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SOME PROPULSION SYSTEM NOISE DATA HANDLING CONVENTIONS AND COMPUTER PROGRAMS USED AT THE LEWIS RESEARCH CENTER

by Francis J. Montegani

Lewis Research Center
Cleveland, Ohio 44135

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SUMMARY

Methods of handling one-third-octave band noise data originating from the outdoor full-scale fan noise facility and the engine acoustic facility at the Lewis Research Center are presented. Procedures for standardizing, retrieving, extrapolating, and reporting these data are explained. Computer programs are given which are used to accomplish these and other noise data analysis tasks. This information is useful as background for interpretation of data from these facilities appearing in NASA reports and can aid data exchange by promoting standardization.

INTRODUCTION

The last several years have seen a rapid rise in the level of research relating to the noise of aircraft propulsion systems. Various companies, universities, and government agencies have been contributing to an increasing body of technical data. A significant volume among these data is comprised of the results of one-third-octave band analyses of the noise signatures of propulsion systems or components either from full-scale hardware or from models. Thorough analyses of these data are essential to the development of an understanding of the mechanisms of noise generation and, at the very least, to the development of noise prediction methods which are important to the proper evolution of quiet propulsion systems. Researchers using the full-scale fan and the engine acoustic facilities at the Lewis Research Center are among those generating and manipulating large volumes of one-third-octave band noise data. Several years ago, the generation of such quantities of data was anticipated, and data handling practices were established to facilitate the manipulation and analyses of these data at the user level. These practices center around a collection of computer programs which are used to process the data and a philosophy of data standardization and storage. Extensive use of these methods has demonstrated their worth. Interest shown by others outside of NASA has indicated that these practices may be generally useful, particularly with regard to standardization and facilitation of more direct data exchange especially in computer-compatible form. In addition, considerable data from the full-scale fan facility and the engine acoustic facility are being published which are handled by the methods discussed herein. Typical of such publications is reference 1.

This report therefore sets forth the practices that are followed at the Lewis Research Center with regard to standardizing, retrieving, extrapolating, and reporting noise data from these facilities. The adjustments made to the data for standardization purposes and other practices are explained, and a collection of computer programs is given. It is hoped that these practices, which have proven useful at Lewis over the past several years, will be of use to others engaged in propulsion system noise research.

DATA ACQUISITION AND DOCUMENTATION

This section includes information on the manner in which collections of data are identified and manipulated. To assist in presenting this information, a block diagram is presented in figure 1. This diagram gives an overview of the major elements which are involved in the data handling system. It is pertinent to much of the discussion which follows.

Data Standardization

Measured array. - The kind of data under consideration in the context of this report are the results of one-third-octave band spectral analyses of the far-field radiated noise from axisymmetric sources. In general, measurements are made about the source at equal angle increments. Irrespective of the manner of testing, and whether one run is made or the data from a few runs are averaged, the net result is an array of data comprised of sound pressure levels in one-third-octave bands for a number of angles. This array is referred to herein as the "Measured Array" and is the starting point for all further discussion. Effects of instrumentation frequency response are presumed to be removed.

A Measured Array is identified with an operating point of the source and consists of an NF×NM matrix of sound pressure levels, where NF is the number of frequency bands and NM is the number of microphones or angles. The usual range of frequencies is from 50 to 20 000 hertz. Microphones commonly are employed in 10° increments over most of a 180° arc.

Site effects. - The Measured Array, whether obtained indoors or out, in general possesses measurement anomalies which are attributable to the site and also to the ambient air conditions. Site-related anomalies such as ground plane reflections are the subject of continuing interest. A discussion of them exceeds the scope of this report. For full-scale fan and engine facilities, data are not adjusted routinely for site effects, but their inclusion is always implied, and it is intended that they be given consideration as the use of the data dictates.

Excess atmospheric attenuation. - Data are filed for use essentially as obtained except for standardization for atmospheric effects. Ambient air, of course, is known to cause excess sound attenuation (over and above inverse square law attenuation) which is a function of frequency, temperature, and humidity. Data to evaluate this effect are contained in reference 2.

Reference 2 was created in a framework of jet noise. And in addition to the air attenuation data contained therein, which are essentially continuous functions of frequency, guidelines are presented for applying those data to one-third-octave band spectra which are discontinuous. The guidelines specify the use of the band center frequency for determining the air attenuation for one-third-octave bands to 4000 hertz and for using the band lower limiting frequency above 4000 hertz. This procedure is biased for jet noise, which has a characteristic fall-off at high frequency. The theoretically correct attenuation which should be used must be the result of an integration which accounts for the combination of spectral and attenuation variations over a frequency band. When both these characteristics are relatively flat, the use of the attenuation at the band center frequency is appropriate. But when large changes occur in either characteristic over a frequency band, the band center frequency is not an adequate parameter. For jet noise, use of the band lower limiting frequency is satisfactory; but this is not true in general. The manner of determining atmospheric correction which is discussed in the next section uses the data of reference 2, but does so by an integration process over each frequency band. This integration cannot be done precisely with knowledge only of the one-third-octave band spectrum, but the spectrum shape is approximated conceptually by assuming a straight-line connection between sound pressure levels in adjacent frequency bands on a spectral plot with a logarithmic frequency scale.

Referred array. - The only adjustments which the Measured Array undergoes prior to use at the working level are removal of the effect of atmospheric absorption for the conditions that prevailed at the test site and adjustment to a standard radius for any microphones not on that standard radius for the test. The atmospheric attenuation for the test ambient temperature and relative humidity for each one-third-octave band spectrum is calculated as noted in the previous section. These results are added to the measured data for the appropriate propagation distance. And inverse square adjustments are made where necessary (fig. 1). The results are sound pressure levels that would exist at the microphones on a constant radius if the atmosphere were completely nonattenuating. Therefore, these results are never to be expected in reality. It is from these data, however, that source acoustic power and directivity properties must be calculated. The array so adjusted is termed the "Referred Array," implying that it possesses acoustic properties that refer back to the source and are uninfluenced by the propagation properties of the medium except for inverse square attenuation.

It follows that a Referred Array may be extrapolated to any distance by using the inverse square law while preserving its intrinsic acoustic power and directivity properties. Conversely, when acoustic power and directivity properties of a source are known, a Referred Array can be constructed for any distance from the source (fig. 1), and by incorporating the effects of atmospheric absorption, far-field sound pressure levels may be constructed.

Working Data

From the Referred Array, the essential properties of the source acoustic emission are calculated. These properties consist of overall power level, normalized power spectrum, and directivity index for each frequency band. These data are useful directly in the characterization of the source acoustic emission and in understanding noise generating mechanisms. Further, they are independent of the original measurement distances.

It is these data, retained on punched cards, that constitute the heart of the retrieval system. The data in this form are called "Working Data."

These noise data so decomposed into fundamental emission properties can contribute to understanding of noise generating mechanisms through the development of improved prediction techniques, for which they are suited particularly well. Each of the three basic elements - power level, normalized spectrum, and directivity index - can be examined separately and independently. Power level is a single variable which, in general, can be expected to correlate simply with size, thrust, or mechanical power. Quite independently, normalized power spectrum (which embodies only the shape and frequency scale of the spectral emission) may be expected to correlate with such things as mechanical design and characteristic speed. And finally, directivity index may be isolated and separately investigated insofar as it pertains to questions of theoretical acoustic propagation, duct terminations, flow refraction, and so forth. The extent of understanding any one of these emission properties is not dependent necessarily on the understanding of any other.

This general independence of the emission properties is also particularly useful to meet short-term needs for noise predictions. State-of-the-art noise prediction methods rely heavily on an empirical data base. Working Data facilitate such predictions by permitting selective use of the appropriate emission properties from a variety of sources.

Although Working Data, at a glance, do not consist of familiar sound pressure levels, this is no obstacle to users desirous of data in that form. With a computer-oriented system such as this, it is a simple task to assemble the Working Data into a referred sound pressure level array. This array in turn can be extrapolated for any far-field conditions (fig. 1).

For the foregoing reasons, all noise data are decomposed into the source fundamental emission properties, punched into cards, and filed for use in this form at the working level. Appendix A contains a sample listing of Working Data, with complete explanation of the format. The retention of data in this form, in conjunction with a family of computer programs which are given herein, facilitates rapid dissemination and efficient utilization of the data. The manner in which Working Data are computed from the Referred Array is discussed in the next sections.

Acoustic power. - A general sound source emits acoustic energy radially to the far-field and nonuniformly with direction. The acoustic power emitted by the source can be obtained by integrating the far-field sound intensity over an enclosing surface. It is here presumed that the source and its associated sound field are axisymmetric so that the intensity field is a function of only two coordinates, radial distance r from the source and azimuth angle θ from the source axis. For far-field noise radiation, discounting excess atmospheric attenuation, the sound intensity varies inversely as the square of the distance from the source so that the functional dependence on r is known. Further, the sound intensity I is related to the rms acoustic pressure P, which is the usual measured quantity, according to

$$I = \frac{P^2}{\rho c} \tag{1}$$

where ρc is the characteristic impedance of the propagating medium. Under such conditions, the rms sound pressure may be determined at a constant radius R, from which the acoustic power W is obtained according to

$$W = \frac{1}{\rho c} \int_0^{\pi} P^2(\theta)\, dA \tag{2}$$

where

$$dA = 2\pi R^2\, d\theta \tag{3}$$

is the elemental annulus area on an enclosing sphere.

In practice, a function $P^2(\theta)$ is not usually available, but rather, discrete values P_i^2 ($i = 0, 1, \ldots, n$) are known from measurements corresponding to values of θ_i. Under these conditions, equation (2) must be approximated as a finite sum

$$W = \frac{1}{\rho c} \sum_{i=0}^{n} P_i^2 \, \Delta A_i \tag{4}$$

where the ΔA_i are contiguous finite incremental areas on which the corresponding P_i^2 are presumed constant.

If the θ_i are taken to be equally spaced by an angle increment $\Delta\theta$, which therefore becomes also the arc width of any elemental area ΔA_i, and if the θ_i are written as $i\Delta\theta$, the incremental areas can be expressed as

$$\Delta A_i = 2\pi R^2 \sin\left(\frac{\Delta\theta}{2}\right) \tan\left(\frac{\Delta\theta}{4}\right) \qquad i\,\Delta\theta = 0,\ \pi \tag{5}$$

$$\Delta A_i = 4\pi R^2 \sin\left(\frac{\Delta\theta}{2}\right) \sin(i\,\Delta\theta) \qquad 0 < i\,\Delta\theta < \pi \tag{6}$$

The geometry of the arrangement is shown in figure 2. When the azimuth angle $i\,\Delta\theta$ corresponds with a polar area on the sphere, equation (5) applies; otherwise equation (6) applies.

