.1	52.1	56.1	60.1	64.1	67.1	70.1	73.1	75.8	77.1	75.8	72.1	68.4	63.3	58.1	53.0	47.8	122.9
OSPL	49.4	53.4	57.5	61.5	65.6	69.6	73.7	76.8	80.0	83.2	86.0	87.6	86.1	82.0	78.0	72.8	67.5	62.3	57.1	133.1
PNL	62.1	66.4	70.6	74.8	79.0	83.1	87.3	90.5	93.7	97.0	100.0	101.7	100.1	95.7	91.5	86.2	80.9	75.6	70.3	
PNLT	62.4	66.7	71.1	75.3	79.5	83.7	87.9	91.1	94.5	97.8	100.9	102.7	101.0	96.4	92.1	86.7	81.4	76.0	70.5	

TABLE VIII. - Continued.

QSRA (YF102) NOISE: SINGLE ENGINE, NO FLAPS, NO ATTENUATION

ENGINE PERFORMANCE PARAMETER = 37.78

NOISE SPECTRA OF TOTAL OF ALL SOURCES
1 ENGINE(S) AT A CONSTANT RADIUS OF 100.0 FEET, IN THE PLANE OF PHI = 0.0 DEGREES

SOURCES AND EFFECTS INCLUDED ARE DESIGNATED BY CODE > OR =1.
SOURCES: IFAN =1, IJET =1, IFLAP =0, ICORE =1, ITURB =1, IAIRF =0, IREVR =0
PROPAGATION EFFECTS: IATM =0, IGND =1, IEGA =0, IDOP =0, ISHLD =0, ICORR =1

	POLAR ANGLE, THETA, DEGREES																			POWER LEVEL
FREQ	0.0	10.0	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	170.0	180.0	
50	61.3	61.4	61.5	61.7	62.0	62.4	62.7	63.1	63.6	64.4	65.2	65.8	65.8	65.7	66.4	67.9	69.5	70.2	68.1	113.0
63	62.0	62.1	62.3	62.6	62.9	63.4	63.8	64.3	64.8	65.7	66.6	67.2	67.3	67.2	67.8	69.0	70.2	70.5	67.8	114.2
79	62.6	62.7	63.0	63.3	63.8	64.4	64.9	65.5	66.1	67.0	68.1	68.7	68.8	68.8	69.2	70.0	70.6	70.4	67.9	115.4
99	63.0	63.2	63.6	64.0	64.5	65.3	65.9	66.5	67.2	68.2	69.3	70.1	70.1	70.1	70.4	70.7	70.8	70.3	68.4	116.4
125	63.4	63.7	64.1	64.7	65.3	66.2	66.9	67.5	68.3	69.4	70.6	71.4	71.5	71.5	71.6	71.6	71.3	70.7	69.5	117.6
158	63.7	64.1	64.7	65.4	66.2	67.3	68.0	68.7	69.6	70.8	72.0	72.8	73.0	72.9	72.9	72.7	72.3	71.8	71.1	118.8
199	63.8	64.3	65.0	65.8	66.7	67.9	68.7	69.5	70.3	71.6	72.9	73.7	73.9	73.7	73.7	73.4	72.9	72.5	72.1	119.6
251	63.9	64.5	65.3	66.2	67.2	68.4	69.3	70.1	71.0	72.4	73.7	74.6	74.7	74.5	74.4	74.0	73.6	73.3	73.0	120.4
316	63.8	64.6	65.5	66.4	67.5	68.8	69.7	70.5	71.5	72.8	74.2	75.1	75.2	75.0	74.8	74.4	74.0	73.7	73.5	120.8
398	63.8	64.6	65.6	66.5	67.6	68.9	69.8	70.6	71.6	73.1	74.5	75.4	75.5	75.2	74.9	74.5	74.1	73.9	73.7	121.0
501	63.7	64.6	65.6	66.5	67.6	68.7	69.6	70.4	71.5	73.0	74.5	75.4	75.4	75.0	74.6	74.2	73.8	73.6	73.4	120.9
630	64.1	65.0	66.1	66.9	67.7	68.6	69.4	70.2	71.3	72.9	74.5	75.5	75.4	74.9	74.4	73.8	73.4	73.2	73.1	120.8
794	65.0	66.0	67.0	67.6	68.3	68.6	69.2	69.9	71.1	72.8	74.6	75.6	75.5	74.8	74.1	73.3	72.8	72.6	72.4	120.8
999	66.4	67.4	68.5	68.8	69.2	69.0	69.1	69.7	70.9	72.8	74.8	75.8	75.7	74.8	73.8	72.6	72.0	71.7	71.5	120.8
1258	68.1	69.1	70.1	70.3	70.6	69.8	69.4	69.8	71.1	73.2	75.2	76.4	76.2	75.2	73.8	72.2	71.3	70.8	70.5	121.2
1584	69.7	70.7	71.7	71.8	72.0	70.8	70.0	70.2	71.6	73.8	76.0	77.2	77.0	75.9	74.3	72.1	70.7	70.0	69.6	121.9
1995	78.4	79.8	81.2	81.2	81.2	80.0	78.0	75.7	74.9	76.1	78.0	79.3	79.4	78.7	76.7	73.7	71.3	69.6	68.6	126.3
2511	72.2	73.2	74.2	74.3	74.4	72.8	71.5	71.4	72.9	75.3	77.6	79.0	78.7	77.5	75.4	72.1	69.6	67.9	67.1	123.5
3162	73.0	74.0	75.0	75.0	75.1	73.5	72.2	72.1	73.7	76.1	78.5	79.9	79.5	78.3	76.0	72.4	69.4	67.1	65.9	124.3
3981	77.1	78.4	79.7	79.7	79.7	78.4	76.7	75.8	76.7	79.0	81.3	82.8	82.9	82.1	79.9	76.3	72.8	69.4	66.4	127.8
5011	75.4	76.6	77.8	77.8	77.9	76.5	75.1	74.8	76.3	78.8	81.2	82.6	82.3	81.1	78.7	74.9	71.3	67.7	64.7	127.0
6309	73.1	74.2	75.2	75.2	75.4	74.2	74.2	75.8	78.7	82.0	85.1	87.1	85.5	81.7	78.1	73.5	69.3	65.3	62.6	129.5
7943	73.8	74.9	76.1	76.1	76.2	74.8	73.7	73.9	75.8	78.4	80.9	82.3	81.7	80.0	77.5	73.4	69.5	65.5	62.1	126.3
9999	72.3	73.4	74.5	74.5	74.6	73.2	72.3	72.7	74.7	77.4	80.0	81.3	80.7	78.7	76.1	71.9	68.0	63.9	60.5	125.2
OSPL	84.8	85.9	87.1	87.2	87.4	86.4	85.4	85.4	86.7	89.0	91.3	92.7	92.2	90.7	89.0	86.8	85.6	84.8	84.0	137.1
PNL	98.6	99.8	100.9	101.1	101.2	100.2	99.2	98.9	100.1	102.6	105.2	106.7	105.9	104.6	102.8	99.9	97.5	95.3	93.6	
PNLT	101.1	102.4	103.7	103.8	103.9	103.0	101.6	100.5	100.9	103.2	105.8	107.5	106.5	105.2	103.6	100.8	98.0	95.8	93.8	

TABLE VIII. - Continued.

QSRA (YF102) NOISE: SINGLE ENGINE, NO FLAPS, NO ATTENUATION

ENGINE PERFORMANCE PARAMETER = 87.70

FAN NOISE SPECTRA
1 ENGINE(S) AT A CONSTANT RADIUS OF 100.0 FEET, IN THE PLANE OF PHI = 0.0 DEGREES

INPUT PARAMETERS: FAN SPEED = 6490. RPM; FAN MASS FLOW (WAFAN) = 236.3 LB/S; FAN DIAMETER (FANDIA) = 3.392 FT;
TIP REL MACH NO.(TIPM) = 1.129; DESIGN REL TIP MACH (TIPMD) = 1.240; TEMP RISE (DELT) = 55.3 DEG R;
PRESS RATIO(1 STAGE)(FPR) = 1.350; NO. BLADES(NBL) = 40; NO. VANES(NVAN) = 85; ROTOR/STATOR SPACING (RSS) = 275. %;
NO. STAGES(NSTG) = 1; STAGE EFF (FANEFF) =0.840; INLET GUIDE VANES (IGV) =0; INLET FLOW DISTOR (IFD) =1;
EXHAUST NOISE OPTION (IEXH) =2; NO. OF TONE HARM CALC (NH) = 5; AIR GAMMAF = 1.40; FAN HUB DIAM(FANHUB) = 1.450 FT.

	POLAR ANGLE, THETA, DEGREES																			POWER LEVEL
FREQ	0.0	10.0	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	170.0	180.0	
50	42.9	43.9	45.4	47.4	50.4	52.4	52.4	48.9	44.9	43.4	42.9	42.4	41.9	41.4	40.9	40.4	39.9	39.4	38.9	98.2
63	45.9	46.9	48.4	50.4	53.4	55.4	55.4	51.9	47.9	46.4	45.9	45.4	44.9	44.4	43.9	43.4	42.9	42.4	41.9	101.2
79	48.9	49.9	51.4	53.4	56.4	58.4	58.4	54.9	50.9	49.4	48.9	48.4	47.9	47.4	46.9	46.4	45.9	45.4	44.9	104.2
99	51.9	52.9	54.4	56.4	59.4	61.4	61.4	57.9	53.9	52.4	51.9	51.4	50.9	50.4	49.9	49.4	48.9	48.4	47.9	107.2
125	54.9	55.9	57.4	59.4	62.4	64.4	64.4	60.9	56.9	55.4	54.9	54.4	53.9	53.4	52.9	52.4	51.9	51.4	50.9	110.2
158	57.9	58.9	60.4	62.4	65.4	67.4	67.4	63.9	59.9	58.4	57.9	57.4	56.9	56.4	55.9	55.4	54.9	54.4	53.9	113.2
199	60.9	61.9	63.4	65.4	68.4	70.4	70.4	66.9	62.9	61.4	60.9	60.4	59.9	59.5	58.9	58.4	57.9	57.4	56.9	116.2
251	64.0	65.0	66.5	68.5	71.5	73.5	73.5	70.0	66.0	64.5	64.0	63.5	63.0	62.5	62.0	61.5	61.0	60.5	60.0	119.3
316	67.0	68.0	69.5	71.5	74.5	76.5	76.5	73.0	69.0	67.5	67.0	66.6	66.1	65.6	65.1	64.5	64.0	63.5	63.0	122.3
398	70.1	71.1	72.6	74.6	77.6	79.6	79.6	76.1	72.1	70.6	70.1	69.7	69.2	68.7	68.2	67.6	67.1	66.6	66.1	125.4
501	73.2	74.2	75.7	77.7	80.7	82.7	82.7	79.2	75.2	73.7	73.3	72.8	72.4	71.9	71.3	70.7	70.2	69.7	69.2	128.5
630	76.1	77.1	78.6	80.6	83.6	85.6	85.6	82.1	78.1	76.6	76.2	75.8	75.4	74.9	74.3	73.7	73.1	72.6	72.1	131.4
794	79.2	80.2	81.7	83.6	86.6	88.6	88.6	85.1	81.1	79.7	79.3	78.9	78.5	78.1	77.4	76.7	76.1	75.6	75.1	134.4
999	82.3	83.3	84.8	86.8	89.7	91.7	91.7	88.2	84.2	82.8	82.4	82.0	81.7	81.3	80.6	79.9	79.3	78.7	78.2	137.5
1258	85.1	86.1	87.6	89.5	92.5	94.5	94.4	91.0	87.0	85.6	85.2	84.9	84.5	84.1	83.4	82.7	82.0	81.5	80.9	140.3
1584	88.1	89.1	90.6	92.5	95.5	97.4	97.4	93.9	90.0	88.6	88.2	87.9	87.5	87.2	86.4	85.6	85.0	84.4	83.9	143.3
1995	91.1	92.1	93.6	95.5	98.4	100.4	100.4	96.9	93.0	91.6	91.2	90.9	90.5	90.1	89.4	88.6	88.0	87.4	86.9	146.3
2511	88.6	89.6	91.0	92.8	95.6	97.5	97.4	94.0	90.1	89.0	88.9	88.9	88.8	88.6	87.6	86.2	85.3	84.5	83.9	143.5
3162	86.8	87.8	89.2	90.6	93.0	94.7	94.6	91.2	87.7	87.0	87.6	88.1	88.4	88.4	87.0	84.7	83.1	81.8	81.1	141.2
3981	96.8	98.3	99.8	99.8	100.0	99.2	97.5	94.8	93.1	94.0	95.4	97.1	98.1	98.1	96.1	92.7	89.3	85.7	82.0	148.0
5011	86.5	87.5	88.6	89.0	90.1	90.3	89.6	86.8	85.2	86.3	88.0	89.2	90.0	90.3	88.4	84.7	81.5	78.2	76.1	139.4
6309	87.0	88.0	89.1	89.3	89.8	89.2	88.1	85.8	85.1	86.8	88.7	90.1	90.9	91.2	89.2	85.4	81.7	77.6	74.5	139.6
7943	92.8	94.1	95.5	95.5	95.6	94.4	92.5	90.5	90.1	91.8	93.6	95.3	96.3	96.4	94.4	90.7	87.1	82.9	78.3	144.9
9999	87.7	88.7	89.8	89.8	89.9	88.4	86.6	85.0	85.4	87.4	89.5	90.9	91.8	92.1	90.1	86.1	82.2	77.4	73.0	140.0
OSPL	100.8	102.1	103.5	104.2	105.6	106.5	106.0	102.8	99.9	99.8	100.8	101.9	102.6	102.6	100.9	98.0	95.6	93.6	92.3	153.9
PNL	115.2	116.5	117.9	118.5	119.5	119.7	118.6	115.7	113.4	113.7	114.7	115.9	116.5	116.5	114.8	111.9	109.3	106.6	104.9	
PNLT	118.6	120.1	121.6	121.8	122.4	121.9	120.4	117.6	115.6	116.1	117.3	118.7	119.5	119.4	117.6	114.6	111.7	108.5	106.1	

TABLE VIII. - Continued.

QSRA (YF102) NOISE: SINGLE ENGINE, NO FLAPS, NO ATTENUATION

ENGINE PERFORMANCE PARAMETER = 87.79

JET NOISE SPECTRA
1 ENGINE(S) AT A CONSTANT RADIUS OF 100.0 FEET, IN THE PLANE OF PHI = 0.0 DEGREES

INPUT PARAMETERS: NOZZLE TYPE(SIMPLE=0,COAX=1)(INOZ) =1; IPLUG=0; ISLOT=0; FWD VEL EFFECTS(IFWD)=0;

	AREA(SQ FT)	VEL(FPS)	TEMP(R)	GAMMA	GAS CONST	DES MACH #	HYD DIA(FT)	ANNUL HT(FT)	FUEL (#/S)
CORE:	1.215	1059.2	1600.8	1.360	53.380	1.000	0.000	0.000	0.000
FAN :	3.951	748.4	582.4	1.400	53.350	1.000	1.321	0.660	

POLAR ANGLE, THETA, DEGREES

FREQ	0.0	10.0	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	170.0	180.0	POWER LEVEL
50	75.7	75.8	75.9	76.0	76.2	76.5	76.9	77.4	77.9	78.5	79.2	80.0	80.1	84.3	88.4	90.8	92.9	90.3	88.5	134.7
63	77.1	77.2	77.3	77.5	77.7	78.0	78.4	78.9	79.5	80.2	81.1	82.0	82.4	86.8	90.8	93.2	95.2	92.9	91.2	137.0
79	78.3	78.3	78.4	78.7	79.0	79.4	79.8	80.4	81.0	81.8	82.7	83.7	84.6	88.7	92.6	95.2	96.7	94.6	92.7	138.7
99	79.2	79.2	79.4	79.6	80.0	80.4	80.9	81.6	82.4	83.2	84.1	85.2	86.4	90.2	94.1	96.8	97.3	95.2	93.1	140.0
125	79.9	80.0	80.1	80.4	80.8	81.2	81.8	82.5	83.4	84.3	85.3	86.5	87.9	91.4	95.1	98.0	97.6	94.8	92.5	140.9
158	80.5	80.6	80.7	81.0	81.4	82.0	82.6	83.3	84.2	85.2	86.3	87.5	89.2	92.4	95.8	98.9	97.4	94.0	91.3	141.5
199	80.9	81.0	81.2	81.5	81.9	82.5	83.2	84.0	84.9	85.9	87.1	88.3	90.2	93.2	96.2	98.7	96.4	92.9	89.9	141.7
251	81.1	81.2	81.4	81.8	82.2	82.8	83.6	84.4	85.4	86.5	87.7	89.0	90.9	93.7	96.1	98.0	94.8	91.6	88.2	141.5
316	81.2	81.3	81.5	81.9	82.4	83.0	83.8	84.7	85.7	86.9	88.2	89.5	91.4	93.9	95.6	96.6	93.1	90.0	86.3	141.1
398	81.1	81.2	81.4	81.8	82.4	83.1	83.9	84.8	85.9	87.1	88.4	89.9	91.8	94.0	94.8	95.2	91.3	88.2	84.2	140.7
501	80.8	80.9	81.2	81.6	82.2	82.9	83.8	84.8	85.9	87.2	88.6	90.1	91.9	93.7	94.0	93.7	90.0	86.3	81.8	140.3
630	80.4	80.5	80.7	81.2	81.8	82.5	83.5	84.5	85.8	87.1	88.5	90.1	91.9	93.3	92.9	92.2	87.8	84.0	79.5	139.8
794	79.8	79.9	80.1	80.6	81.3	82.0	83.0	84.1	85.4	86.8	88.3	89.9	91.6	92.7	91.6	90.5	85.6	81.9	77.0	139.1
999	79.1	79.2	79.4	79.9	80.6	81.4	82.4	83.6	84.9	86.3	87.9	89.5	91.1	91.9	90.2	88.9	83.7	79.8	74.6	138.4
1258	78.2	78.3	78.6	79.1	79.8	80.7	81.7	82.9	84.2	85.7	87.3	89.0	90.4	90.8	88.9	87.2	81.8	77.7	72.2	137.5
1584	77.2	77.3	77.6	78.1	78.8	79.7	80.8	82.1	83.5	85.0	86.6	88.3	89.6	89.7	87.5	85.6	80.0	75.7	69.9	136.6
1995	76.2	76.3	76.6	77.1	77.8	78.7	79.8	81.1	82.5	84.1	85.8	87.6	88.7	88.4	86.1	84.0	78.0	73.6	67.5	135.6
2511	75.1	75.2	75.5	76.0	76.7	77.6	78.8	80.1	81.5	83.1	84.8	86.7	87.6	87.2	84.8	82.3	76.1	71.4	65.2	134.5
3162	74.0	74.1	74.4	74.9	75.6	76.5	77.7	79.0	80.4	82.0	83.8	85.7	86.6	85.9	83.4	80.7	74.2	69.4	62.8	133.3
3981	72.9	73.0	73.3	73.8	74.5	75.4	76.6	77.9	79.3	80.9	82.7	84.6	85.4	84.7	82.0	79.0	72.3	67.3	60.6	132.1
5011	71.7	71.8	72.1	72.7	73.4	74.3	75.5	76.8	78.2	79.8	81.6	83.5	84.2	83.5	80.6	77.4	70.4	65.3	58.2	131.0
6309	70.5	70.6	71.0	71.5	72.2	73.2	74.3	75.6	77.1	78.7	80.5	82.4	83.0	82.3	79.2	75.8	68.6	63.1	55.8	129.8
7943	69.3	69.4	69.8	70.3	71.0	72.0	73.1	74.5	75.9	77.6	79.4	81.3	81.9	81.1	77.8	74.1	66.7	61.1	53.4	128.6
9999	68.2	68.3	68.6	69.1	69.9	70.8	71.9	73.3	74.8	76.4	78.2	80.1	80.7	79.9	76.3	72.4	64.8	59.1	51.0	127.4
OSPL	92.2	92.2	92.5	92.8	93.4	94.0	94.9	95.8	97.0	98.2	99.6	101.1	102.6	104.4	105.8	107.4	106.0	103.2	100.7	152.2
PNL	101.5	101.6	101.9	102.4	103.0	103.8	104.8	106.0	107.3	108.8	110.3	112.0	113.2	113.8	113.0	113.0	109.7	106.2	102.4	
PNLT	101.6	101.6	101.9	102.4	103.1	103.9	104.9	106.0	107.3	108.8	110.4	112.0	113.2	113.8	113.0	113.1	109.8	106.2	102.5	

TABLE VIII. - Continued.

QSRA (YF102) NOISE: SINGLE ENGINE, NO FLAPS, NO ATTENUATION

ENGINE PERFORMANCE PARAMETER = 87.70

CORE NOISE SPECTRA
1 ENGINE(S) AT A CONSTANT RADIUS OF 100.0 FEET, IN THE PLANE OF PHI = 0.0 DEGREES

MODIFIED NOISE LEVEL PREDICTION
INPUT PARAMETERS: COMBUSTOR INLET TEMP (T3) =1089.4 DEG R; EXHAUST TEMP (T4) =2366.2 DEG R;
INLET PRESS (P3) =19298.9 PSF; CORE MASS FLOW (WCORE) = 33.0 LB/S; DESIGN TURBINE DELTA T (DTEMD) = 900.0 DEG R

	POLAR ANGLE, THETA, DEGREES																			POWER LEVEL
FREQ	0.0	10.0	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	170.0	180.0	
50	56.8	58.3	59.8	61.2	62.6	64.2	65.2	66.0	66.9	68.2	69.6	70.4	70.7	70.7	70.6	70.4	70.3	70.2	70.1	119.4
63	59.3	60.8	62.3	63.7	65.1	66.7	67.7	68.5	69.4	70.8	72.1	72.9	73.2	73.2	73.1	73.0	72.8	72.7	72.6	121.9
79	61.9	63.4	64.9	66.3	67.7	69.3	70.3	71.1	72.0	73.4	74.7	75.5	75.8	75.8	75.7	75.6	75.4	75.3	75.2	124.5
99	63.9	65.4	66.9	68.3	69.7	71.3	72.3	73.1	74.0	75.4	76.7	77.5	77.8	77.8	77.7	77.6	77.4	77.3	77.2	126.5
125	65.9	67.4	68.9	70.3	71.7	73.3	74.3	75.1	76.0	77.3	78.7	79.5	79.8	79.8	79.7	79.5	79.4	79.3	79.2	128.5
158	67.8	69.3	70.8	72.2	73.6	75.2	76.2	77.0	77.9	79.3	80.6	81.4	81.7	81.7	81.6	81.5	81.3	81.2	81.1	130.4
199	68.9	70.4	71.9	73.3	74.7	76.3	77.3	78.1	79.0	80.4	81.7	82.5	82.8	82.8	82.7	82.6	82.4	82.3	82.2	131.5
251	69.9	71.4	72.9	74.3	75.7	77.3	78.3	79.1	80.0	81.4	82.7	83.5	83.8	83.8	83.7	83.6	83.4	83.3	83.2	132.5
316	70.5	72.0	73.5	74.9	76.3	77.9	78.9	79.7	80.6	81.9	83.3	84.1	84.4	84.4	84.3	84.1	84.0	83.9	83.8	133.1
398	70.7	72.2	73.7	75.1	76.5	78.1	79.1	79.9	80.8	82.2	83.5	84.3	84.6	84.6	84.5	84.4	84.2	84.1	84.0	133.3
501	70.4	71.9	73.4	74.8	76.2	77.8	78.8	79.6	80.5	81.9	83.2	84.0	84.3	84.3	84.2	84.1	83.9	83.8	83.7	133.0
630	70.1	71.6	73.1	74.5	75.9	77.5	78.5	79.3	80.2	81.5	82.9	83.7	84.0	84.0	83.9	83.7	83.6	83.5	83.4	132.7
794	69.4	70.9	72.4	73.8	75.2	76.8	77.8	78.6	79.5	80.9	82.2	83.0	83.3	83.3	83.2	83.1	82.9	82.8	82.7	132.0
999	68.5	70.0	71.5	72.9	74.3	75.9	76.9	77.7	78.6	79.9	81.3	82.1	82.4	82.4	82.3	82.1	82.0	81.9	81.8	131.1
1258	67.5	69.0	70.5	71.9	73.3	74.9	75.9	76.7	77.6	79.0	80.3	81.1	81.4	81.4	81.3	81.2	81.0	80.9	80.8	130.1
1584	66.6	68.1	69.6	71.0	72.4	74.0	75.0	75.8	76.7	78.0	79.4	80.2	80.5	80.5	80.4	80.2	80.1	80.0	79.9	129.2
1995	65.2	66.7	68.2	69.6	71.0	72.6	73.6	74.4	75.3	76.6	78.0	78.8	79.1	79.1	79.0	78.8	78.7	78.6	78.5	127.8
2511	63.8	65.3	66.8	68.2	69.6	71.2	72.2	73.0	73.9	75.2	76.6	77.4	77.7	77.7	77.6	77.4	77.3	77.2	77.1	126.4
3162	62.3	63.8	65.3	66.7	68.1	69.7	70.7	71.5	72.4	73.8	75.1	75.9	76.2	76.2	76.1	76.0	75.8	75.7	75.6	124.9
3981	60.9	62.4	63.9	65.3	66.7	68.3	69.3	70.1	71.0	72.4	73.7	74.5	74.8	74.8	74.7	74.6	74.4	74.3	74.2	123.5
5011	59.3	60.8	62.3	63.7	65.1	66.7	67.7	68.5	69.4	70.7	72.1	72.9	73.2	73.2	73.1	72.9	72.8	72.7	72.6	121.9
6309	57.6	59.1	60.6	62.0	63.4	65.0	66.0	66.8	67.7	69.0	70.4	71.2	71.5	71.5	71.4	71.2	71.1	71.0	70.9	120.2
7943	55.9	57.4	58.9	60.3	61.7	63.3	64.3	65.1	66.0	67.3	68.7	69.5	69.8	69.8	69.7	69.5	69.4	69.3	69.2	118.5
9999	54.2	55.7	57.2	58.6	60.0	61.6	62.6	63.4	64.3	65.6	67.0	67.8	68.1	68.1	68.0	67.8	67.7	67.6	67.5	116.8
OSPL	80.6	82.1	83.6	85.0	86.4	88.0	89.0	89.8	90.7	92.0	93.4	94.2	94.5	94.5	94.4	94.2	94.1	94.0	93.9	143.2
PNL	89.7	91.2	92.8	94.2	95.6	97.2	98.2	99.0	100.0	101.3	102.7	103.5	103.8	103.8	103.7	103.5	103.4	103.3	103.2	
PNLT	89.8	91.3	92.8	94.2	95.7	97.3	98.3	99.1	100.0	101.4	102.7	103.5	103.8	103.8	103.7	103.6	103.4	103.3	103.2	

TABLE VIII. - Continued.