Combining equations (4) to (6) results in

$$W = \frac{4\pi R^2}{\rho c} \sin\left(\frac{\Delta\theta}{2}\right)\left[\frac{P_0^2}{2} \tan\left(\frac{\Delta\theta}{4}\right) + \sum_{i=1}^{n-1} P_i^2 \sin(i\,\Delta\theta) + \frac{P_n^2}{2} \tan\left(\frac{\Delta\theta}{4}\right)\right] \tag{7}$$

where the subscripts 0 and n denote the polar areas.

Equation (7) is basically that used for acoustic power calculation as discussed herein. However, as written, it applies specifically to radiation in the absence of a ground plane since a summation is taken with fully circular annuli. Most practical propulsion system noise measurements are taken in an environment with a reflecting ground plane, and the problems it presents must be considered.

In actual fact, the directly radiated instantaneous sound pressure and that reflected from the ground plane sum algebraically at the microphone. The resultant effects depend on the geometry of the problem, the frequency of the radiation, the phase shifts and attenuations in the reflection process, and the bandwidth of the analysis technique, among other things. For one-third-octave band analysis, there usually result band-dominant signal reinforcement and cancellation effects in the low-frequency end of the spectrum which are highly dependent on the test arrangement. However, for any arrangement, many signal reinforcements and cancellations occur in any given one-third-octave band at the high-frequency end of the spectrum which, for hard reflecting surfaces, result in a theoretical doubling of intensity there. Since Lewis test sites use hard pavement reflecting surfaces for purposes of maintaining surface constancy, the doubling of intensity at high frequencies is taken to be the prevailing phenomenon. The acoustic power calculation therefore proceeds on the assumption that the acoustic intensities determined to exist in the presence of the ground plane are double what they would be in its absence. Thus, the intensities are halved for all frequency bands and summed over the entire sphere according to equation (7). No attempts are made to correct the data for ground interference effects at low frequencies.

The use of Working Data offers a convenient means of transmitting data to other users. It must be cautioned, however, that if the Referred Array is to be precisely reconstructed, the exact power calculation method which was used to generate the Working Data must be available and inverted; otherwise differences will result. The computer subroutine to compute acoustic power as given by equation (7) and the preceding discussion is called POWER and is given in appendix B. Where sound pressure level data are not available (e.g., near the source axis, where jet flow would impinge on the microphones), the associated areas are excluded from the summation process of the power calculation.

Directivity index. - Directivity index is a normalizing way of characterizing the directional property of far-field acoustic emission. It is defined as the difference, in decibels, between the existing sound pressure level at a point and the sound pressure level that would exist at the same point from a simple source emitting the same acoustic power. Directivity index is a function of direction only; and for an axisymmetric source, therefore, it is a function of azimuth angle θ. For discrete values of θ_i it is defined by

$$DI_{\theta_i} = SPL_{\theta_i} - SPL_{AV} \tag{8}$$

where SPL_{θ_i} denotes the existing sound pressure levels and SPL_{AV} represents the simple-source sound pressure level. The simple-source sound pressure level can be shown to be exactly the area-weighted average sound pressure level of the existing SPL_{θ_i}. It is computed according to

$$SPL_{AV} = 10 \log_{10} \left(\frac{\sum_{i=0}^{n} 10^{\frac{SPL_{\theta_i}}{10}} \cdot \Delta A_i}{\sum_{i=0}^{n} \Delta A_i} \right) \tag{9}$$

where the ΔA_i are given by equations (5) and (6).

A subroutine AVSLR for computing the area-weighted sound pressure level is given in appendix B. As in the acoustic power calculation, where no data exist for angles at or near the axis, such angles are omitted from the summation process.

Extrapolation

Often, for practical purposes, the detailed properties of the source radiation such as directivity index are not needed, but rather the far-field sound pressure levels that result when the data are extrapolated to various distances are necessary. Usually, data of this kind are reported in the literature. To generate such data, it is only necessary to assemble a Referred Array from the Working Data and extrapolate it to the desired distances by using the inverse square law and excess atmospheric attenuation for the conditions desired, usually standard day (fig. 1). Other effects such as ground reflections or extra ground attenuation are given consideration by some investigators in extrapolation calculations. However, as in the case of measurement anomalies, other extrapolation phenomena are the subject of continuing research and exceed the scope of the discussion here. These phenomena are neglected in ordinary data extrapolations for reporting purposes or for data retention at the working level. Such a practice avoids the need for qualifying the data. Further, it permits any user to quickly deduce from the data the referred arrays which accurately reflect the original data which were measured and which he may modify to suit his needs considering test site or extrapolation anomalies.

COMPUTER PROGRAMS

Working Data Generation

The key to the efficient retrieval and use of noise data at the working level lies in maintaining a punched card file of Working Data sets and a family of programs and subroutines for manipulating those data. There exists, of course, archival storage of the raw measured data. But utilization of these data directly requires extensive computer interaction and program handling, particularly since the data to be so retrieved and processed consist of repeat runs which must be averaged, corrected for measurement instrumentation response when necessary, and adjusted to standard-day conditions. The use of Working Data, which is one level removed from the archival data, permits rapid data access by persons not necessarily skilled in computer usage.

The effort avoided by the routine use of Working Data in place of archival data is replaced by the one-time use of a computer program which generates the Working Data and which also generates other useful data listings. This program is called WODAG (for Working Data Generation), and an outline of the calculations it performs and the listings it generates are discussed next. WODAG is a subroutine whose principal input is a Measured Array. A main program which must provide suitable Measured Arrays and call the subroutine WODAG is the responsibility of the reader. The complete codes of the subroutine WODAG and of the subroutines which it calls are given in appendix B.

Listings. - A sample listing of the printed output generated by WODAG is presented in table I. Each page of output is somewhat self-explanatory, but they are reviewed briefly here. A summary of the pages by title is as follows:

(1) Measured Array
(2) Test-day excess atmospheric attenuation
(3) Referred Array
(4) Acoustic power computations
(5) Normalized power spectrum (graph)
(6) Directivity index
(7) Atmospheric attenuation
(8) Standard-day data excess atmospheric attenuation
(9) Standard-day data
(10 and following) Sideline extrapolated data

The Measured Array has been discussed. It is identifiable with a particular operating condition of the source and represents the actual measured data (or an average of data) from the test site with instrumentation frequency response characteristics removed. Variable microphone radii are permitted and appear in the listing. Atmospheric conditions for the test are also listed. All test data as printed are adjusted to a constant radius for review purposes by using inverse square law only. For all subsequent calculations the proper atmospheric absorptions and distances are accurately accounted for.

The test-day excess atmospheric attenuation table gives the actual adjustments, based on test temperature, relative humidity, and actual measurement distances, used to generate the Referred Array.

The Referred Array is tabulated for a selected radius and, in addition, overall levels at each angle are listed. No perceived noise levels are presented since the referred data represent a condition that cannot be observed.

Results of acoustic power calculations which are listed include overall acoustic power, acoustic power spectrum, and normalized power spectrum. The normalized spectrum is obtained by subtracting the maximum band power level from the power spectrum. In addition, the simple-source sound pressure levels are listed. These are referred sound pressure levels created by a nondirectional source emitting the same acoustic power as the real source. Simple-source sound pressure levels (average sound pressure levels given by eq. (9)) are used to calculate directivity index according to equation (8). Directivity index is listed in a separate table for the sound pressure levels in each frequency band and for the overall levels.

Tables of standard-day excess atmospheric attenuation are given, the first of which is the attenuation per thousand feet of propagation distance. This table is computed from the Referred Array as discussed in the section Excess atmospheric attenuation and is used for all subsequent extrapolations. A second atmospheric attenuation table is given which lists the exact adjustments that were made to the referred array to generate the standard-day array for the same radius. The atmospheric adjustments vary from angle to angle because the spectral shapes are accounted for as previously discussed.

Subsequent tables provide data extrapolated to selected sidelines. The first of these sidelines is always at the same distance as the radius used for the standard-day data.

Punched cards. - In addition to the foregoing printed output, WODAG also punches data into cards in the Working Data format as discussed previously. These cards are intended for routine use at the user working level in conjunction with a family of programs and subroutines which are discussed next.

General Programs and Subroutines

A principal reason for the use of Working Data is to permit convenient access to data in all its detail. Since the card data format is standardized and contains control information, one set may be read into computer storage with a simple call to a subroutine. Similar calls to other subroutines will generate Referred Arrays, do extrapolations, generate perceived noise levels, and so forth. This modular approach to programming for purposes of handling the data frees the user-programmer from concern over routine data handling tasks. The use of other main programs permits nonprogrammers also to conveniently access, extrapolate, and analyze data starting with Working Data (fig. 1). A number of programs used for these various purposes are discussed in this section.

Source codes written in FORTRAN IV for all the programs which are discussed in this report and other utility subroutines necessary to support them are given in appendix B alphabetically by name. All program listings contain information which makes them self-explanatory. Many of them have a general use to those engaged in noise work. Others, described as "utility" routines, are used solely to perform very specific and mundane calling program tasks.

Following is an alphabetical summary of all the programs in appendix B with descriptions of their functions:

Program name	Description
ANGLE	(Utility)
APNDB	(Utility)
ASMBL	Assembles one set of Working Data already in storage into a Referred Array.
ATMAT	Computes excess atmospheric attenuation in decibels for any temperature, relative humidity, frequency, and distance. Uses empirical curve-fits of data contained in reference 2.
AVLSR	Computes simple-source sound pressure level (area-weighted average sound pressure level) from directional data on an arc. Results used for directivity index calculations.
BASPAT	Computes excess atmospheric attenuation for all bands of a fractional octave band spectrum considering spectrum shape. Also extrapolates spectrum to a new distance, accounting for inverse square and atmospheric attenuation.
DADIFF	Used for thorough comparison of noise characteristics of two sources. Computes the differences between two sets of data. Differences include acoustic power (including front/rear power split arbitrarily divided at 90^{o} to the source axis), Referred Arrays, and perceived noise levels and tone-corrected perceived noise levels for standard-day data extrapolated to selected sidelines.
DBSUM	(Utility)

Program name	Description
FARDTA	Extrapolates a Referred Array to any far-field radius or sideline, accounting for inverse square and excess atmospheric attenuation.
GRAPH	(Utility)
LIST	Reads and assembles sets of Working Data and prepares printed output of the basic data and standard-day arc extrapolations including optional extrapolations to selected sideline distances. (Output identical with that of WODAG commencing with Referred Array.)
OASPL	(Utility)
PNDB	Computes perceived noise level in PNdB in accordance with reference 3.
PNLT	Computes tone-corrected perceived noise level (PNLT) for a one-third-octave band sound spectrum in accordance with reference 4. Also computes perceived noise level.
POWER	Computes total acoustic power by incremental area summation for a set of angles and referred sound pressure levels on an arc. Perfectly reflective gound plane assumed.
SIDLAT	(Utility)
TABLE	Prepares a compact one-page table of data in a format suitable for reporting purposes. The output includes standard-day extrapolated data on an arc, total acoustic power, power spectrum, simple-source sound pressure levels (which, with nominal band atmospheric attenuation, permit quick evaluation of directivity index), and optional sideline perceived noise levels.
TBLOP	(Utility)
TITLE	(Utility)
TITLE 2	(Utility)
WDATA	Reads one set of Working Data from cards into storage.
WODAG	As discussed herein, standardizes measured data, prepares data listings, and punches Working Data.

Sample output from WODAG, TABLE, and DADIFF are given herein tables I, II, and III, respectively.

CONCLUDING REMARKS

Methods of data handling and computer programs have been presented which have proven useful for a wide variety of tasks with data from the full-scale fan and engine acoustic test facilities at the Lewis Research Center. These methods center on the use of immediately accessible data punched into cards as standard-format Working Data which include power level, normalized power spectrum, and directivity index. Working Data are useful in understanding mechanisms of generation, developing prediction methods, and executing empirical predictions. Working Data and the associated programs also simplify the problems of user-programmers and nonprogrammers in the tasks of accessing and manipulating the data and increase the productivity and quality of data analyses. It is hoped that these advantages, in addition to the information presented herein, will be of use to others and may lead ultimately to improvements in information exchange.

Lewis Research Center,
National Aeronautics and Space Administration,
Cleveland, Ohio, October 12, 1973,
501-24.

APPENDIX A

WORKING DATA CARD FORMAT

Working Data are normalized acoustic data arranged in a standard format and used for card input for a variety of data analysis programs. A single set of data is complete and self-contained and represents the acoustic emission properties for one operating condition of a sound source.

The data are arranged in five blocks. Block 1 consists always of four cards of identifying information. This information is not manipulated in any way but is read alphanumerically. Any or all of the four cards may be blank, and all 80 card columns may be used.

Block 2 consists of a single card providing control data and identification of the particular operating conditions for this data set. The data, location, and format on the block 2 card are as follows:

Card column	1	5	13	21	24	27
Variable	NCONF	RPM	PCS	NF	NM	NB
FORTRAN format	I4	F8.1	F8.1	I3	I3	I3

NCONF configuration number

RPM speed, rpm

PCS percent speed

NF number of fractional-octave band filters employed, up to 27

NM number of equally spaced angles for the data array, up to 19

NB 1/NB-octave frequency bands

Obviously, where NCONF, RPM, and PCS as defined are inappropriate for the sound source, other operating variables may be used.

Block 3 consists of one, two, or three cards, depending on the value of NF. The first card is arranged in the following way:

Card column	1	7	13	19	...	67
Variable name	PWL	SUMN	PSM(1)	PSM(2)	...	PSM(10)
FORTRAN format	F6.1	F6.1	F6.1	F6.1	...	F6.1

PWL total acoustic power level, dB referenced to 10^{-13} W

SUMN antilogarithmic sum in decibels of the normalized power spectrum

PSM(I) normalized power spectrum, the power spectrum from which has been subtracted the maximum band level

Cards 2 and 3 of block 3, when they exist, are arranged as follows:

Card column	1	13	19	...	67
Variable	(Blank)	PSM(11)	PSM(12)	...	PSM(20)
FORTRAN format	12x	F6.1	F6.1	...	F6.1

Card column	1	13	19	...	49
Variable	(Blank)	PSM(21)	PSM(22)	...	PSM(27)
FORTRAN format	12x	F6.1	F6.1	...	F6.1

The index of PSM(I) terminates with the value of NF.

Block 4 consists of at least one card having the increment angle DT followed by the actual microphone angles AI(J), continuing on to the first column of a second card if necessary. The format is 12F6.1/8F6.1. Not counting the increment angle, the number of angles agrees with the value of NM.

Block 5 cards contain the directivity index DI(I, J) for each frequency band denoted by both a band number I and the band center frequency NFIL(I). The subscript J denotes angle. Block 5 consists of NF sets of one or two cards each. The card formats for the I^{th} set are

Card column	1	7	13	19	...	67
Variable name	I	NFIL(I)	DI(I, 1)	DI(I, 2)	...	DI(I, 10)
FORTRAN format	I6	I6	F6.1	F6.1	...	F6.1

Card column	1	13	...	61	...
Variable name	(Blank)	DI(I, 11)	...	DI(I, 19)	...
FORTRAN format	12x	F6.1	...	F6.1	...

The index J of DI(I, J) terminates with the value of NM.

A listing of a typical set of working data is given in table IV. The maximum number of cards in a set is 64.