QSRA (YF102) NOISE: SINGLE ENGINE, NO FLAPS, NO ATTENUATION

ENGINE PERFORMANCE PARAMETER = 87.70

TURBINE NOISE SPECTRA
1 ENGINE(S) AT A CONSTANT RADIUS OF 100.0 FEET, IN THE PLANE OF PHI = 0.0 DEGREES

INPUT PARAMETERS: EXIT TEMP (TCTUR) =1600.8 DEG R; ROTOR TIP SPEED (TURTS) = 837.8 FPS; MASS FLOW (WCORE) = 33.031 LB/S;
FAN SPEED (RPM) = 6490. RPM; TURBINE/FAN SPEED (GEAR) = 2.30; DIAMETER (TBNDIA) = 1.530 FT; NO. BLADES (NBLR) = 60;
STATOR CHORD/ROTOR SPACING (CS) =700.0%; TYPE (SHORT CORE DUCT=1,COPLANAR OR TURBOJET=0)(TYPTB) =1

	POLAR ANGLE, THETA, DEGREES																			POWER LEVEL
FREQ	0.0	10.0	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	170.0	180.0	
50	27.5	31.5	35.5	39.5	43.5	47.5	51.5	54.5	57.5	60.5	63.2	64.5	63.2	59.5	55.8	50.6	45.5	40.3	35.2	110.2
63	28.5	32.5	36.5	40.5	44.5	48.5	52.5	55.5	58.5	61.5	64.2	65.5	64.2	60.5	56.8	51.6	46.5	41.3	36.2	111.2
79	29.5	33.5	37.5	41.5	45.5	49.5	53.5	56.5	59.5	62.5	65.2	66.5	65.2	61.5	57.8	52.6	47.5	42.3	37.2	112.2
99	30.5	34.5	38.5	42.5	46.5	50.5	54.5	57.5	60.5	63.5	66.2	67.5	66.2	62.5	58.8	53.6	48.5	43.3	38.2	113.2
125	31.5	35.5	39.5	43.5	47.5	51.5	55.5	58.5	61.5	64.5	67.2	68.5	67.2	63.5	59.8	54.6	49.5	44.3	39.2	114.2
158	32.5	36.5	40.5	44.5	48.5	52.5	56.5	59.5	62.5	65.5	68.2	69.5	68.2	64.5	60.8	55.6	50.5	45.3	40.2	115.2
199	33.5	37.5	41.5	45.5	49.5	53.5	57.5	60.5	63.5	66.5	69.2	70.5	69.2	65.5	61.8	56.6	51.5	46.3	41.2	116.2
251	34.6	38.6	42.6	46.6	50.6	54.6	58.6	61.6	64.6	67.6	70.3	71.6	70.3	66.6	62.9	57.7	52.6	47.4	42.3	117.3
316	35.6	39.6	43.6	47.6	51.6	55.6	59.6	62.6	65.6	68.6	71.3	72.6	71.3	67.6	63.9	58.7	53.6	48.4	43.3	118.3
398	36.6	40.6	44.6	48.6	52.6	56.6	60.6	63.6	66.6	69.6	72.3	73.6	72.3	68.6	64.9	59.7	54.6	49.4	44.3	119.3
501	37.6	41.6	45.6	49.6	53.6	57.6	61.6	64.6	67.6	70.6	73.3	74.6	73.3	69.6	65.9	60.7	55.6	50.4	45.3	120.3
630	38.6	42.6	46.6	50.6	54.6	58.6	62.6	65.6	68.6	71.6	74.3	75.6	74.3	70.6	66.9	61.7	56.6	51.4	46.3	121.3
794	39.7	43.7	47.7	51.7	55.7	59.7	63.7	66.7	69.7	72.7	75.4	76.7	75.4	71.7	68.0	62.8	57.7	52.5	47.4	122.4
999	40.7	44.7	48.7	52.7	56.7	60.7	64.7	67.7	70.7	73.7	76.4	77.7	76.4	72.7	69.0	63.8	58.7	53.5	48.4	123.4
1258	41.8	45.8	49.8	53.8	57.8	61.8	65.8	68.8	71.8	74.8	77.5	78.8	77.5	73.8	70.1	64.9	59.8	54.6	49.5	124.5
1584	42.9	46.9	50.9	54.9	58.9	62.9	66.9	69.9	72.9	75.9	78.6	79.9	78.6	74.9	71.2	66.0	60.9	55.7	50.6	125.6
1995	44.0	48.0	52.0	56.0	60.0	64.0	68.0	71.0	74.0	77.0	79.7	81.0	79.7	76.0	72.3	67.1	62.0	56.8	51.7	126.7
2511	45.1	49.1	53.1	57.1	61.1	65.1	69.1	72.1	75.1	78.1	80.8	82.1	80.8	77.1	73.4	68.2	63.1	57.9	52.8	127.8
3162	46.3	50.3	54.3	58.3	62.3	66.3	70.3	73.3	76.3	79.3	82.0	83.3	82.0	78.3	74.6	69.4	64.3	59.1	54.0	129.0
3981	47.7	51.7	55.7	59.7	63.7	67.7	71.7	74.7	77.7	80.7	83.4	84.7	83.4	79.7	76.0	70.8	65.7	60.5	55.4	130.4
5011	48.9	52.9	56.9	60.9	64.9	68.9	72.9	75.9	78.9	81.9	84.6	85.9	84.6	80.9	77.2	72.0	66.9	61.7	56.6	131.6
6309	50.5	54.5	58.5	62.5	66.5	70.5	74.5	77.5	80.5	83.5	86.2	87.5	86.2	82.5	78.8	73.6	68.5	63.3	58.2	133.2
7943	52.4	56.4	60.4	64.4	68.4	72.4	76.4	79.4	82.4	85.4	88.1	89.4	88.1	84.4	80.7	75.5	70.4	65.2	60.1	135.1
9999	54.7	58.7	62.7	66.7	70.7	74.7	78.7	81.7	84.7	87.7	90.4	91.7	90.4	86.7	83.0	77.8	72.7	67.5	62.4	137.4
OSPL	59.5	63.5	67.5	71.5	75.5	79.5	83.5	86.5	89.5	92.5	95.2	96.5	95.2	91.5	87.8	82.7	77.5	72.4	67.2	142.3
PNL	71.1	75.1	79.2	83.2	87.2	91.2	95.3	98.3	101.3	104.3	107.0	108.3	107.0	103.3	99.6	94.4	89.2	84.1	78.9	
PNLT	71.1	75.2	79.2	83.2	87.2	91.3	95.3	98.3	101.3	104.3	107.0	108.3	107.0	103.3	99.6	94.4	89.3	84.1	78.9	

TABLE VIII. - Concluded.

QSRA (YF102) NOISE: SINGLE ENGINE, NO FLAPS, NO ATTENUATION

ENGINE PERFORMANCE PARAMETER = 87.70

NOISE SPECTRA OF TOTAL OF ALL SOURCES
1 ENGINE(S) AT A CONSTANT RADIUS OF 100.0 FEET, IN THE PLANE OF PHI = 0.0 DEGREES

SOURCES AND EFFECTS INCLUDED ARE DESIGNATED BY CODE > OR =1.
SOURCES: IFAN =1, IJET =1, IFLAP =0, ICORE =1, ITURB =1, IAIRF =0, IREVR =0
PROPAGATION EFFECTS: IATM =0, IGND =1, IEGA =0, IDOP =0, ISHLD =0, ICORR =1

	POLAR ANGLE, THETA, DEGREES																		POWER LEVEL
FREQ	0.0	10.0	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	170.0	180.0	
50	78.8	78.9	79.0	79.2	79.4	79.8	80.2	80.7	81.3	81.9	82.7	83.6	83.6	87.5	91.5	93.8	96.0	93.4	91.6	134.9
63	80.2	80.3	80.4	80.7	81.0	81.4	81.8	82.3	83.0	83.8	84.7	85.6	86.0	90.0	93.9	96.2	98.3	95.9	94.2	137.1
79	81.4	81.5	81.7	81.9	82.3	82.8	83.3	83.9	84.6	85.4	86.4	87.4	88.2	91.9	95.7	98.2	99.7	97.7	95.7	138.9
99	82.3	82.4	82.6	83.0	83.4	84.0	84.6	85.2	86.0	86.9	87.9	88.9	90.0	93.4	97.2	99.9	100.4	98.3	96.2	140.2
125	83.1	83.2	83.5	83.8	84.3	85.0	85.6	86.3	87.1	88.1	89.3	90.3	91.6	94.7	98.3	101.1	100.7	98.0	95.7	141.2
158	83.8	83.9	84.2	84.6	85.2	85.9	86.6	87.3	88.2	89.2	90.4	91.5	92.9	95.8	99.0	102.0	100.5	97.2	94.7	141.9
199	84.2	84.4	84.7	85.2	85.9	86.7	87.4	88.1	89.0	90.0	91.3	92.4	94.0	96.6	99.4	101.9	99.5	96.3	93.6	142.1
251	84.5	84.7	85.1	85.7	86.4	87.3	88.0	88.7	89.6	90.7	92.0	93.2	94.7	97.1	99.4	101.1	98.1	95.2	92.4	142.1
316	84.7	85.0	85.4	86.0	86.9	87.9	88.6	89.1	90.0	91.2	92.5	93.7	95.3	97.4	98.9	99.9	96.6	94.0	91.2	141.8
398	84.8	85.1	85.6	86.3	87.4	88.6	89.2	89.5	90.3	91.5	92.8	94.0	95.6	97.5	98.2	98.6	95.1	92.7	90.1	141.6
501	84.9	85.2	85.8	86.7	88.1	89.5	90.0	89.8	90.4	91.5	92.9	94.2	95.7	97.3	97.4	97.2	94.0	91.3	89.0	141.3
630	85.1	85.5	86.3	87.4	89.2	90.8	91.2	90.3	90.4	91.5	92.9	94.2	95.7	96.9	96.5	95.8	92.3	90.0	88.1	141.1
794	85.7	86.3	87.3	88.7	91.0	92.7	92.9	91.2	90.6	91.5	92.8	94.2	95.4	96.3	95.3	94.4	90.8	88.8	87.3	141.0
999	87.1	87.9	89.1	90.7	93.3	95.2	95.3	92.8	91.2	91.7	92.8	94.1	95.2	95.7	94.3	93.2	89.8	88.1	86.9	141.5
1258	89.0	89.9	91.2	93.0	95.8	97.7	97.7	94.8	92.2	92.3	93.2	94.2	95.0	95.1	93.6	92.3	89.4	88.1	87.2	142.5
1584	91.5	92.4	93.8	95.7	98.6	100.5	100.5	97.3	94.1	93.6	94.1	94.8	95.2	95.0	93.5	92.3	90.2	89.2	88.5	144.3
1995	94.2	95.2	96.7	98.6	101.5	103.5	103.5	100.1	96.5	95.5	95.7	96.0	96.1	95.7	94.4	93.3	91.9	91.1	90.5	146.7
2511	91.8	92.8	94.2	95.9	98.7	100.5	100.5	97.2	93.9	93.4	94.0	94.6	94.8	94.4	92.8	91.1	89.4	88.5	87.8	144.2
3162	90.1	91.0	92.3	93.7	96.1	97.8	97.7	94.5	91.8	91.9	93.0	94.0	94.3	93.8	92.0	89.6	87.3	86.0	85.2	142.2
3981	99.9	101.3	102.8	102.9	103.1	102.3	100.6	98.0	96.5	97.4	98.9	100.6	101.5	101.4	99.4	96.0	92.6	89.1	85.7	148.2
5011	89.6	90.6	91.7	92.1	93.2	93.4	92.9	90.6	89.8	91.4	93.3	94.7	95.0	94.6	92.4	88.9	85.4	82.5	80.8	140.6
6309	90.1	91.1	92.2	92.4	92.9	92.3	91.5	89.8	89.9	91.9	94.1	95.4	95.7	95.2	93.0	89.2	85.4	81.7	79.2	140.9
7943	95.8	97.1	98.5	98.5	98.6	97.5	95.7	93.9	93.9	95.8	97.8	99.5	100.0	99.8	97.7	94.0	90.3	86.2	81.9	145.4
9999	90.8	91.8	92.8	92.9	93.0	91.6	90.4	89.9	91.3	93.7	96.1	97.5	97.4	96.4	94.1	90.0	85.9	81.3	77.4	142.1
OSPL	104.4	105.5	106.8	107.5	108.9	109.8	109.5	106.9	105.2	105.9	107.3	108.5	109.3	110.0	110.3	111.1	109.7	107.1	105.0	156.5
PNL	119.5	120.7	122.0	122.5	123.4	123.5	122.7	120.4	119.1	119.9	121.3	122.6	123.4	123.7	122.6	120.9	118.3	115.6	113.7	
PNLT	122.8	124.2	125.5	125.8	126.2	125.7	124.4	122.2	121.0	121.8	123.2	124.7	125.7	126.1	125.0	123.2	120.3	117.2	114.6	