APPENDIX B

COMPUTER PROGRAMS

SUBROUTINE ANGLE (AI,NM)

```
      SUBROUTINE ANGLE (AI,NM)
C                /ANGLE - ANGLE OUTPUT/
C   * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C   *                                                                   *
C   *  UTILITY ROUTINE TO OUTPUT ANGLE ARRAY.                           *
C   *                                                                   *
C   *  AI          ANGLES                                               *
C   *  NM          NUMBER OF ANGLES                                     *
C   *                                                                   *
C   * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
      DIMENSION AI(19)
      WRITE (6,1) (AI(I),I=1,NM)
1     FORMAT (10X,5HANGLE,19F6.0)
      WRITE (6,2)
2     FORMAT (/)
      RETURN
      END
```

```
      SUBROUTINE APNDB (A,NB,NM,PL)
C                /APNDB - ARRAY PNDB/
C   * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C   *                                                                   *
C   *  UTILITY ROUTINE TO COMPUTE PNDB FOR ALL ANGLES OF A DATA ARRAY.  *
C   *                                                                   *
C   *  A           DATA ARRAY                                           *
C   *  NB          1/NB-OCTAVE FREQUENCY BANDS                          *
C   *  NM          NUMBER OF ANGLES                                     *
C   *  PL          PERCEIVED NOISE LEVELS, ALL ANGLES                   *
C   *                                                                   *
C   *  CALLS          PNDB                                              *
C   *                                                                   *
C   * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
      DIMENSION A(27,19),PL(19)
      DO 1 J=1,NM
      CALL PNDB (NB,A(1,J),DB,0)
1     PL(J)=DB
      RETURN
      END
```

```
      SUBROUTINE ASMBL (R,SL)
C                /ASMBL - ASSEMBLE DATA/
C   * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C   *                                                                   *
C   *  ASSEMBLES ONE SET OF WORKING DATA FROM COMMON BLOCK /WD/ INTO     *
C   *  A REFERRED ARRAY.                                                *
C   *                                                                   *
C   *  R           RADIUS FOR REFERRED ARRAY                            *
C   *  SL          REFERRED ARRAY                                       *
C   *                                                                   *
C   * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
      DIMENSION SL(27,19)
      COMMON /WD/A(20,4),NCONF,RPM,PCS,NF,NM,NB,PWL,SUMN,PSM(27),DT,
     1 AI(19),NFIL(27),DI(27,19)
C   * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C   *                                                                   *
C   *  VARIABLES IN COMMON BLOCK /WD/                                   *
C   *                                                                   *
C   *  A(20,4)     FOUR CARDS OF ID (WORD LENGTH 4)                     *
C   *  NCONF       CONFIGURATION NUMBER                                 *
C   *  RPM         SPEED IN RPM                                         *
C   *  PCS         PERCENT SPEED                                        *
C   *  NF          NUMBER OF FREQUENCY BANDS                            *
C   *  NM          NUMBER OF ANGLES                                     *
C   *  NB          1/NB-OCTAVE BANDS                                    *
C   *  PWL         OVERALL ACOUSTIC POWER LEVEL                         *
C   *  SUMN        DECIBEL SUM OF NORMALIZED POWER SPECTRUM             *
C   *  PSM(27)     NORMALIZED POWER SPECTRUM                            *
C   *  DT          ANGLE INCREMENT                                      *
C   *  AI(19)      ANGLES                                               *
C   *  NFIL(27)    BAND CENTER FREQUENCIES                              *
C   *  DI(27,19)   DIRECTIVITY INDEX                                    *
C   *                                                                   *
C   * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
      F=3.1415927/180.0
      RHO=0.0023769
      C=1116.3975
      CONST=2.0*59.141053*1.0E-15
      SPHERE=4.0*3.1415927*R**2
      NFT=1
      NLT=NM
      SUM=0.0
      IF (AI(1).GT.0.0) GO TO 1
      SUM=SUM+1.0
      NFT=2
1     IF (AI(NM).LT.180.0) GO TO 2
      SUM=SUM+1.0
      NLT=NM-1
2     SUM=TAN(DT/4.0*F)/2.0*SUM
      DO 3 J=NFT,NLT
3     SUM=SUM+SIN(AI(J)*F)
      FAC=CONST/(RHO*C)*SPHERE*SIN(DT/2.0*F)*SUM
      DELTA=130.0+10.0*ALOG10(FAC)
      PPSUM=PWL-SUMN-DELTA
      DO 4 I=1,NF
      PSUM=PPSUM+PSM(I)
      DO 4 J=1,NM
4     SL(I,J)=PSUM+DI(I,J)
      RETURN
      END
```

```
      SUBROUTINE ATMAT (T,RH,DIST,FREQ,ATT)
C                /ATMAT - ATMOSPHERIC ATTENUATION/
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C  *                                                                 *
C  *  COMPUTES EXCESS ATMOSPHERIC ATTENUATION IN DECIBELS FOR GIVEN   *
C  *  TEMPERATURE, RELATIVE HUMIDITY, DISTANCE, AND FREQUENCY.        *
C  *  USES EMPIRICAL CURVE-FITS OF DATA CONTAINED IN SOCIETY OF       *
C  *  AUTOMOTIVE ENGINEERS AEROSPACE RECOMMENDED PRACTICE NO. 866,    *
C  *  AUGUST, 1964.                                                   *
C  *                                                                 *
C  *  T          TEMPERATURE (DEGREES FAHRENHEIT)                     *
C  *  RH         RELATIVE HUMIDITY                                    *
C  *  DIST       DISTANCE (FEET)                                      *
C  *  FREQ       FREQUENCY (HERTZ)                                    *
C  *  ATT        ATTENUATION (DECIBELS)                               *
C  *                                                                 *
C  * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
      DIMENSION A(22)
      DATA A/0.870,0.750,0.652,0.570,0.505,0.452,0.406,0.369,0.335,
     1 0.308,0.286,0.268,0.253,0.240,0.231,0.225,0.220,0.215,0.210,
     2 0.208,0.202,0.200/
      AC=(0.1*(FREQ/1000.0)**2.05)/(1.651-.00103*T)**2.05
      AMM=(10.0*(FREQ/1000.0)**1.003)/10.0**(0.52-.00504*(T+SQRT(256.0-(
     110.0-T/5.0)**2)))
      HA=0.25*RH/10.0**(1.493-.01638*T-.02*SQRT(128.2-(10.0-T/5.00)**2))
      HMM=10.0**(0.4973*ALOG10(FREQ)-1.4894)
      HH=HA/HMM
      IF (HH.GT.0.25) GO TO 1
      AA=1.2*HH
      GO TO 8
1     IF (HH.GT.0.60) GO TO 2
      AA=1.543*HH-.086
      GO TO 8
2     IF (HH.GT.0.95) GO TO 3
      AA=0.84+0.16*SIN(3.14159/2.0*(HH-0.6)/0.35)
      GO TO 8
3     IF (HH.GT.1.25) GO TO 4
      AA=0.87+0.13*COS(3.14159/2.0*(HH-0.95)/0.3)
      GO TO 8
4     IF (HH.GT.6.5) GO TO 7
      HTEST=1.25
      DO 5 I=2,22
      HTEST=HTEST+0.25
      IF (HH.LE.HTEST) GO TO 6
5     CONTINUE
6     AA=A(I)+((HTEST-HH)/0.25)*(A(I-1)-A(I))
      GO TO 8
7     AA=0.2
8     CONTINUE
      ATT=(AMM*AA+AC)*(DIST/1000.0)
      RETURN
      END
```

```
      SUBROUTINE AVSLR (SL,AI,DT,NM,SLR)
C                /AVSLR - AVERAGE SL ON AN ARC/
C   * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C   *                                                                 *
C   *  COMPUTES SIMPLE-SOURCE SOUND PRESSURE LEVEL (AREA-WEIGHTED      *
C   *  AVERAGE SOUND PRESSURE LEVEL) FROM DIRECTIONAL DATA ON AN ARC.  *
C   *  RESULTS USED FOR DIRECTIVITY INDEX CALCULATION.                *
C   *                                                                 *
C   *  SL          REFERRED DATA ON AN ARC                             *
C   *  AI          CORRESPONDING ANGLES                                *
C   *  DT          ANGLE INCREMENT                                     *
C   *  NM          NUMBER OF ANGLES                                    *
C   *  SLR         AVERAGE SOUND PRESSURE LEVEL                        *
C   *                                                                 *
C   * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
      DIMENSION SL(19),AI(19)
      F=3.1415927/180.0
      NFT=1
      NLT=NM
      SUM=0.0
      SUMD=0.0
      IF (AI(1).GT.0.0) GO TO 1
      SUM=SUM+10.0**(SL(1)/10.0)
      SUMD=SUMD+1.0
      NFT=2
1     IF (AI(NM).LT.180.0) GO TO 2
      SUM=SUM+10.0**(SL(NM)/10.0)
      SUMD=SUMD+1.0
      NLT=NM-1
2     SUM=TAN(DT/4.0*F)/2.0*SUM
      SUMD=TAN(DT/4.0*F)/2.0*SUMD
      DO 3 J=NFT,NLT
      SUM=SUM+10.0**(SL(J)/10.0)*SIN(AI(J)*F)
3     SUMD=SUMD+SIN(AI(J)*F)
      SLR=10.0*ALOG10(SUM/SUMD)
      RETURN
      END
```

```
      SUBROUTINE BASPAT (A,RT,NF,NB,T,RH,TFA,R,ATA)
C                 /BASPAT - BAND SPECTRUM ATTENUATION/
C  * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C  *                                                                     *
C  *  COMPUTES FRACTIONAL-OCTAVE BAND EXCESS ATMOSPHERIC ATTENUATION     *
C  *  CONSIDERING SPECTRUM SHAPE.  EXTRAPOLATES SPECTRUM TO NEW          *