TABLE IX. - OUTPUT FROM EXAMPLE FIVE

```
                    APPROACH NOISE CALC FOR GE EEE AIRCRAFT
 OBSERVER COORDINATES (IN FEET).
   XO: -7518.0
   YO:     0.0
   ZO:     0.0
 AIRCRAFT TRAJECTORY POINTS AND OPERATING CONDITIONS.
   XA: -7518.0      0.0
   YA:     0.0      0.0
   ZA:   394.0      0.0
  EPP:    24.5     24.5
   VA:   228.0    228.0
 ALF1:     8.8      8.8
  GAM:     0.0      0.0
  PSY:     0.0      0.0
FLAPA:    42.0     42.0
 ILGR:       1        1
IREVR:       0        0


                 SPECTRA FOR EACH NOISE SOURCE
  FREQ      50     63     79     99    125    158    199    251    316    398    501    630    794    999   1258   1584   1995
          2511   3162   3981   5011   6309   7943   9999
          SOURCES WHEN   XO=-7518.0 FT,  YO=    0.0 FT,  TAU =   -3.8 SEC,  R = 1206.0 FT,  THETA =  27.9 DEG
FAN   :   10.9   17.3   23.3   28.8   34.0   38.7   43.2   47.0   50.6   53.6   56.1   58.3   59.9   61.0   69.5   61.7   61.3
          66.6   64.5   67.6   67.1   66.6   65.3   64.5                       OASPL =   76.5 PNL =   89.4 PNLT =   92.1
JET   :   46.9   47.5   47.8   48.0   48.1   48.0   47.6   47.1   46.5   45.8   44.9   43.9   42.8   41.7   40.6   39.5   38.4
          37.2   36.0   34.8   33.6   32.5   31.3   30.1                       OASPL =   58.3 PNL =   63.9 PNLT =   63.9
CORE  :   36.1   38.7   41.3   43.9   45.8   47.8   49.7   50.8   51.8   52.3   52.5   52.2   51.8   51.2   50.2   49.3   48.3
          46.9   45.5   44.1   42.6   40.9   39.2   37.5                       OASPL =   62.4 PNL =   71.8 PNLT =   71.9
TURB  :   28.2   29.1   30.0   30.9   31.8   32.7   33.6   34.6   35.4   36.2   37.0   37.8   38.6   39.3   40.0   40.5   41.2
          41.8   42.2   44.2   42.4   41.4   41.0   40.4                       OASPL =   52.8 PNL =   66.2 PNLT =   66.7
AIRFR :   66.5   67.5   67.7   67.3   66.8   66.3   65.9   65.3   64.8   64.2   63.6   63.0   61.2   58.4   55.8   53.4   51.1
          49.1   47.2   45.6   44.2   42.8   41.6   40.4                       OASPL =   77.0 PNL =   81.0 PNLT =   81.1
TOTALS:   69.6   70.6   70.7   70.3   69.8   69.3   68.8   68.2   67.7   67.2   66.8   66.5   65.6   64.6   70.7   63.1   61.7
          65.3   61.4   61.5   56.7   49.6   38.1   22.0                       OASPL =   80.9 PNL =   89.2 PNLT =   91.5

          SOURCES WHEN   XO=-7518.0 FT,  YO=    0.0 FT,  TAU =   -3.4 SEC,  R = 1098.9 FT,  THETA =  29.8 DEG
FAN   :   11.7   18.1   24.1   29.6   34.9   39.6   44.0   47.8   51.4   54.4   56.9   59.1   60.7   61.8   70.2   62.5   62.1
          67.4   65.3   68.3   67.9   67.4   66.1   65.2                       OASPL =   77.2 PNL =   90.1 PNLT =   92.8
JET   :   47.7   48.3   48.7   48.9   48.9   48.8   48.5   48.0   47.3   46.6   45.7   44.7   43.7   42.6   41.5   40.4   39.2
          38.0   36.8   35.7   34.5   33.3   32.1   30.9                       OASPL =   59.2 PNL =   64.7 PNLT =   64.8
CORE  :   37.2   39.8   42.4   45.0   46.9   48.9   50.8   51.9   52.8   53.4   53.6   53.3   52.9   52.2   51.3   50.3   49.3
          47.9   46.5   45.1   43.7   42.0   40.3   38.6                       OASPL =   63.4 PNL =   72.9 PNLT =   72.9
TURB  :   29.7   30.6   31.5   32.4   33.3   34.2   35.1   36.1   36.9   37.7   38.5   39.3   40.1   40.8   41.5   42.1   42.7
          43.3   43.7   45.7   44.0   42.9   42.5   41.9                       OASPL =   54.4 PNL =   67.9 PNLT =   68.3
AIRFR :   67.4   68.5   68.6   68.2   67.7   67.3   66.8   66.3   65.7   65.2   64.6   64.0   62.1   59.4   56.8   54.4   52.2
          50.2   48.4   46.8   45.4   44.1   42.9   41.7                       OASPL =   78.0 PNL =   82.0 PNLT =   82.1
TOTALS:   70.5   71.5   71.6   71.2   70.7   70.3   69.8   69.2   68.7   68.2   67.8   67.5   66.6   65.6   71.7   64.2   62.8
          66.5   62.8   63.0   58.7   52.1   41.5   26.6                       OASPL =   81.9 PNL =   90.4 PNLT =   92.7
```

TABLE IX. - Continued.

```
          SOURCES WHEN  XO=-7518.0 FT,  YO=    0.0 FT,  TAU =   -3.0 SEC,  R =  993.3 FT,  THETA =  32.2 DEG
FAN    :  12.7   19.0   25.0   30.5   35.8   40.5   44.9   48.7   52.3   55.3   57.8   60.0   61.5   62.7   71.0   63.3   62.9
          68.2   66.1   69.1   68.7   68.2   66.9   66.0                        OASPL =   78.1 PNL =   91.0 PNLT =   93.7
JET    :  48.7   49.2   49.6   49.8   49.9   49.7   49.4   48.9   48.3   47.6   46.6   45.6   44.6   43.5   42.4   41.3   40.1
          38.9   37.7   36.6   35.4   34.2   33.0   31.8                        OASPL =   60.1 PNL =   65.7 PNLT =   65.7
CORE   :  38.4   41.0   43.6   46.2   48.1   50.1   52.0   53.1   54.0   54.6   54.7   54.4   54.0   53.4   52.4   51.4   50.5
          49.1   47.6   46.2   44.8   43.1   41.4   39.7                        OASPL =   64.6 PNL =   74.1 PNLT =   74.1
TURB   :  31.4   32.3   33.2   34.1   35.0   35.9   36.8   37.8   38.6   39.4   40.2   41.0   41.8   42.5   43.2   43.8   44.4
          45.0   45.4   47.5   45.7   44.7   44.3   43.7                        OASPL =   56.1 PNL =   69.7 PNLT =   70.1
AIRFR  :  68.5   69.5   69.6   69.2   68.7   68.3   67.8   67.3   66.8   66.2   65.6   65.0   63.1   60.4   57.9   55.5   53.4
          51.4   49.7   48.1   46.8   45.5   44.3   43.2                        OASPL =   79.0 PNL =   83.1 PNLT =   83.3
TOTALS:   71.5   72.5   72.6   72.2   71.8   71.3   70.8   70.3   69.8   69.3   68.9   68.6   67.7   66.7   72.7   65.3   64.0
          67.7   64.2   64.7   60.6   54.6   44.8   31.2                        OASPL =   83.0 PNL =   91.7 PNLT =   93.9

          SOURCES WHEN  XO=-7518.0 FT,  YO=    0.0 FT,  TAU =   -2.6 SEC,  R =  889.7 FT,  THETA =  35.1 DEG
FAN    :  13.7   20.0   26.0   31.5   36.8   41.4   45.8   49.7   53.2   56.2   58.7   60.9   62.5   63.6   71.9   64.2   63.8
          69.1   67.0   70.0   69.5   69.0   67.7   66.8                        OASPL =   78.9 PNL =   91.8 PNLT =   94.5
JET    :  49.7   50.2   50.6   50.8   50.9   50.7   50.4   49.9   49.2   48.5   47.6   46.6   45.6   44.5   43.4   42.3   41.1
          39.9   38.7   37.5   36.4   35.2   34.0   32.8                        OASPL =   61.1 PNL =   66.8 PNLT =   66.8
CORE   :  39.8   42.4   45.0   47.5   49.5   51.5   53.3   54.4   55.3   55.9   56.0   55.7   55.3   54.7   53.7   52.7   51.7
          50.3   48.9   47.5   46.1   44.4   42.7   41.0                        OASPL =   65.9 PNL =   75.4 PNLT =   75.5
TURB   :  33.5   34.4   35.3   36.2   37.1   38.0   38.9   39.9   40.7   41.5   42.3   43.1   43.9   44.6   45.3   45.9   46.5
          47.1   47.5   49.5   47.7   46.7   46.3   45.7                        OASPL =   58.2 PNL =   71.8 PNLT =   72.2
AIRFR  :  69.6   70.6   70.7   70.3   69.8   69.4   68.9   68.4   67.9   67.3   66.7   66.1   64.2   61.5   59.1   56.8   54.7
          52.8   51.1   49.6   48.3   47.0   45.8   44.7                        OASPL =   80.1 PNL =   84.4 PNLT =   84.5
TOTALS:   72.6   73.6   73.7   73.3   72.9   72.4   71.9   71.4   70.9   70.5   70.1   69.8   68.8   67.9   73.8   66.5   65.2
          69.0   65.6   66.3   62.7   57.1   48.2   35.8                        OASPL =   84.1 PNL =   93.1 PNLT =   95.3

          SOURCES WHEN  XO=-7518.0 FT,  YO=    0.0 FT,  TAU =   -2.2 SEC,  R =  789.1 FT,  THETA =  38.7 DEG
FAN    :  14.8   21.2   27.1   32.6   37.9   42.5   46.9   50.7   54.3   57.2   59.8   61.9   63.5   64.6   72.8   65.1   64.8
          70.0   67.9   70.9   70.4   69.9   68.6   67.7                        OASPL =   79.8 PNL =   92.8 PNLT =   95.4
JET    :  50.8   51.4   51.7   51.9   52.0   51.8   51.5   51.0   50.4   49.7   48.7   47.7   46.6   45.5   44.4   43.3   42.2
          41.0   39.8   38.6   37.5   36.3   35.1   33.9                        OASPL =   62.2 PNL =   67.9 PNLT =   67.9
CORE   :  41.4   44.0   46.6   49.1   51.1   53.0   54.9   56.0   56.8   57.4   57.5   57.2   56.8   56.1   55.2   54.2   53.2
          51.8   50.4   49.0   47.5   45.8   44.1   42.4                        OASPL =   67.4 PNL =   76.9 PNLT =   77.0
TURB   :  35.8   36.7   37.6   38.5   39.4   40.3   41.2   42.2   43.0   43.8   44.6   45.4   46.2   46.9   47.6   48.2   48.8
          49.4   49.8   51.9   50.1   49.1   48.7   48.1                        OASPL =   60.6 PNL =   74.2 PNLT =   74.7
AIRFR  :  70.8   71.8   71.9   71.4   71.0   70.6   70.1   69.6   69.1   68.5   67.9   67.3   65.3   62.8   60.3   58.1   56.1
          54.3   52.7   51.2   49.9   48.7   47.6   46.5                        OASPL =   81.3 PNL =   85.7 PNLT =   85.9
TOTALS:   73.8   74.8   74.9   74.5   74.1   73.6   73.2   72.7   72.2   71.8   71.4   71.1   70.1   69.1   74.9   67.7   66.5
          70.4   67.1   68.0   64.7   59.7   51.6   40.4                        OASPL =   85.4 PNL =   94.5 PNLT =   96.6

          SOURCES WHEN  XO=-7518.0 FT,  YO=    0.0 FT,  TAU =   -1.8 SEC,  R =  692.6 FT,  THETA =  43.4 DEG
FAN    :  15.4   21.7   27.7   33.2   38.4   43.0   47.4   51.2   54.7   57.7   60.2   62.3   63.9   64.9   73.4   65.5   65.1
          70.5   68.2   71.3   70.8   70.2   68.8   67.9                        OASPL =   80.2 PNL =   93.1 PNLT =   95.9
JET    :  52.1   52.6   53.0   53.2   53.2   53.1   52.7   52.2   51.6   50.9   49.9   48.9   47.8   46.7   45.6   44.5   43.4
          42.2   41.0   39.8   38.6   37.5   36.3   35.1                        OASPL =   63.4 PNL =   69.2 PNLT =   69.2
CORE   :  43.3   45.9   48.5   51.0   52.9   54.9   56.7   57.8   58.6   59.1   59.3   59.0   58.5   57.9   56.9   55.9   54.9
          53.5   52.1   50.7   49.2   47.5   45.8   44.1                        OASPL =   69.2 PNL =   78.7 PNLT =   78.8
TURB   :  38.7   39.6   40.5   41.4   42.3   43.2   44.1   45.1   45.9   46.7   47.5   48.3   49.1   49.8   50.5   51.1   51.7
          52.3   52.7   54.8   53.0   51.9   51.5   50.9                        OASPL =   63.4 PNL =   77.1 PNLT =   77.6
AIRFR  :  72.1   73.1   73.1   72.7   72.3   71.9   71.4   71.0   70.4   69.9   69.2   68.6   66.6   64.1   61.7   59.6   57.6
          55.9   54.4   53.0   51.7   50.5   49.4   48.3                        OASPL =   82.6 PNL =   87.2 PNLT =   87.3
TOTALS:   75.1   76.1   76.1   75.7   75.3   74.9   74.5   74.1   73.6   73.1   72.7   72.3   71.2   70.1   75.6   68.6   67.4
          71.2   68.0   69.2   66.2   61.7   54.3   44.2                        OASPL =   86.6 PNL =   95.6 PNLT =   97.7
```

TABLE IX. - Continued.

SOURCES WHEN XO=-7518.0 FT, YO= 0.0 FT, TAU = -1.4 SEC, R = 602.3 FT, THETA = 49.6 DEG

FAN :	15.6	21.9	27.9	33.3	38.5	43.1	47.5	51.3	54.8	57.7	60.2	62.3	63.8	64.8	73.6	65.3	65.0
	70.6	68.0	71.3	70.7	70.0	68.5	67.5				OASPL = 80.2	PNL = 93.1	PNLT = 95.9				
JET :	53.5	54.0	54.3	54.6	54.6	54.4	54.1	53.6	52.9	52.2	51.2	50.2	49.2	48.1	47.0	45.9	44.7
	43.5	42.3	41.1	40.0	38.8	37.6	36.4				OASPL = 64.8	PNL = 70.6	PNLT = 70.6				
CORE :	45.5	48.1	50.7	53.1	55.1	57.1	58.8	59.9	60.7	61.2	61.3	61.0	60.6	59.8	58.9	57.9	56.9
	55.4	54.0	52.6	51.2	49.5	47.8	46.1				OASPL = 71.2	PNL = 80.8	PNLT = 80.8				
TURB :	42.1	43.0	43.9	44.8	45.7	46.6	47.5	48.5	49.3	50.1	50.9	51.7	52.5	53.2	53.9	54.5	55.1
	55.7	56.1	58.3	56.4	55.3	55.0	54.3				OASPL = 66.8	PNL = 80.6	PNLT = 81.1				
AIRFR :	73.4	74.4	74.4	74.0	73.6	73.2	72.8	72.3	71.8	71.2	70.6	70.0	67.8	65.4	63.1	61.1	59.3
	57.7	56.2	54.9	53.7	52.5	51.4	50.3				OASPL = 83.9	PNL = 88.7	PNLT = 88.9				
TOTALS:	76.5	77.5	77.4	77.0	76.7	76.3	75.9	75.5	75.0	74.5	74.1	73.6	72.3	71.1	76.1	69.3	68.2
	71.9	68.6	70.0	67.2	63.1	56.4	47.4				OASPL = 87.8	PNL = 96.6	PNLT = 98.6				

SOURCES WHEN XO=-7518.0 FT, YO= 0.0 FT, TAU = -0.9 SEC, R = 521.3 FT, THETA = 57.8 DEG

FAN :	15.4	21.7	27.5	33.0	38.1	42.7	47.0	50.8	54.2	57.2	59.6	61.7	63.2	64.2	72.8	64.6	64.4
	69.9	67.3	70.5	69.8	69.1	67.5	66.5				OASPL = 79.4	PNL = 92.3	PNLT = 95.1				
JET :	55.0	55.5	55.9	56.1	56.1	55.9	55.5	55.0	54.3	53.6	52.7	51.7	50.6	49.5	48.4	47.3	46.1
	44.9	43.7	42.5	41.3	40.2	39.0	37.8				OASPL = 66.3	PNL = 72.1	PNLT = 72.1				
CORE :	47.7	50.3	52.9	55.2	57.2	59.2	60.8	61.9	62.7	63.1	63.2	62.9	62.4	61.6	60.7	59.7	58.6
	57.2	55.8	54.4	52.9	51.2	49.5	47.8				OASPL = 73.1	PNL = 82.6	PNLT = 82.6				
TURB :	46.2	47.1	48.0	48.9	49.8	50.7	51.6	52.6	53.4	54.2	55.0	55.8	56.6	57.3	58.0	58.6	59.2
	59.8	60.2	62.5	60.5	59.5	59.1	58.4				OASPL = 70.9	PNL = 84.8	PNLT = 85.3				
AIRFR :	74.7	75.7	75.5	75.2	74.9	74.5	74.1	73.6	73.1	72.5	71.9	71.2	69.0	66.7	64.5	62.6	60.9
	59.4	58.1	56.8	55.6	54.5	53.4	52.4				OASPL = 85.2	PNL = 90.2	PNLT = 90.3				
TOTALS:	77.8	78.8	78.6	78.3	78.0	77.6	77.3	76.9	76.4	75.9	75.4	74.9	73.3	72.0	75.9	70.0	69.1
	72.0	69.0	70.4	67.7	64.0	57.9	49.9				OASPL = 88.9	PNL = 97.3	PNLT = 99.0				

SOURCES WHEN XO=-7518.0 FT, YO= 0.0 FT, TAU = -0.5 SEC, R = 454.7 FT, THETA = 68.7 DEG

FAN :	15.3	21.6	27.4	32.8	37.9	42.5	46.7	50.5	53.9	56.8	59.2	61.3	62.7	63.7	71.6	64.0	64.5
	69.4	67.0	69.8	69.0	68.3	66.5	65.4				OASPL = 78.6	PNL = 91.7	PNLT = 94.2				
JET :	56.6	57.1	57.4	57.6	57.6	57.4	57.0	56.5	55.8	55.1	54.1	53.1	52.0	50.9	49.8	48.7	47.5
	46.3	45.1	43.9	42.7	41.6	40.4	39.2				OASPL = 67.8	PNL = 73.6	PNLT = 73.6				
CORE :	49.9	52.5	55.1	57.3	59.3	61.3	62.8	63.9	64.6	65.0	64.9	64.6	64.1	63.3	62.3	61.3	60.2
	58.8	57.4	55.9	54.4	52.7	51.0	49.3				OASPL = 74.9	PNL = 84.3	PNLT = 84.3				
TURB :	50.2	51.1	52.0	52.9	53.8	54.7	55.6	56.6	57.4	58.2	59.0	59.8	60.6	61.3	62.0	62.6	63.2
	63.8	64.2	66.7	64.5	63.5	63.3	62.5				OASPL = 75.0	PNL = 89.0	PNLT = 89.5				
AIRFR :	75.7	76.7	76.4	76.1	75.8	75.5	75.1	74.7	74.1	73.5	72.9	72.1	69.8	67.6	65.7	64.0	62.4
	61.0	59.7	58.5	57.4	56.3	55.3	54.2				OASPL = 86.2	PNL = 91.3	PNLT = 91.5				
TOTALS:	78.8	79.8	79.5	79.2	78.9	78.7	78.4	78.0	77.6	77.1	76.5	76.0	74.3	73.1	75.6	71.3	70.7
	72.6	70.3	71.4	68.6	65.1	59.8	52.6				OASPL = 89.9	PNL = 98.3	PNLT = 99.4				

SOURCES WHEN XO=-7518.0 FT, YO= 0.0 FT, TAU = -0.0 SEC, R = 409.6 FT, THETA = 82.7 DEG

FAN :	17.8	24.0	29.8	35.2	40.2	44.8	49.0	52.8	56.1	59.0	61.4	63.4	64.8	65.7	72.5	65.8	67.2
	71.4	70.9	69.6	70.6	69.8	68.0	66.6				OASPL = 80.2	PNL = 93.2	PNLT = 95.4				
JET :	58.1	58.6	58.9	59.0	59.0	58.7	58.3	57.8	57.1	56.3	55.3	54.3	53.2	52.1	51.0	49.9	48.7
	47.5	46.3	45.1	44.0	42.8	41.6	40.4				OASPL = 69.1	PNL = 74.9	PNLT = 74.9				
CORE :	52.3	54.9	57.5	59.6	61.6	63.5	64.9	65.9	66.5	66.8	66.7	66.4	65.8	64.9	63.9	63.0	61.7
	60.3	58.9	57.5	55.9	54.2	52.5	50.8				OASPL = 76.7	PNL = 86.0	PNLT = 86.1				
TURB :	54.5	55.4	56.3	57.2	58.1	59.0	59.9	60.9	61.7	62.5	63.3	64.1	64.9	65.6	66.3	66.9	67.5
	68.1	68.5	71.2	68.8	67.7	67.6	66.8				OASPL = 79.3	PNL = 93.4	PNLT = 94.2				
AIRFR :	75.9	76.6	76.4	76.2	76.0	75.7	75.4	74.9	74.4	73.8	73.1	72.0	69.9	67.9	66.2	64.7	63.2
	62.0	60.8	59.6	58.5	57.5	56.4	55.4				OASPL = 86.3	PNL = 91.8	PNLT = 91.9				
TOTALS:	79.0	79.7	79.5	79.4	79.2	79.1	78.9	78.6	78.2	77.8	77.3	76.6	75.5	74.7	76.9	73.5	73.5
	75.1	74.2	73.7	71.4	68.1	63.4	56.8				OASPL = 90.6	PNL = 100.2	PNLT = 101.1				

TABLE IX. - Continued.

```
         SOURCES WHEN   XO=-7518.0 FT,  YO=    0.0 FT,  TAU =    0.4 SEC,  R =  393.5 FT,  THETA =  98.8 DEG
FAN    :  22.3   28.4   34.1   39.5   44.4   48.9   53.0   56.7   59.9   62.8   65.1   67.0   68.3   76.0   69.5   69.0   73.4
          71.7   73.9   73.5   72.9   71.7   70.6   69.0                        OASPL =   83.3 PNL =   96.2 PNLT =  98.6
JET    :  59.2   59.6   59.9   60.0   59.9   59.6   59.2   58.6   57.9   57.1   56.1   55.1   54.0   52.9   51.8   50.6   49.5
          48.3   47.1   45.9   44.7   43.5   42.4   41.2                        OASPL =   70.0 PNL =   75.7 PNLT =  75.7
CORE   :  55.0   57.6   60.1   62.1   64.1   66.0   67.2   68.1   68.7   68.9   68.6   68.3   67.6   66.7   65.7   64.8   63.4
          62.0   60.6   59.1   57.5   55.8   54.1   52.4                        OASPL =   78.8 PNL =   87.9 PNLT =  87.9
TURB   :  59.4   60.3   61.2   62.1   63.0   63.9   64.8   65.8   66.6   67.4   68.2   69.0   69.8   70.5   71.2   71.8   72.4
          73.0   74.9   72.0   70.7   70.3   69.0   68.8                        OASPL =   83.3 PNL =   97.2 PNLT =  97.8
AIRFR  :  74.6   75.0   75.0   74.9   74.9   74.7   74.4   73.9   73.4   72.7   72.0   70.6   68.8   67.1   65.6   64.3   63.0
          61.8   60.7   59.6   58.6   57.5   56.5   55.5                        OASPL =   85.2 PNL =   90.9 PNLT =  91.0
TOTALS:   77.9   78.4   78.4   78.5   78.6   78.6   78.6   78.5   78.3   78.1   77.9   77.6   77.3   80.3   77.1   76.8   78.3
          77.3   78.6   76.1   73.7   70.5   65.8   59.6                        OASPL =   91.3 PNL =  102.8 PNLT = 103.8

         SOURCES WHEN   XO=-7518.0 FT,  YO=    0.0 FT,  TAU =    1.0 SEC,  R =  409.6 FT,  THETA = 115.0 DEG
FAN    :  24.7   30.7   36.3   41.6   46.4   50.9   54.9   58.5   61.6   64.4   66.6   68.4   69.6   77.3   70.6   70.1   74.6
          72.6   74.9   74.4   73.6   72.2   71.0   69.4                        OASPL =   84.3 PNL =   97.2 PNLT =  99.6
JET    :  59.6   59.9   60.2   60.3   60.2   59.8   59.4   58.8   53.1   57.2   56.2   55.2   54.1   53.0   51.9   50.7   49.5
          48.3   47.2   46.0   44.8   43.6   42.4   41.2                        OASPL =   70.3 PNL =   75.8 PNLT =  75.9
CORE   :  55.9   58.4   60.9   62.9   64.8   66.6   67.7   68.5   69.0   69.1   68.9   68.4   67.7   66.7   65.8   64.7   63.3
          61.9   60.5   59.0   57.3   55.6   53.9   52.2                        OASPL =   79.0 PNL =   88.0 PNLT =  88.0
TURB   :  59.0   59.9   60.8   61.7   62.6   63.5   64.4   65.4   66.2   67.0   67.8   68.6   69.4   70.1   70.9   71.4   72.0
          72.6   74.8   71.6   70.3   70.1   68.7   68.5                        OASPL =   83.0 PNL =   97.0 PNLT =  97.9
AIRFR  :  71.3   71.7   72.0   72.2   72.2   72.2   71.9   71.5   70.9   70.1   69.3   67.9   66.4   65.0   63.8   62.6   61.4
          60.3   59.3   58.2   57.2   56.1   55.1   54.1                        OASPL =   82.5 PNL =   88.6 PNLT =  88.6
TOTALS:   74.9   75.4   75.8   76.2   76.5   76.8   77.0   77.1   77.1   77.1   77.1   77.1   77.1   81.1   77.1   76.8   78.8
          77.4   78.9   76.3   73.8   70.5   65.5   59.0                        OASPL =   90.5 PNL =  102.6 PNLT = 103.9

         SOURCES WHEN   XO=-7518.0 FT,  YO=    0.0 FT,  TAU =    1.5 SEC,  R =  454.7 FT,  THETA = 128.9 DEG
FAN    :  24.9   30.9   36.4   41.6   46.4   50.8   54.7   58.2   61.3   64.0   66.1   67.9   69.0   76.3   69.9   69.3   73.6
          71.6   73.8   73.3   72.5   71.0   69.7   68.1                        OASPL =   83.3 PNL =   96.2 PNLT =  98.5
JET    :  59.7   60.0   60.1   60.1   59.7   59.2   58.5   57.7   56.8   55.7   54.6   53.5   52.3   51.1   50.0   48.8   47.6
          46.4   45.2   44.1   42.9   41.7   40.5   39.3                        OASPL =   69.6 PNL =   74.2 PNLT =  74.3
CORE   :  55.2   57.8   60.1   62.1   64.1   65.7   66.8   67.5   68.0   68.0   67.7   67.2   66.4   65.4   64.5   63.3   61.9
          60.5   59.1   57.6   55.9   54.2   52.5   50.8                        OASPL =   77.9 PNL =   86.7 PNLT =  86.7
TURB   :  53.5   54.4   55.3   56.2   57.1   58.0   58.9   59.9   60.7   61.5   62.3   63.1   63.9   64.6   65.3   65.9   66.5
          67.1   68.6   66.0   64.7   64.2   63.1   62.8                        OASPL =   77.2 PNL =   91.1 PNLT =  91.5
AIRFR  :  66.3   67.1   67.9   68.4   68.7   68.8   68.5   68.1   67.5   66.6   65.7   64.5   63.3   62.2   61.0   59.9   58.9
          57.8   56.8   55.7   54.7   53.7   52.7   51.7                        OASPL =   78.9 PNL =   85.5 PNLT =  85.5
TOTALS:   70.6   71.5   72.3   73.0   73.6   74.0   74.3   74.4   74.5   74.5   74.6   74.8   74.8   79.4   74.7   74.0   76.5
          74.7   75.8   73.8   71.2   67.3   62.0   54.6                        OASPL =   87.8 PNL =   99.7 PNLT = 101.2

         SOURCES WHEN   XO=-7518.0 FT,  YO=    0.0 FT,  TAU =    2.1 SEC,  R =  521.3 FT,  THETA = 139.8 DEG
FAN    :  22.1   28.0   33.4   38.6   43.3   47.7   51.6   55.1   58.1   60.8   62.8   64.6   65.6   72.7   66.4   65.8   70.0
          68.0   70.2   69.6   68.7   67.2   65.9   64.2                        OASPL =   79.7 PNL =   92.6 PNLT =  94.8
JET    :  59.8   59.7   59.3   58.8   58.1   57.1   56.0   54.7   53.5   52.2   50.9   49.7   48.5   47.3   46.1   44.9   43.7
          42.4   41.2   40.0   38.7   37.5   36.3   35.0                        OASPL =   67.9 PNL =   70.7 PNLT =  70.7
CORE   :  54.0   56.6   58.9   60.8   62.8   64.3   65.4   66.1   66.4   66.4   66.1   65.6   64.7   63.8   62.8   61.6   60.2
          58.8   57.4   55.9   54.2   52.5   50.8   49.1                        OASPL =   76.4 PNL =   85.0 PNLT =  85.0
TURB   :  47.7   48.6   49.5   50.4   51.3   52.2   53.1   54.1   54.9   55.7   56.5   57.3   58.1   58.8   59.5   60.1   60.7
          61.3   62.4   60.3   59.0   58.3   57.4   57.0                        OASPL =   71.5 PNL =   85.1 PNLT =  85.4
AIRFR  :  62.3   63.5   64.5   65.2   65.5   65.6   65.3   64.9   64.2   63.4   62.4   61.3   60.2   59.1   58.0   57.0   55.9
          54.9   53.8   52.8   51.8   50.8   49.8   48.8                        OASPL =   75.6 PNL =   82.3 PNLT =  82.3
TOTALS:   67.7   68.7   69.5   70.3   70.9   71.4   71.7   71.9   71.9   71.9   71.8   71.8   71.7   75.8   71.1   70.2   72.6
          70.5   71.4   69.4   66.5   62.2   56.3   47.9                        OASPL =   84.6 PNL =   95.7 PNLT =  97.2
```