C  *  DISTANCE ACCOUNTING FOR INVERSE SQUARE AND EXCESS ATMOSPHERIC      *
C  *  ATTENUATION.                                                       *
C  *                                                                     *
C  *  A           REFERRED SPECTRUM                                      *
C  *  RT          CORRESPONDING RADIUS                                   *
C  *  NF          NUMBER OF FREQUENCY BANDS                              *
C  *  NB          1/NB-OCTAVE FREQUENCY BANDS                            *
C  *  T           TEMPERATURE (DEGREES FAHRENHEIT)                       *
C  *  RH          RELATIVE HUMIDITY                                      *
C  *  TFA         ATTENUATION IN DECIBELS PER THOUSAND FEET              *
C  *  R           RADIUS FOR ATTENUATED SPECTRUM                         *
C  *  ATA         ATTENUATED SPECTRUM AT R                               *
C  *              (INVERSE SQUARE AND ATMOSPHERIC ATTENUATION)           *
C  *                                                                     *
C  *  CALLS        ATMAT                                                 *
C  *                                                                     *
C  * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
      DIMENSION A(27),TFA(27),ATA(27)
      REAL M(27,2)
      NLS=NF-1
      DO 1 I=1,NLS
      M(I,2)=A(I+1)-A(I)
1     M(I+1,1)=M(I,2)
      M(1,1)=M(1,2)
      M(NF,2)=M(NF,1)
      NS=3
      S=NS
      B=NB
      BI=B*2.0*FLOAT(NS)
      F1=1.0
      IF (NB.EQ.1) F1=10.0**1.8
      IF (NB.EQ.3) F1=10.0**1.7
      DO 3 I=1,NF
      FC=10.0**(0.3/B*FLOAT(I-1))*F1
      CALL ATMAT (T,RH,1000.0,FC,AC)
      SL=1.0
      SLA=10.0**(-AC/10.0)
      DO 2 K=1,NS
      XL=-K
      XR=K
      EL=M(I,1)/2.0*XL/S
      ER=M(I,2)/2.0*XR/S
      SL=SL+10.0**(EL/10.0)+10.0**(ER/10.0)
      FL=10.0**(0.3/BI*XL)*FC
      FR=10.0**(0.3/BI*XR)*FC
      CALL ATMAT (T,RH,1000.0,FL,AL)
      CALL ATMAT (T,RH,1000.0,FR,AR)
2     SLA=SLA+10.0**((EL-AL)/10.0)+10.0**((ER-AR)/10.0)
      TFA(I)=10.0*ALOG10(SL)-10.0*ALOG10(SLA)
3     ATA(I)=A(I)-TFA(I)*R/1000.0-20.0*ALOG10(R/RT)
      RETURN
      END
```

```
C     MAIN PROGRAM DADIFF
C                /DADIFF - DATA DIFFERENCE/
C   * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C   *                                                                   *
C   *  COMPUTES DIFFERENCES BETWEEN TWO SETS OF DATA, INCLUDING         *
C   *  ACOUSTIC POWER, REFERRED ARRAY, AND EXTRAPOLATED DATA.           *
C   *                                                                   *
C   *  CALLS      ASMBL,  ATMAT, BASPAT,  DBSUM,   PNDB,   PNLT,        *
C   *             POWER, TITLE2,  WDATA                                 *
C   *                                                                   *
C   * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
      COMMON A(20,4,2),AI(19,2),NFIL(27,2),NCONF(2),RPM(2),PCS(2),
     1 NB(2),NF(2),NM(2),DT(2)
      COMMON /WD/AA(20,4),NCON,RP,PC,NNF,NNM,NNB,PW,SUMN,PS(27),DTT,
     1AAI(19),NFI(27),DII(27,19)
      DIMENSION DI(27,19,2),TSL(27,19,2),TBL(27,19,2)
      DIMENSION PSM(27,2),AF(19,2),AR(19,2),F(19,2),R(19,2),TW(27,2),
     1 TPWL(27,2),FPSM(27,2),RPSM(27,2),DIF(27,19)
      DIMENSION SUM(19,2),FW(27,2),RW(27,2)
      DIMENSION PWL(2),SOM(2),WF(27),W(27),WR(27),PWF(2),PWR(2),
     1 DELTF(27),DELTR(27),DIFF(29)
      DIMENSION PNL(19,2),DPNL(19),S(5),TFA(27),ATA(27,19,2),PNT(19,2),
     1DPNT(19)
      LOGICAL FTEST,ATEST,SPLIT(2)
      THREE=10.0*ALOG10(2.0)
      T=59.0
      RH=70.0
      WRITE (6,1)
1     FORMAT (1H1)
C
      READ (5,2) (S(I),I=1,5)
2     FORMAT (5F6.0)
C   * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C   *                                                                   *
C   *  INPUT DATA REQUIRED                                              *
C   *                                                                   *
C   *            ONE CARD WITH UP TO FIVE SIDELINE DISTANCES,           *
C   *            OR A BLANK CARD FOR NO SIDELINE EXTRAPOLATIONS.        *
C   *                                                                   *
C   * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
      DO 3 I=1,5
      IF (S(I).LE.0.0) GO TO 4
3     CONTINUE
      NS=5
      GO TO 5
4     NS=I-1
5     CONTINUE
6     CONTINUE
C
C        READ, ASSEMBLE TWO SETS OF DATA
C
      DO 10 K=1,2
C
      CALL WDATA
C   * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C   *                                                                   *
C   *  INPUT DATA REQUIRED                                              *
C   *                                                                   *
C   *            ONE OR MORE PAIR OF SETS OF WORKING DATA.              *
C   *            DIFFERENCES TAKEN USING SET TWO MINUS SET ONE.         *
C   *                                                                   *
C   * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
```

```
      DO 7 J=1,4
      DO 7 I=1,20
7     A(I,J,K)=AA(I,J)
      NCONF(K)=NCON
      RPM(K)=RP
      PCS(K)=PC
      NF(K)=NNF
      NM(K)=NNM
      NB(K)=NNB
      PWL(K)=PW
      DT(K)=DTT
      DO 8 J=1,NNM
8     AI(J,K)=AAI(J)
      DO 9 I=1,NNF
      PSM(I,K)=PS(I)
      NFIL(I,K)=NFI(I)
      DO 9 J=1,NNM
9     DI(I,J,K)=DII(I,J)
      CALL ASMBL (100.0,TSL(1,1,K))
10    CONTINUE
      FTEST=.TRUE.
      ATEST=.TRUE.
      SPLIT(1)=.FALSE.
      SPLIT(2)=.FALSE.
      DO 22 K=1,2
      NMM=NM(K)
      DO 11 J=1,NMM
      IF (AI(J,K).EQ.90.0) GO TO 12
11    CONTINUE
      GO TO 13
12    SPLIT(K)=.TRUE.
13    CONTINUE
      JS=J
      NFF=NF(K)
      DO 14 I=1,NFF
      DO 14 J=1,NMM
14    TBL(I,J,K)=TSL(I,J,K)
      DO 15 I=1,NFF
15    TSL(I,JS,K)=TSL(I,JS,K)-THREE
      DO 16 J=1,JS
16    AF(J,K)=AI(J,K)
      DO 17 J=JS,NMM
      I=J-JS+1
17    AR(I,K)=AI(J,K)
      NMF=JS
      NMR=NMM-JS+1
      DO 20 I=1,NFF
      DO 18 J=1,JS
18    F(J,K)=TSL(I,J,K)
      DO 19 J=JS,NMM
      JJ=J-JS+1
19    R(JJ,K)=TSL(I,J,K)
      CALL POWER (F(1,K),100.0,AF(1,K),NMF,DT(K),59.0,29.92,FPSM(I,K),FW
     1(I,K))
      CALL POWER (R(1,K),100.0,AR(1,K),NMR,DT(K),59.0,29.92,RPSM(I,K),RW
     1(I,K))
      TW(I,K)=FW(I,K)+RW(I,K)
      TPWL(I,K)=130.0+10.0*ALOG10(TW(I,K))
20    CONTINUE
      WF(K)=0.0
      W(K)=0.0
      WR(K)=0.0
```

```
      DO 21 I=1,NFF
      WF(K)=WF(K)+FW(I,K)
      W(K)=W(K)+TW(I,K)
21    WR(K)=WR(K)+RW(I,K)
      PWF(K)=130.0+10.0*ALOG10(WF(K))
      PWL(K)=130.0+10.0*ALOG10(W(K))
      PWR(K)=130.0+10.0*ALOG10(WR(K))
22    CONTINUE
      DPWL=PWL(2)-PWL(1)
      NFF=MINO(NF(1),NF(2))
      DO 23 I=1,NFF
      IF (NFIL(I,1).NE.NFIL(I,2)) FTEST=.FALSE.
23    CONTINUE
C
C        SHIFT SPECTRUM ARRAYS TO GET FREQUENCY CORRESPONDENCE
C
      IF (NB(1).EQ.NB(2).AND..NOT.FTEST) GO TO 24
      GO TO 30
24    IF (NFIL(1,2).GT.NFIL(1,1)) GO TO 25
      LL=2
      LH=1
      GO TO 26
25    LL=1
      LH=2
26    CONTINUE
      II=NF(LL)
      DO 27 I=1,II
      IF (NFIL(I,LL).EQ.NFIL(1,1)) GO TO 28
27    CONTINUE
28    ID=I
      NF(LL)=NF(LL)-ID+1
      II=NF(LL)
      DO 29 I=1,II
      K=I+ID-1
      NFIL(I,LL)=NFIL(K,LL)
      JJ=NM(LL)
      DO 29 J=1,JJ
29    TBL(I,J,LL)=TBL(K,J,LL)
      NFF=MINO(NF(1),NF(2))
      FTEST=.TRUE.
C
C        SHIFT ANGLE ARRAYS TO GET ANGLE CORRESPONDENCE
C
30    CONTINUE
      NMM=MINO(NM(1),NM(2))
      IF (DT(1).EQ.DT(2)) GO TO 31
      ATEST=.FALSE.
      GO TO 37
31    IF (AI(1,2).GT.AI(1,1)) GO TO 32
      LL=2
      LH=1
      GO TO 33
32    LL=1
      LH=2
33    CONTINUE
      JJ=NM(LL)
      DO 34 J=1,JJ
      IF (AI(J,LL).EQ.AI(1,LH)) GO TO 35
34    CONTINUE
      GO TO 37
35    JD=J
      NM(LL)=NM(LL)-JD+1
```

```
      JJ=NM(LL)
      DO 36 J=1,JJ
      K=J+JD-1
      AI(J,LL)=AI(K,LL)
      II=NF(LL)
      DO 36 I=1,II
36    TBL(I,J,LL)=TBL(I,K,LL)
      NMM=MIN0(NM(1),NM(2))
      ATEST=.TRUE.
C
C        PAGE ONE OUTPUT
C
37    CONTINUE
      CALL TITLE2
      WRITE (6,38)
38    FORMAT (1H ,40X,45HP O W E R   L E V E L   D I F F E R E N C E S//
     147X,33H(DATA SET TWO MINUS DATA SET ONE)//)
      IF (FTEST.AND.SPLIT(1).AND.SPLIT(2)) GO TO 45
      WRITE (6,39) PWL(2),PWL(1),DPWL
39    FORMAT (1H ,22X,11HTOTAL POWER//15X,27HSET TWO  SET ONE  DELTA PWL
     1//4X,8HOVERALL ,3F9.1)
      IF (FTEST) GO TO 41
      WRITE (6,40)
40    FORMAT (1H2,30X,83H(FREQUENCIES INCOMPATIBLE FOR COMPARISON, NO 90
     1 DEGREE ANGLE TO PERMIT 90/90 SPLIT))
      GO TO 54
41    WRITE (6,42)
42    FORMAT (1H ,3X,8HOVERALL ,3F9.1//15H BAND FREQUENCY)
      DO 43 I=1,NFF
      DELTA=TPWL(I,2)-TPWL(I,1)
43    WRITE (6,44) I,NFIL(I,1),TPWL(I,2),TPWL(I,1),DELTA
44    FORMAT (1H ,I3,I8,3F9.1)
      GO TO 54
45    WRITE (6,46)
46    FORMAT (1H ,22X,11HTOTAL POWER,45X,14HFRONT QUADRANT,19X,13HREAR Q
     1UADRANT//15X,27HSET TWO  SET ONE  DELTA PWL,26X,2(5X,27HSET TWO  S
     2ET ONE  DELTA PWL)//)
      DPF=PWF(2)-PWF(1)
      DPR=PWR(2)-PWR(1)