TABLE IX. - Continued.

```
          SOURCES WHEN   XO=-7518.0 FT,  YO=     0.0 FT,  TAU =     2.6 SEC,  R =  602.3 FT,  THETA = 148.0 DEG
FAN    :  17.7    23.6    29.0    34.2    38.9    43.2    47.0    50.5    53.5    56.2    58.2    59.9    60.9    68.2    61.7    61.0    65.4
          65.0    63.6    64.8    63.9    62.3    60.9    59.2                           OASPL =    74.9 PNL =    87.6 PNLT =    89.9
JET    :  58.3    57.6    56.7    55.5    54.3    53.1    51.8    50.3    49.0    47.7    46.3    44.9    43.6    42.2    40.8    39.5    38.1
          36.8    35.5    34.1    32.8    31.5    30.2    28.8                           OASPL =    64.9 PNL =    65.7 PNLT =    65.7
CORE   :  52.7    55.3    57.5    59.4    61.4    62.8    63.9    64.6    64.9    64.8    64.6    64.0    63.1    62.2    61.2    60.0    58.6
          57.2    55.8    54.2    52.5    50.8    49.1    47.4                           OASPL =    74.8 PNL =    83.4 PNLT =    83.4
TURB   :  42.0    42.9    43.8    44.7    45.6    46.5    47.4    48.4    49.2    50.0    50.8    51.6    52.4    53.1    53.8    54.4    55.0
          55.6    56.5    54.6    53.2    52.5    51.6    51.2                           OASPL =    65.7 PNL =    79.2 PNLT =    79.6
AIRFR  :  62.2    62.7    63.1    63.4    63.6    63.5    63.2    62.7    62.0    61.2    60.3    58.9    57.6    56.3    55.1    54.0    52.9
          51.8    50.8    49.8    48.7    47.7    46.7    45.7                           OASPL =    73.7 PNL =    79.6 PNLT =    79.7
TOTALS:   67.1    67.4    67.9    68.4    68.9    69.4    69.7    69.8    69.8    69.6    69.3    68.9    68.4    71.7    67.3    66.2    68.1
          67.0    65.0    64.1    60.9    56.0    49.4    39.9                           OASPL =    81.6 PNL =    91.3 PNLT =    92.6

          SOURCES WHEN   XO=-7518.0 FT,  YO=     0.0 FT,  TAU =     3.2 SEC,  R =  692.6 FT,  THETA = 154.2 DEG
FAN    :  14.2    20.0    25.4    30.6    35.2    39.5    43.4    46.8    49.8    52.4    54.5    56.1    57.1    64.6    57.8    57.1    61.7
          61.2    59.7    61.0    60.0    58.3    56.9    55.2                           OASPL =    71.2 PNL =    83.8 PNLT =    86.1
JET    :  56.6    55.5    54.3    52.8    51.3    49.9    48.4    46.9    45.4    44.0    42.5    41.0    39.5    38.0    36.5    35.0    33.6
          32.1    30.7    29.2    27.8    26.3    24.9    23.5                           OASPL =    62.4 PNL =    61.6 PNLT =    61.6
CORE   :  51.4    54.0    56.2    58.1    60.1    61.5    62.6    63.2    63.5    63.4    63.1    62.5    61.7    60.7    59.8    58.5    57.1
          55.7    54.3    52.7    51.0    49.3    47.6    45.9                           OASPL =    73.4 PNL =    81.9 PNLT =    81.9
TURB   :  37.4    38.3    39.2    40.1    41.0    41.9    42.8    43.8    44.6    45.4    46.2    47.0    47.8    48.5    49.2    49.8    50.4
          51.0    51.9    50.0    48.6    47.8    47.0    46.6                           OASPL =    61.1 PNL =    74.5 PNLT =    74.8
AIRFR  :  63.0    62.9    62.9    62.8    62.7    62.4    62.0    61.5    60.9    60.2    59.2    57.3    55.6    54.0    52.6    51.3    50.1
          49.0    47.9    46.9    45.8    44.8    43.8    42.7                           OASPL =    72.9 PNL =    77.8 PNLT =    77.9
TOTALS:   67.2    67.1    67.2    67.4    67.8    68.1    68.3    68.4    68.3    68.0    67.6    66.8    66.1    68.5    64.5    63.2    64.6
          63.3    60.9    59.8    56.2    50.7    43.3    32.7                           OASPL =    79.8 PNL =    88.2 PNLT =    89.3

          SOURCES WHEN   XO=-7518.0 FT,  YO=     0.0 FT,  TAU =     3.8 SEC,  R =  789.1 FT,  THETA = 158.9 DEG
FAN    :  11.2    17.1    22.5    27.6    32.2    36.5    40.3    43.8    46.8    49.4    51.4    53.1    54.1    61.6    54.7    54.0    58.7
          58.1    56.5    57.9    56.9    55.1    53.7    51.9                           OASPL =    68.1 PNL =    80.6 PNLT =    83.1
JET    :  55.0    53.6    52.1    50.5    49.0    47.4    45.8    44.2    42.5    41.0    39.3    37.7    36.2    34.6    32.9    31.3    29.8
          28.2    26.7    25.1    23.6    22.1    20.6    19.1                           OASPL =    60.3 PNL =    58.0 PNLT =    58.0
CORE   :  50.2    52.8    55.0    56.9    58.9    60.3    61.3    61.9    62.3    62.1    61.9    61.2    60.4    59.4    58.5    57.2    55.8
          54.4    53.0    51.4    49.7    48.0    46.3    44.6                           OASPL =    72.2 PNL =    80.5 PNLT =    80.6
TURB   :  33.7    34.6    35.5    36.4    37.3    38.2    39.1    40.1    40.9    41.7    42.5    43.3    44.1    44.8    45.5    46.1    46.7
          47.3    48.2    46.3    45.0    44.1    43.3    42.9                           OASPL =    57.4 PNL =    70.7 PNLT =    71.0
AIRFR  :  63.4    63.1    62.8    62.5    62.2    61.8    61.4    60.9    60.3    59.6    58.5    56.3    54.2    52.3    50.6    49.0    47.7
          46.4    45.2    44.1    43.0    42.0    41.0    39.9                           OASPL =    72.5 PNL =    76.5 PNLT =    76.7
TOTALS:   67.2    66.9    66.8    66.8    67.0    67.1    67.3    67.3    67.2    66.8    66.2    65.3    64.3    66.0    62.3    60.9    61.7
          60.2    57.7    56.2    52.2    46.1    37.9    26.1                           OASPL =    78.5 PNL =    85.8 PNLT =    86.7

          SOURCES WHEN   XO=-7518.0 FT,  YO=     0.0 FT,  TAU =     4.4 SEC,  R =  889.7 FT,  THETA = 162.6 DEG
FAN    :   8.5    14.3    19.7    24.8    29.5    33.8    37.6    41.0    44.0    46.6    48.6    50.2    51.2    59.0    51.9    51.2    56.0
          55.4    53.7    55.1    54.1    52.2    50.8    49.0                           OASPL =    65.3 PNL =    77.8 PNLT =    80.3
JET    :  53.1    51.6    49.9    48.2    46.5    44.8    43.2    41.5    39.7    38.1    36.3    34.7    33.0    31.3    29.6    28.0    26.3
          24.7    23.1    21.5    19.9    18.3    16.9    15.4                           OASPL =    58.1 PNL =    54.3 PNLT =    54.3
CORE   :  49.1    51.7    53.9    55.8    57.8    59.1    60.2    60.8    61.1    61.0    60.7    60.1    59.2    58.3    57.3    56.0    54.6
          53.2    51.8    50.2    48.5    46.8    45.1    43.4                           OASPL =    71.0 PNL =    79.4 PNLT =    79.4
TURB   :  30.7    31.6    32.5    33.4    34.3    35.2    36.1    37.1    37.9    38.7    39.5    40.3    41.1    41.8    42.5    43.1    43.7
          44.3    45.1    43.3    41.9    41.1    40.3    39.9                           OASPL =    54.4 PNL =    67.5 PNLT =    67.8
AIRFR  :  63.5    63.1    62.6    62.2    61.8    61.4    60.9    60.4    59.8    59.2    58.1    55.5    53.1    50.9    48.9    47.1    45.5
          44.1    42.8    41.6    40.5    39.4    38.3    37.3                           OASPL =    72.1 PNL =    75.5 PNLT =    75.7
TOTALS:   67.0    66.6    66.4    66.2    66.3    66.4    66.5    66.4    66.2    65.8    65.1    63.9    62.8    63.9    60.5    59.0    59.3
          57.6    54.8    53.0    48.6    41.9    32.8    19.8                           OASPL =    77.6 PNL =    83.7 PNLT =    84.2
```

TABLE IX. - Concluded.

```
          SOURCES WHEN   XO=-7518.0 FT,  YO=     0.0 FT,  TAU □     5.0 SEC,  R =  993.3 FT,  THETA = 165.5 DEG
FAN   :    6.1    12.0    17.3   22.5   27.1    31.4    35.2    38.6    41.6    44.1    46.2   47.8   48.8    56.8   49.4    48.7    53.7
          53.0    51.2    52.7   51.6   49.7    48.3    46.5                            OASPL =   62.9 PNL □   75.4 PNLT =  77.9
JET   :   50.6    49.2    47.3   45.4   43.7    41.9    40.2    38.4    36.6    34.9    33.1   31.4   29.7    27.9   26.2    24.5    22.8
          21.1    19.5    17.9   16.3   14.9    13.5    12.3                            OASPL =   55.5 PNL =   50.3 PNLT =  50.3
CORE  :   48.2    50.8    52.9   54.9   56.8    58.2    59.2    59.8    60.1    60.0    59.7   59.1   58.2    57.2   56.3    55.0    53.6
          52.2    50.8    49.2   47.5   45.8    44.1    42.4                            OASPL □   70.0 PNL =   78.3 PNLT =  78.3
TURB  :   28.2    29.1    30.0   30.9   31.8    32.7    33.6    34.5    35.3    36.1    36.9   37.7   38.6    39.3   40.0    40.5    41.2
          41.8    42.6    40.7   39.4   38.6    37.8    37.4                            OASPL =   51.8 PNL =   64.9 PNLT =  65.2
AIRFR :   63.3    62.8    62.4   61.9   61.4    61.0    60.4    59.9    59.3    58.7    57.6   54.9   52.3    49.8   47.6    45.5    43.7
          42.1    40.6    39.3   38.1   37.0    35.9    34.8                            OASPL □   71.8 PNL □   74.6 PNLT =  74.8
TOTALS:   66.7    66.3    65.9   65.7   65.7    65.7    65.7    65.6    65.4    64.9    64.2   62.8   61.5    62.1   59.0    57.4    57.3
          55.4    52.4    50.1   45.3   38.0    28.1    13.8                            OASPL =   76.8 PNL =   82.0 PNLT =  82.5

          SOURCES WHEN   XO=-7518.0 FT,  YO=     0.0 FT,  TAU =     5.6 SEC,  R = 1098.9 FT,  THETA = 167.8 DEG
FAN   :    4.1     9.9    15.3   20.4   25.0    29.3    33.1    36.5    39.5    42.1    44.1   45.7   46.7    54.9   47.3    46.6    51.7
          51.0    49.1    50.7   49.6   47.6    46.2    44.4                            OASPL =   60.9 PNL =   73.3 PNLT =  75.9
JET   :   48.5    47.2    45.0   43.1   41.3    39.5    37.7    35.9    34.0    32.3    30.4   28.6   26.9    25.1   23.3    21.6    19.9
          18.2    16.6    15.1   13.7   12.4    11.3    10.4                            OASPL □   53.3 PNL =   46.9 PNLT =  46.9
CORE  :   47.3    49.9    52.0   53.9   55.9    57.2    58.3    58.9    59.2    59.1    58.8   58.1   57.3    56.3   55.3    54.1    52.6
          51.2    49.8    48.2   46.5   44.8    43.1    41.4                            OASPL =   69.1 PNL =   77.3 PNLT =  77.4
TURB  :   26.0    26.9    27.8   28.7   29.6    30.5    31.4    32.4    33.2    34.0    34.8   35.6   36.4    37.1   37.8    38.4    39.0
          39.6    40.4    38.6   37.3   36.4    35.7    35.2                            OASPL =   49.7 PNL =   62.6 PNLT =  62.9
AIRFR :   63.0    62.5    62.0   61.5   61.0    60.5    60.0    59.4    58.9    58.3    57.1   54.3   51.6    48.9   46.5    44.2    42.1
          40.3    38.7    37.2   35.9   34.7    33.6    32.5                            OASPL =   71.4 PNL =   73.8 PNLT =  74.0
TOTALS:   66.3    65.8    65.5   65.2   65.1    65.1    65.0    64.9    64.6    64.1    63.3   61.8   60.4    60.7   57.7    56.0    55.6
          53.5    50.3    47.7   42.4   34.5    23.8     8.2                            OASPL □   76.1 PNL =   80.8 PNLT =  81.2

          SOURCES WHEN   XO=-7518.0 FT,  YO=     0.0 FT,  TAU =     6.2 SEC,  R □ 1206.0 FT,  THETA = 169.8 DEG
FAN   :    2.3     8.2    13.5   18.6   23.3    27.5    31.3    34.8    37.7    40.3    42.3   43.9   44.9    53.2   45.5    44.8    50.0
          49.3    47.3    48.9   47.8   45.8    44.4    42.6                            OASPL =   59.2 PNL =   71.5 PNLT =  74.2
JET   :   46.7    45.4    43.1   41.1   39.2    37.4    35.6    33.7    31.8    30.0    28.1   26.3   24.5    22.7   20.9    19.2    17.5
          15.9    14.4    13.0   11.8   10.8     9.9     9.3                            OASPL =   51.4 PNL =   43.9 PNLT □  43.9
CORE  :   46.4    49.0    51.2   53.1   55.1    56.4    57.5    58.1    58.4    58.2    57.9   57.3   56.4    55.4   54.5    53.2    51.8
          50.4    49.0    47.4   45.7   44.0    42.3    40.6                            OASPL =   68.3 PNL =   76.5 PNLT =  76.5
TURB  :   24.2    25.1    26.0   26.9   27.8    28.7    29.6    30.6    31.4    32.2    33.0   33.8   34.6    35.3   36.0    36.6    37.2
          37.8    38.6    36.8   35.4   34.6    33.8    33.4                            OASPL =   47.9 PNL =   60.7 PNLT =  61.0
AIRFR :   62.7    62.1    61.6   61.1   60.6    60.1    59.5    59.0    58.4    57.9    56.7   53.8   51.0    48.2   45.6    43.1    40.9
          38.8    37.0    35.4   33.9   32.6    31.4    30.3                            OASPL □   70.9 PNL =   73.1 PNLT =  73.3
TOTALS:   65.9    65.4    65.0   64.7   64.6    64.5    64.4    64.2    63.9    63.4    62.5   60.9   59.4    59.4   56.6    54.8    54.1
          51.8    48.4    45.4   39.8   31.3    19.7     2.8                            OASPL □   75.5 PNL =   79.8 PNLT =  80.1


                VALUES OF EPNL
 XO ,                    YO POSITION
 POS             0.
-7518. LEVEL    97.6
        THETA  115.0
         TIME    0.96
```