      WRITE (6,47) PWL(2),PWL(1),DPWL,PWF(2),PWF(1),DPF,PWR(2),PWR(1),DP
     1R
47    FORMAT (1H ,3X,8HOVERALL ,3F9.1,24X,8HOVERALL ,3F9.1,5X,3F9.1//)
      IF (FTEST) GO TO 49
      WRITE (6,48)
48    FORMAT (1H2,41H(FREQUENCIES INCOMPATIBLE FOR COMPARISON))
      GO TO 54
49    WRITE (6,50)
50    FORMAT (1H ,15H BAND FREQUENCY,45X,14HBAND FREQUENCY)
      DO 51 I=1,NFF
      DELTF(I)=FPSM(I,2)-FPSM(I,1)
51    DELTR(I)=RPSM(I,2)-RPSM(I,1)
      DO 52 I=1,NFF
      DELTA=TPWL(I,2)-TPWL(I,1)
52    WRITE (6,53) I,NFIL(I,1),TPWL(I,2),TPWL(I,1),DELTA,I,NFIL(I,1),FPS
     1M(I,2),FPSM(I,1),DELTF(I),RPSM(I,2),RPSM(I,1),DELTR(I)
53    FORMAT (1H ,I3,I8,3F9.1,21X,I3,I8,3F9.1,5X,3F9.1)
C
C        PAGE TWO OUTPUT
C
54    WRITE (6,1)
      CALL TITLE2
      WRITE (6,55)
55    FORMAT (1H ,32X,61HD I F F E R E N C E S   O F   R E F E R R E D
```

```
     1 D A T A       //47X,33H(DATA SET TWO MINUS DATA SET ONE)//)
      IF (ATEST) GO TO 57
      WRITE (6,56)
56    FORMAT (1H2,45H(DATA SET ANGLES INCOMPATIBLE FOR COMPARISON))
      GO TO 6
57    WRITE (6,58) (AI(J,1),J=1,NMM)
58    FORMAT (1H ,9X,5HANGLE,19F6.0)
      WRITE (6,59)
59    FORMAT (//)
      DO 60 K=1,2
      DO 60 J=1,NMM
60    CALL DBSUM (TBL(1,J,K),NFF,SUM(J,K))
      DO 61 J=1,NMM
61    DIFF(J)=SUM(J,2)-SUM(J,1)
      WRITE (6,62) (DIFF(J),J=1,NMM)
62    FORMAT (1H ,7X,7HOVERALL,19F6.1)
      IF (FTEST) GO TO 64
      WRITE (6,63)
63    FORMAT (1H2,30X,50H(DATA SET FREQUENCIES INCOMPATIBLE FOR COMPARIS
     1ON))
      GO TO 69
64    DO 65 I=1,NFF
      DO 65 J=1,NMM
65    DIF(I,J)=TBL(I,J,2)-TBL(I,J,1)
      WRITE (6,66)
66    FORMAT (1H ,14HBAND FREQUENCY)
      DO 67 I=1,NFF
67    WRITE (6,68) I,NFIL(I,1),(DIF(I,J),J=1,NMM)
68    FORMAT (1H ,I3,I8,3X,19F6.1)
69    CONTINUE
C
C      PAGE THREE OUTPUT
C
      IF (NS.LE.0) GO TO 6
      WRITE (6,1)
      CALL TITLE2
      WRITE (6,70) T,RH
70    FORMAT (1H ,20X,83HPERCEIVED AND TONE-CORRECTED RERCEIVED NOISE LE
     1VELS AND DIFFERENCES ALONG SIDELINES///50X,F5.1,3H F,,F5.1,11H PER
     2CENT RH)
      DO 81 KK=1,NS
      IF (KK.EQ.3.OR.KK.EQ.5) WRITE (6,1)
      IF (KK.EQ.3.OR.KK.EQ.5) CALL TITLE2
      IF (KK.EQ.3.OR.KK.EQ.5) WRITE (6,70) T,RH
      DO 71 K=1,2
      NM1=1
      IF (AI(1,K).LE.0.0) NM1=2
      IF (AI(NMM,K).GE.180.0) NMM=NMM-1
      DO 71 J=NM1,NMM
      RDIST=S(KK)/SIN(AI(J,K)*3.1415927/180.0)
      CALL BASPAT (TBL(1,J,K),100.0,NFF,NB,T,RH,TFA,RDIST,ATA(1,J,K))
71    CALL PNLT (ATA(1,J,K),PNL(J,K),PNT(J,K))
      DO 72 J=NM1,NMM
72    DPNL(J)=PNL(J,2)-PNL(J,1)
      WRITE (6,73) S(KK),(AI(J,1),J=NM1,NMM)
73    FORMAT (///,11X,F6.0,12H FT SIDELINE//5X,5HANGLE,5X,19F6.0)
      WRITE (6,74) (PNL(J,2),J=NM1,NMM)
74    FORMAT (1H0,1X,12HSET TWO PNDB,1X,19F6.1)
      WRITE (6,75) (PNL(J,1),J=NM1,NMM)
75    FORMAT (1H ,1X,12HSET ONE PNDB,1X,19F6.1)
      WRITE (6,76) (DPNL(J),J=NM1,NMM)
76    FORMAF (1H0,1X,10HDELTA PNDB,3X,19F6.1)
      DO 77 J=NM1,NMM
```

```
77    DPNT(J)=PNT(J,2)-PNT(J,1)
      WRITE (6,78) (PNT(J,2),J=NM1,NMM)
78    FORMAT (1H0,1X,12HSET TWO PNLT,1X,19F6.1)
      WRITE (6,79) (PNT(J,1),J=NM1,NMM)
79    FORMAT (1H ,1X,12HSET ONE PNLT,1X,19F6.1)
      WRITE (6,80) (DPNT(J),J=NM1,NMM)
80    FORMAT (1H0,1X,10HDELTA PNLT,3X,19F6.1)
81    CONTINUE
      WRITE (6,1)
      GO TO 6
      END
```

```
      SUBROUTINE DBSUM (A,N,SUM)
C                /DBSUM - DECIBEL SUM/
C  * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C  *                                                                     *
C  *  UTILITY ROUTINE TO COMPUTE A DECIBEL SUM (ANTILOGARITHMIC SUM)     *
C  *  FOR A NUMBER OF LEVELS.                                            *
C  *                                                                     *
C  *  A          ARRAY OF DECIBEL VALUES                                 *
C  *  N          NUMBER OF VALUES                                        *
C  *  SUM        DECIBEL SUM                                             *
C  *                                                                     *
C  * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
      DIMENSION A(27)
      SUM=0.0
      DO 1 I=1,N
1     SUM=SUM+10.0**(A(I)/10.0)
      SUM=10.0*ALOG10(SUM)
      RETURN
      END
```

```
      SUBROUTINE FARDTA (SL,RT,NF,NB,NM,AI,T,RH,DIST,IC,FARSL)
C                /FARDTA - FAR DATA/
C   * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C   *                                                                 *
C   *  EXTRAPOLATES REFERRED ARRAY TO A FAR FIELD RADIUS OR SIDELINE  *
C   *  ACCOUNTING FOR INVERSE SQUARE AND EXCESS ATMOSPHERIC ATTEN-    *
C   *  UATION.                                                        *
C   *                                                                 *
C   *  SL          REFERRED ARRAY                                     *
C   *  RT          CORRESPONDING RADIUS                               *
C   *  NF          NUMBER OF FREQUENCY BANDS                          *
C   *  NB          1/NB-OCTAVE FREQUENCY BANDS                        *
C   *  NM          NUMBER OF ANGLES                                   *
C   *  AI          ANGLES                                             *
C   *  T           TEMPERATURE (DEGREES FAHRENHEIT)                   *
C   *  RH          RELATIVE HUMIDITY                                  *
C   *  DIST        DISTANCE FROM SOURCE FOR EXTRAPOLATION             *
C   *  IC          CONTROL.  IF IC EQUALS ZERO, DIST IS TAKEN AS A    *
C   *              RADIUS ABOUT THE SOURCE.  IF IC = 1, DIST IS TAKEN *
C   *              AS NORMAL DISTANCE TO A PARALLEL SIDELINE.         *
C   *  FARSL       EXTRAPOLATED DATA ARRAY ON A RADIUS OR SIDELINE    *
C   *                                                                 *
C   *  CALLS       BASPAT                                             *
C   *                                                                 *
C   * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
      DIMENSION SL(27,19),AI(19),FARSL(27,19),TFA(27)
      RDIST=DIST
      F=3.1415927/180.0
      DO 6 J=1,NM
      IF (IC.EQ.0) GO TO 3
      IF (IC.EQ.1) GO TO 2
      WRITE (6,1)
1     FORMAT (62H SIDELINE OR RADIUS NOT CORRECTLY SPECIFIED, SUBROUTINE
     1 FARDTA)
      RETURN
2     ST=SIN(AI(J)*F)
      IF (ST.LE.0.0) GO TO 4
      RDIST=DIST/ST
3     CALL BASPAT (SL(1,J),RT,NF,NB,T,RH,TFA,RDIST,FARSL(1,J))
      GO TO 6
4     DO 5 I=1,NF
5     FARSL(I,J)=0.0
6     CONTINUE
      RETURN
      END
```

```
      SUBROUTINE GRAPH (SL,NF)
C                /GRAPH - GRAPH OUTPUT ON PRINTER/
C   * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C   *                                                                 *
C   *  UTILITY ROUTINE TO PRINT GRAPH OF A NORMALIZED ARRAY.          *
C   *                                                                 *
C   *  SL          NORMALIZED ARRAY                                   *
C   *  NF          NUMBER OF ELEMENTS OF ARRAY                        *
C   *                                                                 *
C   * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
      DIMENSION SL(27),P(132),D(4)
      DATA BLANK/1H /
```

```
      DATA X,PI,ZERO, SIGN,D/1HO,1HI,1H0,1H-,1H1,1H2,1H3,1H4/
      WRITE (6,1)
1     FORMAT (50X,34HNORMALIZED POWER SPECTRUM          ///)
      DO 2 I=1,NF
2     SL(I)=ABS(SL(I))
      DO 9 L=1,41
      DO 3 J=1,132
3     P(J)=BLANK
      P(24)=PI
      P(4*NF+20)=PI
      IF (L.EQ.1) P(21)=ZERO
      IF (L.EQ.11) GO TO 4
      IF (L.EQ.21) GO TO 4
      IF (L.EQ.31) GO TO 4
      IF (L.EQ.41) GO TO 4
      GO TO 7
4     P(20)=SIGN
      P(22)=ZERO
      K=L/10
      P(21)=D(K)
      IF (L.EQ.41) GO TO 5
      GO TO 7
5     KK=4*NF+19
      DO 6 K=25,KK
6     P(K)=SIGN
7     A=FLOAT(L-1)-0.5
      B=FLOAT(L-1)+0.5
      DO 8 I=1,NF
      IF (SL(I).GE.A.AND.SL(I).LT.B) P(4*I+20)=X
8     CONTINUE
9     WRITE (6,10) (P(I),I=1,132)
10    FORMAT (1H ,132A1)
      WRITE (6,11) (I,I=1,NF)
11    FORMAT (/21X,27I4)
      RETURN
      END
```

```
C    MAIN PROGRAM LIST
C                /LIST - LIST DATA ON PRINTER/
C  * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C
C  *  READS, ASSEMBLES SETS OF WORKING DATA AND PREPARES PRINTED          *
C  *  OUTPUT IDENTICAL WITH THAT OF WODAG COMMENCING WITH REFERRED        *
C  *  ARRAY.                                                             *
C  *                                                                     *
C  * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
      COMMON /WD/A(20,4),NCONF,RPM,PCS,NF,NM,NB,PWL,SUMN,PSM(27),DT,
     1 AI(19),NFIL(27),DI(27,19)
```

```
C  * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C  *                                                                     *
C  *  VARIABLES IN COMMON BLOCK /WD/                                     *
C  *                                                                     *
C  *  A(20,4)     FOUR CARDS OF ID (WORD LENGTH 4)                       *