TABLE X. - OUTPUT FROM EXAMPLE SIX

This initial output for XO=-7000 and XO=1000 is added to illustrate convergence to the desired Y-coordinate.

QSRA FOOTPRINT CONTOUR, LANDING AND GROUND ROLL
TOTAL NOISE HISTORY AT EACH POINT

SOURCE		XO	YO	TAU	OASPL	PNL	PNLT
TOTAL	:	-7000.0	500.0	-24.671	74.6	79.4	80.4
TOTAL	:	-7000.0	500.0	-23.747	75.1	80.1	81.0
TOTAL	:	-7000.0	500.0	-22.819	75.6	80.6	81.9
TOTAL	:	-7000.0	500.0	-21.886	76.1	81.1	82.4
TOTAL	:	-7000.0	500.0	-20.947	76.5	81.6	82.8
TOTAL	:	-7000.0	500.0	-20.002	77.0	82.2	83.2
TOTAL	:	-7000.0	500.0	-19.049	77.4	82.9	83.5
TOTAL	:	-7000.0	500.0	-18.087	77.6	83.7	84.2
TOTAL	:	-7000.0	500.0	-17.115	77.8	84.7	85.2
TOTAL	:	-7000.0	500.0	-16.132	77.9	85.8	86.3
TOTAL	:	-7000.0	500.0	-15.138	77.9	86.8	87.3
TOTAL	:	-7000.0	500.0	-14.132	77.9	87.6	88.0
TOTAL	:	-7000.0	500.0	-13.115	77.7	87.9	88.4
TOTAL	:	-7000.0	500.0	-12.087	77.3	87.6	88.1
TOTAL	:	-7000.0	500.0	-11.049	77.1	87.1	88.0
TOTAL	:	-7000.0	500.0	-10.002	77.1	86.3	87.3
TOTAL	:	-7000.0	500.0	-8.947	77.5	85.7	86.8
TOTAL	:	-7000.0	500.0	-7.886	78.0	84.8	85.6
TOTAL	:	-7000.0	500.0	-6.819	78.4	84.0	84.8
TOTAL	:	-7000.0	500.0	-5.747	78.7	83.2	84.0
TOTAL	:	-7000.0	500.0	-4.671	78.8	82.3	83.1
TOTAL	:	-7000.0	1000.0	-24.477	72.3	76.5	77.4
TOTAL	:	-7000.0	1000.0	-23.543	72.7	76.9	77.8
TOTAL	:	-7000.0	1000.0	-22.604	73.0	77.3	78.2
TOTAL	:	-7000.0	1000.0	-21.661	73.3	77.7	78.5
TOTAL	:	-7000.0	1000.0	-20.712	73.5	78.1	78.9
TOTAL	:	-7000.0	1000.0	-19.757	73.8	78.6	79.3
TOTAL	:	-7000.0	1000.0	-18.794	74.0	79.3	79.9
TOTAL	:	-7000.0	1000.0	-17.825	74.2	80.0	80.6
TOTAL	:	-7000.0	1000.0	-16.847	74.2	80.8	81.4
TOTAL	:	-7000.0	1000.0	-15.860	74.3	81.7	82.2
TOTAL	:	-7000.0	1000.0	-14.864	74.2	82.4	82.9
TOTAL	:	-7000.0	1000.0	-13.860	74.1	83.1	83.6
TOTAL	:	-7000.0	1000.0	-12.847	74.1	83.5	84.0
TOTAL	:	-7000.0	1000.0	-11.825	74.0	83.7	84.2
TOTAL	:	-7000.0	1000.0	-10.794	74.0	83.5	84.1
TOTAL	:	-7000.0	1000.0	-9.757	74.2	83.2	83.9
TOTAL	:	-7000.0	1000.0	-8.712	74.7	82.9	83.6
TOTAL	:	-7000.0	1000.0	-7.661	75.3	82.4	83.2
TOTAL	:	-7000.0	1000.0	-6.604	75.8	82.0	82.8
TOTAL	:	-7000.0	1000.0	-5.543	76.2	81.4	82.3
TOTAL	:	-7000.0	1000.0	-4.477	76.5	80.8	81.6
(First iteration begins here)							
TOTAL	:	-7000.0	413.3	-24.693	74.9	79.8	80.7
TOTAL	:	-7000.0	413.3	-23.771	75.4	80.5	81.4
TOTAL	:	-7000.0	413.3	-22.844	75.9	81.0	82.4
TOTAL	:	-7000.0	413.3	-21.912	76.4	81.6	82.9
TOTAL	:	-7000.0	413.3	-20.975	76.9	82.1	83.3
TOTAL	:	-7000.0	413.3	-20.031	77.4	82.6	83.7
TOTAL	:	-7000.0	413.3	-19.079	77.8	83.4	84.3
TOTAL	:	-7000.0	413.3	-18.119	78.1	84.2	84.7
TOTAL	:	-7000.0	413.3	-17.148	78.3	85.2	85.7
TOTAL	:	-7000.0	413.3	-16.166	78.4	86.4	86.9

TABLE X. - Continued.

TOTAL	:	-7000.0	413.3	-15.172	78.4	87.4	87.9
TOTAL	:	-7000.0	413.3	-14.166	78.4	88.2	88.7
TOTAL	:	-7000.0	413.3	-13.148	78.2	88.5	89.0
TOTAL	:	-7000.0	413.3	-12.119	77.7	88.1	88.7
TOTAL	:	-7000.0	413.3	-11.079	77.5	87.5	88.5
TOTAL	:	-7000.0	413.3	-10.031	77.5	86.7	87.7
TOTAL	:	-7000.0	413.3	-8.975	77.9	86.0	87.1
TOTAL	:	-7000.0	413.3	-7.912	78.3	85.0	86.2
TOTAL	:	-7000.0	413.3	-6.844	78.7	84.2	85.0
TOTAL	:	-7000.0	413.3	-5.771	79.0	83.3	84.1
TOTAL	:	-7000.0	413.3	-4.693	79.1	82.5	83.3
(Second iteration begins here)							
TOTAL	:	-7000.0	366.5	-24.704	75.0	80.0	80.9
TOTAL	:	-7000.0	366.5	-23.781	75.6	80.7	81.6
TOTAL	:	-7000.0	366.5	-22.855	76.1	81.3	82.6
TOTAL	:	-7000.0	366.5	-21.924	76.6	81.8	83.1
TOTAL	:	-7000.0	366.5	-20.988	77.1	82.4	83.6
TOTAL	:	-7000.0	366.5	-20.045	77.6	82.9	84.0
TOTAL	:	-7000.0	366.5	-19.094	78.1	83.6	84.6
TOTAL	:	-7000.0	366.5	-18.134	78.4	84.4	85.2
TOTAL	:	-7000.0	366.5	-17.164	78.6	85.5	86.0
TOTAL	:	-7000.0	366.5	-16.182	78.7	86.7	87.1
TOTAL	:	-7000.0	366.5	-15.188	78.7	87.7	88.2
TOTAL	:	-7000.0	366.5	-14.182	78.6	88.5	89.0
TOTAL	:	-7000.0	366.5	-13.164	78.5	88.9	89.3
TOTAL	:	-7000.0	366.5	-12.134	77.9	88.4	88.9
TOTAL	:	-7000.0	366.5	-11.094	77.7	87.7	88.7
TOTAL	:	-7000.0	366.5	-10.045	77.7	86.8	87.9
TOTAL	:	-7000.0	366.5	-8.988	78.0	86.1	87.2
TOTAL	:	-7000.0	366.5	-7.924	78.5	85.2	86.3
TOTAL	:	-7000.0	366.5	-6.855	78.9	84.3	85.1
TOTAL	:	-7000.0	366.5	-5.781	79.2	83.4	84.2
TOTAL	:	-7000.0	366.5	-4.704	79.3	82.6	83.4
(and at location XO=1000)							
TOTAL	:	1000.0	500.0	44.305	57.1	68.5	69.5
TOTAL	:	1000.0	500.0	45.220	58.3	69.9	70.9
TOTAL	:	1000.0	500.0	46.142	59.6	71.3	72.2
TOTAL	:	1000.0	500.0	47.071	60.7	72.6	73.5
TOTAL	:	1000.0	500.0	48.007	61.5	73.4	74.4
TOTAL	:	1000.0	500.0	48.953	62.2	74.3	75.3
TOTAL	:	1000.0	500.0	49.908	63.0	75.4	76.6
TOTAL	:	1000.0	500.0	50.873	64.1	77.0	78.7
TOTAL	:	1000.0	500.0	51.849	65.6	79.2	81.4
TOTAL	:	1000.0	500.0	52.835	67.6	81.8	84.3
TOTAL	:	1000.0	500.0	53.830	69.8	84.4	87.2
TOTAL	:	1000.0	500.0	54.834	72.4	86.7	89.8
TOTAL	:	1000.0	500.0	55.844	73.3	87.9	91.1
TOTAL	:	1000.0	500.0	56.859	73.8	88.6	92.0
TOTAL	:	1000.0	500.0	57.877	73.0	87.5	90.7
TOTAL	:	1000.0	500.0	58.896	72.3	86.6	89.6
TOTAL	:	1000.0	500.0	59.915	71.3	85.1	87.8
TOTAL	:	1000.0	500.0	60.934	70.5	83.8	86.2
TOTAL	:	1000.0	500.0	61.951	69.8	82.7	84.9
TOTAL	:	1000.0	500.0	62.967	69.3	81.8	83.8
TOTAL	:	1000.0	500.0	63.981	68.9	81.1	82.9
TOTAL	:	1000.0	1000.0	44.579	54.0	64.3	65.3
TOTAL	:	1000.0	1000.0	45.514	54.6	64.7	65.8
TOTAL	:	1000.0	1000.0	46.458	55.1	65.4	66.5
TOTAL	:	1000.0	1000.0	47.409	55.8	66.4	67.7

TABLE X. - Continued.