C  *  NCONF       CONFIGURATION NUMBER                                   *
C  *  RPM         SPEED IN RPM                                           *
C  *  PCS         PERCENT SPEED                                          *
C  *  NF          NUMBER OF FREQUENCY BANDS                              *
C  *  NM          NUMBER OF ANGLES                                       *
C  *  NB          1/NB-OCTAVE BANDS                                      *
C  *  PWL         OVERALL ACOUSTIC POWER LEVEL                           *
C  *  SUMN        DECIBEL SUM OF NORMALIZED POWER SPECTRUM               *
C  *  PSM(27)     NORMALIZED POWER SPECTRUM                              *
C  *  DT          ANGLE INCREMENT                                        *
C  *  AI(19)      ANGLES                                                 *
C  *  NFIL(27)    BAND CENTER FREQUENCIES                                *
C  *  DI(27,19)   DIRECTIVITY INDEX                                      *
C  *                                                                     *
C  * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
      DIMENSION BUF(27,19),TFA(27,19),SL(27,19)
      DIMENSION AM(19)
      DIMENSION B(27),C(27),D(27),E(27),SLR(27)
      DIMENSION DS(6),SD(5)
C
C        DEFINE NUMBER OF SIDELINE DISTANCES
C
      READ (5,1) RSTD,(SD(I),I=1,5)
1     FORMAT (6F6.0)
C  * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C  *                                                                     *
C  *  INPUT DATA REQUIRED                                                *
C  *                                                                     *
C  *              ONE CARD WITH UP TO FIVE SIDELINE DISTANCES,           *
C  *              OR A BLANK CARD FOR NO SIDELINE EXTRAPOLATIONS.        *
C  *                                                                     *
C  * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
      DO 2 I=1,5
      IF (SD(I).LE.0.0) GO TO 3
2     CONTINUE
      NR=5
      GO TO 4
3     CONTINUE
      NR=I-1
4     CONTINUE
C
5     CALL WDATA
C  * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C  *  INPUT DATA REQUIRED                                                *
C  *                                                                     *
C  *              ONE OR MORE SETS OF WORKING DATA TO BE LISTED.         *
C  *                                                                     *
C  * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
      CALL ASMBL (RSTD,SL)
C
C
C   TITLE PAGE
C
      WRITE (6,6)
6     FORMAT (1H1)
      WRITE (6,7)
7     FORMAT (1H4,46X,35HN O I S E   D A T A   L I S T I N G////52X,26HC
     1OMPUTED FROM WORKING DATA//64X,2HOF///)
```

```
      DO 8 J=1,4
8     WRITE (6,9) (A(I,J),I=1,20)
9     FORMAT (30X,20A4)
      WRITE (6,10)
10    FORMAT (/)
      WRITE (6,11) NCONF,PCS,RPM,NF,NB,NFIL(1),NFIL(NF),NM,DT,AI(1),AI(N
     1M)
11    FORMAT (1H ,31X,13HCONFIGURATION,I4,10X,F5.1,14H PERCENT SPEED,10X
     1,F8.0,4H RPM//43X,I2,5H - 1/,I1,18H OCTAVE BANDS FROM,I5,3H TO,I6,
     26H HERTZ//42X,I3,13H ANGLES EVERY,F4.0,13H DEGREES FROM,F5.0,3H TO
     3,F5.0)
C
C        PAGE THREE
C          REFERRED ARRAY
C
      CALL TITLE (A,NCONF,RPM,PCS)
      WRITE (6,12) RSTD
12    FORMAT (52X,27HR E F E R R E D   A R R A Y//38X,7HDATA AT,F6.1,42H
     1 FT RADIUS WITH NO ATMOSPHERIC ATTENUATION/45X,40H(FOR POWER AND D
     2IRECTIVITY COMPUTATIONS)//)
      CALL ANGLE (AI,NM)
      CALL OASPL (SL,NM,NF,E)
      WRITE (6,13) (E(I),I=1,NM)
13    FORMAT (15H COMPUTED OASPL,19F6.1)
      WRITE (6,10)
      CALL TBLOP (SL,NF,NFIL,NM,1)
C
C
C        PAGE FOUR
C          ACOUSTIC POWER
C
C        COMPUTE TOTAL POWER, WATTS
C
      W=1.0E-13*10.0**(PWL/10.0)
      CALL AVSLR (E,AI,DT,NM,SLRO)
C
C        COMPUTE POWER SPECTRUM
C
      DO 14 I=1,NF
14    C(I)=PWL-SUMN+PSM(I)
      DO 16 I=1,NF
      DO 15 J=1,NM
15    D(J)=SL(I,J)
16    CALL AVSLR (D,AI,DT,NM,SLR(I))
      CALL TITLE (A,NCONF,RPM,PCS)
      WRITE (6,17) RSTD
17    FORMAT (40X,53HA C O U S T I C   P O W E R   C O M P U T A T I O N
     1 S//,73X,10HNORMALIZED,10X,6HSIMPLE/29X,4HBAND,8X,9HFREQUENCY,4X,3
     21HPOWER SPECTRUM   POWER SPECTRUM,5X,15HSOURCE SPL, R =,F6.1,3H FT
     3//)
      DO 18 I=1,NF
18    WRITE (6,19) I,NFIL(I),C(I),PSM(I),SLR(I)
19    FORMAT (30X,I2,I16,3F17.1)
      WRITE (6,20) SUMN,SLRO
20    FORMAT (/75X,F7.1,8H OVERALL,F9.1,8H OVERALL)
      WRITE (6,21)
21    FORMAT (/,55X,20HTOTAL ACOUSTIC POWER/72X,3H-13)
      WRITE (6,22) PWL,W
22    FORMAT (52X,5HPWL =,F6.1,16H DB RE 10   WATT//58X,3HW =,F7.1,6H WA
     1TTS/)
C
C
C        PAGE FIVE
```

```
C          NORMALIZED POWER SPECTRUM (GRAPH)
C
      CALL TITLE (A,NCONF,RPM,PCS)
      CALL GRAPH (PSM,NF)
C
C
C        PAGE SIX
C          DIRECTIVITY INDEX
C
      CALL TITLE (A,NCONF,RPM,PCS)
      WRITE (6,23)
23    FORMAT (50X,33HD I R E C T I V I T Y   I N D E X//)
      CALL ANGLE (AI,NM)
      CALL TBLOP (DI,NF,NFIL,NM,1)
      CALL AVSLR (E,AI,DI,NM,DIO)
      DO 24 J=1,NM
24    E(J)=E(J)-DIO
      WRITE (6,25) (E(J),J=1,NM)
25    FORMAT (8X,7HOVERALL,19F6.1)
C
C
C        PAGE SEVEN
C          ATMOSPHERIC ATTENUATION
C
C        COMPUTE THOUSAND FOOT EXCESS ATTENUATION
C
      DO 26 J=1,NM
26    CALL BASPAT (SL(1,J),RSTD,NF,NB,59.0,70.0,TFA(1,J),RSTD,8)
C
      CALL TITLE (A,NCONF,RPM,PCS)
      WRITE (6,27)
27    FORMAT (43X,45HA T M O S P H E R I C   A T T E N U A T I O N//35X,
     161HSTANDARD DAY EXCESS ATMOSPHERIC ATTENUATION PER THOUSAND FEET//
     237X,56HCOMPUTED FROM REFERRED ARRAY CONSIDERING SPECTRUM SHAPES//)
      CALL ANGLE (AI,NM)
      CALL TBLOP (TFA,NF,NFIL,NM,1)
C
C
C        PAGE EIGHT
C          STANDARD DAY DATA ATMOSPHERIC ABSORPTION
C
      CALL TITLE (A,NCONF,RPM,PCS)
      WRITE (6,28) RSTD
28    FORMAT (16X,95HS T A N D A R D   D A Y   D A T A   E X C E S S   A
     1 T M O S P H E R I C   A T T E N U A T I O N//26X,60HADJUSTMENTS T
     2O REFERRED ARRAY TO OBTAIN STANDARD DAY DATA AT,F6.0,10H FT RADIUS
     3//)
      DO 29 J=1,NM
      DO 29 I=1,NF
29    BUF(I,J)=TFA(I,J)*RSTD/1000.0
      CALL ANGLE (AI,NM)
      CALL TBLOP (BUF,NF,NFIL,NM,1)
C
C
C        PAGE NINE
C          STANDARD DAY DATA
C
      CALL TITLE (A,NCONF,RPM,PCS)
      WRITE (6,30) RSTD
30    FORMAT (48X,33HS T A N D A R D   D A Y   D A T A//43X,7HDATA AT,F6
     1.1,30H FT RADIUS ON 59F, 70PC RH DAY//)
      DO 31 J=1,NM
      DO 31 I=1,NF
```

```
31    BUF(I,J)=SL(I,J)-BUF(I,J)
      CALL ANGLE (AI,NM)
      CALL OASPL (BUF,NM,NF,B)
      WRITE (6,13) (B(I),I=1,NM)
      WRITE (6,10)
      CALL TBLOP (BUF,NF,NFIL,NM,1)
      WRITE (6,10)
      WRITE (6,32) RSTD
32    FORMAT (44X,18HPERCEIVED NOISE ON,F8.1,17H FT  RADIUS, PNDB//)
      CALL ANGLE (AI,NM)
      CALL APNDB (BUF,NB,NM,B)
      WRITE (6,33) (B(I),I=1,NM)
33    FORMAT (15X,19F6.1)
C
C
C        PAGE TEN AND FOLLOWING
C          SIDELINE EXTRAPOLATED DATA
C
C        DELETE ON-AXIS DATA
C
      MM=NM
      DO 34 J=1,MM
34    AM(J)=AI(J)
      IF (AM(1).GT.0.0) GO TO 36
      MM=MM-1
      DO 35 J=1,MM
      AM(J)=AM(J+1)
      DO 35 I=1,NF
35    SL(I,J)=SL(I,J+1)
36    IF (AM(MM).LT.180.0) GO TO 37
      MM=MM-1
37    CONTINUE
C
      KK=NR+1
      DO 38 I=2,KK
38    DS(I)=SD(I-1)
      DS(1)=RSTD
      DO 44 K=1,KK
      CALL TITLE (A,NCONF,RPM,PCS)
      WRITE (6,39) DS(K)
39    FORMAT (40X,52HS I D E L I N E   E X T R A P O L A T E D   D A T A
     1 //23X,20HSTANDARD DAY DATA ON,F7.0,59H FT  SIDELINE, INCORPORATIN
     2G EXCESS ATMOSPHERIC ATTENUATION//)
      CALL SIDLAT (MM,AM,RSTD,DS(K),B,C)
      DO 40 J=1,MM
      DO 40 I=1,NF
40    BUF(I,J)=SL(I,J)-B(J)-TFA(I,J)*C(J)/1000.0
      CALL ANGLE (AM,MM)
      CALL OASPL (BUF,MM,NF,C)
      WRITE (6,13) (C(I),I=1,MM)
      WRITE (6,10)
      CALL TBLOP (BUF,NF,NFIL,MM,0)
      WRITE (6,10)
      WRITE (6,41) DS(1),DS(K),(B(I),I=1,MM)
41    FORMAT (30X,35HINVERSE SQUARE LAW ATTENUATION FROM,F7.0,14H FT  RA
     1DIUS TO,F7.0,13H FT  SIDELINE//15X,19F6.1//)
      WRITE (6,10)
      CALL APNDB (BUF,NB,NM,B)
      WRITE (6,42) DS(K)
42    FORMAT (45X,18HPERCEIVED NOISE ON,F7.0,19H FT  SIDELINE, PNDB//)
      CALL ANGLE (AM,MM)
      WRITE (6,43) (B(I),I=1,MM)
43    FORMAT (15X,19F6.1)
```

```
      IF (NR.LE.0) GO TO 45
44    CONTINUE
45    WRITE (6,6)
C
      GO TO 5
      END
```

```
      SUBROUTINE OASPL (A,NM,NF,OA)
C                /OASPL - ARRAY OVERALL SOUND PRESSURE LEVELS/
C  * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C  *                                                                     *
C  *  UTILITY ROUTINE TO COMPUTE OVERALL SOUND PRESSURE LEVELS            *
C  *  FOR ALL ANGLES OF A DATA ARRAY.                                     *
C  *                                                                     *
C  *  A          DATA ARRAY                                              *
C  *  NM         NUMBER OF ANGLES                                        *
C  *  NF         NUMBER OF FREQUENCY BANDS                               *