TOTAL	:	1000.0	1000.0	48.368	56.4	67.3	69.0
TOTAL	:	1000.0	1000.0	49.335	57.1	68.5	70.5
TOTAL	:	1000.0	1000.0	50.309	58.0	69.9	72.1
TOTAL	:	1000.0	1000.0	51.290	58.9	71.3	73.7
TOTAL	:	1000.0	1000.0	52.277	50.0	72.7	75.3
TOTAL	:	1000.0	1000.0	53.270	61.0	74.1	76.8
TOTAL	:	1000.0	1000.0	54.268	62.0	75.4	78.2
TOTAL	:	1000.0	1000.0	55.270	64.3	76.8	79.7
TOTAL	:	1000.0	1000.0	56.275	64.8	77.7	80.7
TOTAL	:	1000.0	1000.0	57.282	65.3	78.4	81.5
TOTAL	:	1000.0	1000.0	58.292	65.5	78.7	82.0
TOTAL	:	1000.0	1000.0	59.302	65.7	79.0	82.3
TOTAL	:	1000.0	1000.0	60.313	65.8	79.2	82.6
TOTAL	:	1000.0	1000.0	61.324	65.9	79.4	82.8
TOTAL	:	1000.0	1000.0	62.334	65.7	79.1	82.5
TOTAL	:	1000.0	1000.0	63.344	65.5	78.8	82.1
TOTAL	:	1000.0	1000.0	64.352	65.3	78.5	81.8
(First iteration begins here)							
TOTAL	:	1000.0	447.5	44.284	57.3	68.8	69.8
TOTAL	:	1000.0	447.5	45.197	58.6	70.2	71.2
TOTAL	:	1000.0	447.5	46.116	59.9	71.7	72.6
TOTAL	:	1000.0	447.5	47.042	61.3	73.2	74.2
TOTAL	:	1000.0	447.5	47.976	62.2	74.3	75.3
TOTAL	:	1000.0	447.5	48.918	63.0	75.3	76.3
TOTAL	:	1000.0	447.5	49.869	63.8	76.2	77.2
TOTAL	:	1000.0	447.5	50.831	64.8	77.7	79.3
TOTAL	:	1000.0	447.5	51.805	66.4	80.0	82.1
TOTAL	:	1000.0	447.5	52.789	68.6	82.8	85.3
TOTAL	:	1000.0	447.5	53.785	71.0	85.7	88.5
TOTAL	:	1000.0	447.5	54.789	73.7	88.2	91.3
TOTAL	:	1000.0	447.5	55.800	74.7	89.4	92.7
TOTAL	:	1000.0	447.5	56.816	74.7	89.5	92.8
TOTAL	:	1000.0	447.5	57.836	73.8	88.3	91.4
TOTAL	:	1000.0	447.5	58.856	72.7	86.8	89.6
TOTAL	:	1000.0	447.5	59.877	71.6	85.1	87.5
TOTAL	:	1000.0	447.5	60.897	70.8	83.8	85.9
TOTAL	:	1000.0	447.5	61.916	70.1	82.6	84.5
TOTAL	:	1000.0	447.5	62.933	69.5	81.7	83.4
TOTAL	:	1000.0	447.5	63.948	69.1	80.9	82.5

TABLE X. - Concluded.

```
(at this point regular output begins)
                    QSRA FOOTPRINT CONTOUR, LANDING AND GROUND ROLL

                   VALUES OF EPNL
 XO ,                       YO POSITION
POS               500.   1000.
-7500. LEVEL      88.6    86.1
        THETA     107.5   108.4
         TIME     -17.26 -15.98
-7000. LEVEL      89.2    86.5
        THETA     108.0   108.7
         TIME     -13.11 -11.82
-6000. LEVEL      90.5    87.1
        THETA     109.3   109.2
         TIME      -4.82  -3.51
-4000. LEVEL      92.7    88.4
        THETA     112.4   115.4
         TIME      11.78  14.18
-2000. LEVEL      95.0    90.6
        THETA     115.4   116.0
         TIME      28.43  30.88
-1000. LEVEL      96.4    90.6
        THETA     116.0   110.0
         TIME      36.78  38.21
    0. LEVEL      91.6    85.9
        THETA      76.8    83.3
         TIME      42.12  42.55
  500. LEVEL      89.8    85.1
        THETA     109.9    61.6
         TIME      49.79  43.32
 1000. LEVEL      89.4    85.4
        THETA     109.9   109.7
         TIME      56.86  61.32
 1500. LEVEL      84.3    77.1
        THETA      89.7    89.9
         TIME      67.48  67.92
 1600. LEVEL      80.7    75.1
        THETA      78.6    84.2
         TIME      67.49  67.93

        COORDINATES FOR  "EPNL"  CONTOUR

  CONTOUR LEVEL =      90.0 DB
X - COORD (FT): -7500.0 -7000.0 -6000.0 -4000.0 -2000.0 -1000.0     0.0   500.0  1000.0  1500.0  1600.0
Y - COORD (FT):    42.1   366.5   570.0   801.0  1074.9  1056.8   621.1   485.9   447.5   257.5    54.7
  APPROX. CONTOUR AREA =  0.642E 07 SQ FT,    147.48 ACRES,    0.23 SQ MILES
```

TABLE XI. - OUTPUT SAMPLES FOR VARIOUS OPTIONS OF IOUT

This table is discussed in the text of this report.

For IOUT = 1,0,0: (see Output from Example One (table V))

For IOUT = 2,0,0:

QSRA LANDING CALCULATION, ENGINE MAP FROM TEST DATA
NOISE CONTRIBUTIONS FOR EACH NOISE SPECTRUM

SOURCE		XO	YO	TAU	OASPL	PNL	PNLT
FAN	:	-2000.0	500.0	21.605	74.5	87.2	88.3
CORE	:	-2000.0	500.0	21.605	65.9	74.7	74.7
TURB	:	-2000.0	500.0	21.605	61.2	72.6	72.6
FLAP	:	-2000.0	500.0	21.605	75.6	79.6	79.6
TOTAL	:	-2000.0	500.0	21.605	79.2	87.9	89.1
FAN	:	-2000.0	500.0	22.534	74.1	86.9	88.0
CORE	:	-2000.0	500.0	22.534	67.6	76.5	76.5
TURB	:	-2000.0	500.0	22.534	64.7	76.1	76.1
FLAP	:	-2000.0	500.0	22.534	76.3	80.3	80.3
TOTAL	:	-2000.0	500.0	22.534	80.0	88.6	89.8
FAN	:	-2000.0	500.0	23.473	73.4	86.2	87.3
CORE	:	-2000.0	500.0	23.473	69.3	78.2	78.2
TURB	:	-2000.0	500.0	23.473	68.6	80.0	80.0
FLAP	:	-2000.0	500.0	23.473	77.0	81.0	81.0
TOTAL	:	-2000.0	500.0	23.473	80.7	89.2	90.3

(and similar output for the remaining times and observer points)

For IOUT = 3,0,0:

QSRA LANDING CALCULATION, ENGINE MAP FROM TEST DATA
TOTAL NOISE HISTORY AT EACH POINT

SOURCE		XO	YO	TAU	OASPL	PNL	PNLT
TOTAL	:	-2000.0	500.0	21.605	79.2	87.9	89.1
TOTAL	:	-2000.0	500.0	22.534	80.0	88.6	89.8
TOTAL	:	-2000.0	500.0	23.473	80.7	89.2	90.3
TOTAL	:	-2000.0	500.0	24.425	81.4	90.0	90.9
TOTAL	:	-2000.0	500.0	25.394	82.1	91.7	92.2
TOTAL	:	-2000.0	500.0	26.384	82.6	93.9	94.3
TOTAL	:	-2000.0	500.0	27.394	83.1	95.3	95.7
TOTAL	:	-2000.0	500.0	28.425	84.7	95.9	96.3
TOTAL	:	-2000.0	500.0	29.473	85.9	95.2	96.2
TOTAL	:	-2000.0	1000.0	23.846	76.7	83.1	84 1
TOTAL	:	-2000.0	1000.0	24.817	77.1	84.1	84.6

(continues through for each time and observer)

TABLE XI. - Continued.

For IOUT = 0,1,0: (compare summary of Output from Example One, table V)

```
                      QSRA LANDING CALCULATION, ENGINE MAP FROM TEST DATA

                VALUES OF PNL-MAX
  XO ,                   YO POSITION
 POS            500.   1000.
-2000. LEVEL    95.9    89.7
        THETA   115.4   110.3
         TIME    28.43   29.85
-1000. LEVEL    98.5    91.4
        THETA   116.0   110.0
         TIME    36.78   38.21
    0. LEVEL    93.8    86.3
        THETA    76.8    83.3
         TIME    42.12   42.55
```

For IOUT = 0,2,0: (compare Output from Example Two, table VI)

```
                      QSRA LANDING CALCULATION, ENGINE MAP FROM TEST DATA

                VALUES OF PNLT-MAX
  XO ,                   YO POSITION
 POS            500.   1000.
-2000. LEVEL    96.3    90.2
        THETA   115.4   116.0
         TIME    28.43   30.88
-1000. LEVEL    99.0    91.8
        THETA   116.0   110.0
         TIME    36.78   38.21
    0. LEVEL    94.3    86.8
        THETA    76.8    83.3
         TIME    42.12   42.55
```

For IOUT = 0,3,0:

```
                      QSRA LANDING CALCULATION, ENGINE MAP FROM TEST DATA

                VALUES OF EPNL
  XO ,                   YO POSITION
 POS            500.   1000.
-2000. LEVEL    95.0    92.4
        THETA   115.4   116.0
         TIME    28.43   30.88
-1000. LEVEL    96.4    92.2
        THETA   116.0   110.0
         TIME    36.78   38.21
    0. LEVEL    91.9    87.0
        THETA    76.8    83.3
         TIME    42.12   42.55
```

TABLE XI. - Concluded.

For IOUT = 0,0,1: (based on inputs for Example Six)

```
                    QSRA FOOTPRINT CONTOUR, LANDING AND GROUND ROLL

 Y-COORD. FOR  90.0 DB CONTOUR DID NOT CONVERGE IN 10 ITERATIONS AT XO =-7500.0
     BEST VALUE OF Y =    1.0, BEST LEVEL =  89.0

           COORDINATES FOR  "PNL"  CONTOUR

   CONTOUR LEVEL =    90.0 DB
 X - COORD (FT): -7500.0 -7000.0 -6000.0 -4000.0 -2000.0 -1000.0     0.0   500.0  1000.0  1500.0  1600.0
 Y - COORD (FT):     1.0    10.4   448.1   696.7   964.2  1110.6   724.5   539.3   430.0   300.2   113.7
   APPROX. CONTOUR AREA =  0.575E 07 SQ FT,    132.10 ACRES,    0.21 SQ MILES
```

For IOUT = 0,0,2:

```
                    QSRA FOOTPRINT CONTOUR, LANDING AND GROUND ROLL

 Y-COORD. FOR  90.0 DB CONTOUR DID NOT CONVERGE IN 10 ITERATIONS AT XO =-7500.0
     BEST VALUE OF Y =    1.0, BEST LEVEL =  89.5

           COORDINATES FOR  "PNLT"  CONTOUR

   CONTOUR LEVEL =    90.0 DB
 X - COORD (FT): -7500.0 -7000.0 -6000.0 -4000.0 -2000.0 -1000.0     0.0   500.0  1000.0  1500.0  1600.0
 Y - COORD (FT):     1.0   250.3   500.0   732.0  1022.8  1152.9   756.8   616.7   573.7   387.3   129.0
   APPROX. CONTOUR AREA =  0.637E 07 SQ FT,    146.34 ACRES,    0.23 SQ MILES
```

For IOUT = 0,0,3: (See Output from Example Six (Table XI))

```
                    QSRA FOOTPRINT CONTOUR, LANDING AND GROUND ROLL

          COORDINATES FOR  "EPNL"  CONTOUR

  CONTOUR LEVEL =    90.0 DB
X - COORD (FT): -7500.0 -7000.0 -6000.0 -4000.0 -2000.0 -1000.0     0.0   500.0  1000.0  1500.0  1600.0
Y - COORD (FT):    42.1   366.5   570.0   801.0  1074.9  1056.8   621.1   485.9   447.5   257.5    54.7
  APPROX. CONTOUR AREA =  0.642E 07 SQ FT,    147.48 ACRES,    0.23 SQ MILES
```

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
NASA TP-1913		

4. Title and Subtitle	5. Report Date
COMPUTER PROGRAM TO PREDICT AIRCRAFT NOISE LEVELS	September 1981
	6. Performing Organization Code 505-32-02
7. Author(s) Bruce J. Clark	8. Performing Organization Report No. E-733
	10. Work Unit No.
9. Performing Organization Name and Address National Aeronautics and Space Administration Lewis Research Center Cleveland, Ohio 44135	11. Contract or Grant No.
	13. Type of Report and Period Covered Technical Paper
12. Sponsoring Agency Name and Address National Aeronautics and Space Administration Washington, D.C. 20546	14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

Methods developed at the NASA Lewis Research Center for predicting the noise contributions from various aircraft noise sources have been programmed to predict aircraft noise levels either in flight or in ground tests. The noise sources include fan inlet and exhaust, jet, flap (for powered lift), core (combustor), turbine, and airframe program obtained from the NASA Langley Research Center. Noise propagation corrections are available for atmospheric attenuation, ground reflections, extra ground attenuation, and shielding. Outputs can include spectra, overall sound pressure level, perceived noise level, tone-weighted perceived noise level, and effective perceived noise level at locations specified by the user. Footprint contour coordinates and approximate footprint areas can also be calculated. Inputs and outputs can be in either System International or U.S. customary units. The subroutines for each noise source and propagation correction are described in detail. Inputs required and some sample inputs and outputs are given in tables. A complete listing is given in an appendix. The program is available to qualified users through COSMIC, 112 Barrow Hall, University of Georgia, Athens, Georgia 30602 (telephone 404-542-3265).

17. Key Words (Suggested by Author(s))	18. Distribution Statement
Aircraft noise Computer program Prediction	Unclassified - unlimited STAR Category 71

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price*
Unclassified	Unclassified	145	A07

* For sale by the National Technical Information Service, Springfield, Virginia 22161

National Aeronautics and
Space Administration

Washington, D.C.
20546

Official Business
Penalty for Private Use, $300

THIRD-CLASS BULK RATE

Postage and Fees Paid
National Aeronautics and
Space Administration
NASA-451

U.S.MAIL

4 1 1U,H, 090481 S00903DS
DEPT OF THE AIR FORCE
AF WEAPONS LABORATORY
ATTN: TECHNICAL LIBRARY (SUL)
KIRTLAND AFB NM 87117

NASA

POSTMASTER: If Undeliverable (Section 158 Postal Manual) Do Not Return