C  *  OA         OVERALL SPLS FOR ALL ANGLES                             *
C  *                                                                     *
C  *  CALLS       DBSUM                                                  *
C  *                                                                     *
C  * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
      DIMENSION A(27,19),OA(19)
      DO 1 J=1,NM
      CALL DBSUM (A(1,J),NF,SUM)
1     OA(J)=SUM
      RETURN
      END
```

```
      SUBROUTINE PNDB (NB,LB,PNL,NC)
C                /PNDB - PERCEIVED NOISE DECIBELS/
C  * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C  *                                                                     *
C  *  COMPUTES PERCEIVED NOISE LEVEL (PNL) IN PNDB IN ACCORDANCE WITH     *
C  *  SOCIETY OF AUTOMOTIVE ENGINEERS AEROSPACE RECOMMENDED PRACTICE     *
C  *  NO. 865A, AUGUST 15, 1969.                                         *
C  *                                                                     *
C  *  NB         1/NB-OCTAVE BANDS                                       *
C  *                                                                     *
C  *  LB         ARRAY OF 8 OR 24 CONSECUTIVE 1/NB-OCTAVE BAND SOUND     *
C  *             PRESSURE LEVELS.  LB(1) CONTAINS SPL FOR 63 HZ BAND     *
C  *             IF NB = 1.  LB(1) CONTAINS SPL FOR 50 HZ BAND IF        *
C  *             NB = 3.                                                 *
C  *                                                                     *
C  *  PNL        PERCEIVED NOISE LEVEL IN PNDB                           *
C  *                                                                     *
C  *  NC         OUTPUT CONTROL.  IF NC EQUALS ZERO, NO PRINTED OUTPUT   *
C  *             (OTHER THAN ERROR MESSAGES) WILL BE GENERATED.          *
C  *             IF NC IS OTHER THAN ZERO, A TABULATION OF BAND NUM-     *
C  *             BERS, LEVELS, NOY VALUES, AND PERCEIVED NOISE LEVEL     *
C  *             WILL BE PRINTED.                                        *
C  *                                                                     *
C  * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
```

```
      REAL LB(27),NOY(24),K,NMAX,NBAR,MJ,LK
      REAL L(24,5),M(24,4)
      DATA L/49.0,44.0,39.0,34.0,30.0,27.0,24.0,21.0,18.0,5*16.0,15.0,
     112.0,9.0,5.0,4.0,5.0,6.0,10.0,17.0,21.0,55.0,51.0,46.0,42.0,39.0,
     236.0,33.0,30.0,27.0,5*25.0,23.0,21.0,18.0,15.0,2*14.0,15.0,17.0,
     323.0,29.0,64.0,60.0,56.0,53.0,51.0,48.0,46.0,44.0,42.0,5*40.0,
     438.0,34.0,32.0,30.0,2*29.0,30.0,31.0,37.0,41.0,52.0,51.0,49.0,
     547.0,46.0,45.0,43.0,42.0,41.0,5*40.0,38.0,      34.0,32.0,30.0,
     62*29.0,30.0,31.0,34.0,37.0,91.01,85.88,87.32,79.85,79.76,75.96,
     773.96,74.91,94.63,13*100.00,44.29,50.72/
      DATA M/0.079520,2*0.068160,0.059640,10*0.053013,0.059640,
     12*0.053013,2*0.047712,2*0.053013,0.068160,0.079520,0.0596401,
     22*0.058098,0.052288,0.047534,2*0.043573,0.040221,0.037349,
     37*0.034859,0.040221,0.037349,4*0.034859,2*0.037349,0.043573,
     40.043478,0.040570,2*0.036831,0.035336,2*0.033333,0.032051,
     50.030675,6*0.030103,7*0.029960,2*0.042285,15*0.030103,9*0.029960/
      IF (NB.EQ.1) GO TO 2
      IF (NB.EQ.3) GO TO 3
      WRITE (6,1)
1     FORMAT (1H0,23HPNDB SUBROUTINE MESSAGE/41H FREQUENCY BANDWIDTH IMP
     1ROPERLY SPECIFIED/47H RETURN TO CALLING PROGRAM WITH PNDB EQUAL ZE
     2RO//)
      PNL=0.0
      RETURN
2     NF=8
      K=0.3
      MM=3
      LL=1
      GO TO 4
3     NF=24
      K=0.15
      MM=1
      LL=0
4     CONTINUE
      NMAX=0.0
      SUMN=0.0
      DO 12 I=1,NF
      J=MM*I-LL
      IF (LB(I).LT.L(J,1)) GO TO 6
      IF (L(J,1).LE.LB(I).AND.LB(I).LT.L(J,2)) GO TO 7
      IF (L(J,2).LE.LB(I).AND.LB(I).LT.L(J,3)) GO TO 8
      IF (L(J,3).LE.LB(I).AND.LB(I).LT.L(J,5)) GO TO 9
      IF (L(J,5).LE.LB(I).AND.LB(I).LT.150.0) GO TO 10
      IF (LB(I).EQ.150.0) GO TO 10
      WRITE (6,5) LB(I)
5     FORMAT (30H PNDB SUBROUTINE ERROR MESSAGE//F6.1,68H DB EXCEEDS RAN
     1GE FOR VALID PNDB CALCULATION.  RETURN WITH PNDB = 0.)
      PNL=0.0
      RETURN
6     NOY(I)=0.0
      GO TO 12
7     MJ=M(J,1)
      LK=L(J,1)
      A=0.1
      GO TO 11
8     MJ=M(J,2)
      LK=L(J,3)
      A=1.0
      GO TO 11
9     MJ=M(J,3)
      LK=L(J,3)
      A=1.0
```

```
      GO TO 11
10    MJ=M(J,4)
      LK=L(J,4)
      A=1.0
11    NOY(I)=A*10.0**(MJ*(LB(I)-LK))
      IF (NOY(I).GT.NMAX) NMAX=NOY(I)
      SUMN=SUMN+NOY(I)
12    CONTINUE
      NBAR=NMAX+K*(SUMN-NMAX)
      PNL=40.0+33.22*ALOG10(NBAR)
      IF (NC.EQ.0) RETURN
      WRITE (6,13)
13    FORMAT (1H0,22HPNDB SUBROUTINE OUTPUT)
      GO TO (15,22,20),NB
14    WRITE (6,16) (I,I=1,NF)
15    WRITE (6,16) (I,I=1,NF)
16    FORMAT (1H0,5H BAND,I6,11I7)
      WRITE (6,17) (LB(I),I=1,NF)
17    FORMAT (1H ,5HLEVEL,12F7.1)
      WRITE (6,18) PNL
18    FORMAT (1H+,92X,F6.1,5H PNDB)
      WRITE (6,19) (NOY(I),I=1,NF)
19    FORMAT (1H ,5H NOYS,12F7.1)
      RETURN
20    IF (NF.LE.12) GO TO 14
      WRITE (6,16) (I,I=1,12)
      WRITE (6,17) (LB(I),I=1,12)
      WRITE (6,19) (NOY(I),I=1,12)
      WRITE (6,21)
21    FORMAT (/)
      WRITE (6,16) (I,I=13,NF)
      WRITE (6,17) (LB(I),I=13,NF)
      WRITE (6,18) PNL
      WRITE (6,19) (NOY(I),I=13,NF)
22    RETURN
      END
```

```
      SUBROUTINE PNLT (SL,PDB,DBT)
C                   /PNLT - TONE-CORRECTED PERCEIVED NOISE LEVEL/
C     * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C     *                                                                   *
C     *  COMPUTES TONE-CORRECTED PERCEIVED NOISE LEVEL (PNLT) FOR A       *
C     *  1/3-OCTAVE BAND SOUND SPECTRUM IN ACCORDANCE WITH FEDERAL        *
C     *  AVIATION REGULATIONS, VOL. III, PART 36 - NOISE STANDARDS,       *
C     *  AIRCRAFT TYPE CERTIFICATION.                                     *
C     *  ALSO COMPUTES PERCEIVED NOISE LEVEL.                             *
C     *                                                                   *
C     *  SL         1/3-OCTAVE BAND SOUND SPECTRUM                        *
C     *  PDB        PERCEIVED NOISE LEVEL, PNDB                           *
C     *  DBT        TONE-CORRECTED PERCEIVED NOISE LEVEL, PNLT            *
C     *                                                                   *
C     *  CALLS        PNDB                                                *
C     *                                                                   *
C     * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
      DIMENSION SL(24),SLP(24),F(24)
      DIMENSION SBAR(25)
      REAL M(25)
      LOGICAL N(24)
```

```
      INTEGER FREQ(24)
      DATA FREQ/50,63,80,100,125,160,200,250,315,400,500,630,800,1000,
     1 1250,1600,2000,2500,3150,4000,5000,6300,8000,10000/
      DO 1 I=1,24
      IF (SL(I).LT.0.0) SL(I)=0.0
1     N(I)=.FALSE.
      DO 2 I=4,24
2     M(I)=SL(I)-SL(I-1)
      DO 3 I=5,24
      IF (ABS(M(I)-M(I-1)).LE.5.0) GO TO 3
      IF (M(I).GT.0.0.AND.M(I).GT.M(I-1)) N(I)=.TRUE.
      IF (M(I).LE.0.0.AND.M(I-1).GT.0.0) N(I-1)=.TRUE.
3     CONTINUE
      DO 6 I=1,24
      IF (.NOT.N(I)) GO TO 4
      IF (I.EQ.24) GO TO 5
      SLP(I)=(SL(I-1)+SL(I+1))/2.0
      GO TO 6
4     SLP(I)=SL(I)
      GO TO 6
5     SLP(24)=SL(23)+M(24)
6     CONTINUE
      DO 7 I=4,24
7     M(I)=SLP(I)-SLP(I-1)
      M(3)=M(4)
      M(25)=M(24)
      DO 8 I=3,23
8     SBAR(I)=(M(I)+M(I+1)+M(I+2))/3.0
      SLP(3)=SL(3)
      DO 9 I=4,24
9     SLP(I)=SLP(I-1)+SBAR(I-1)
      TMAX=0.0
      T=0.0
      DO 14 I=3,24
      F(I)=SL(I)-SLP(I)
      IF (F(I).LE.0.0) GO TO 14
      IF (50.LE.FREQ(I).AND.FREQ(I).LT.500) GO TO 10
      IF (5000.LE.FREQ(I).AND.FREQ(I).LE.10000) GO TO 10
      GO TO 11
10    IF (F(I).LT.3.0) T=0.0
      IF (3.0.LE.F(I).AND.F(I).LT.20.0) T=F(I)/6.0
      IF (20.0.LE.F(I)) T=3.0+1.0/3.0
      GO TO 13
11    IF (500.LE.FREQ(I).AND.FREQ(I).LE.5000) GO TO 12
      GO TO 14
12    IF (F(I).LT.3.0) T=0.0
      IF (3.0.LE.F(I).AND.F(I).LT.20.0) T=F(I)/3.0
      IF (20.0.LE.F(I)) T=6.0+2.0/3.0
13    IF (T.GE.TMAX) TMAX=T
14    CONTINUE
      CALL PNDB (3,SL,PDB,0)
      DBT=PDB+TMAX
      RETURN
      END
```

```
      SUBROUTINE POWER (A,R,AI,NM,DT,T,BAR,PWL,W)
C                /POWER - TOTAL ACOUSTIC POWER/
C  * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C  *                                                                   *
C  *  COMPUTES TOTAL ACOUSTIC POWER BY INCREMENTAL AREA SUMMATION      *
C  *  FOR A SET OF ANGLES AND REFERRED SOUND PRESSURE LEVELS ON AN     *
C  *  ARC.  PRESENCE OF PERFECTLY REFLECTIVE GROUND PLANE ASSUMED.     *
C  *                                                                   *
C  *  A          ARRAY OF REFERRED SPL DATA ON AN ARC                  *
C  *  R          ARC RADIUS                                            *
C  *  AI         CONSECUTIVE ANGLES CORRESPONDING WITH ELEMENTS OF A   *
C  *  NM         NUMBER OF ANGLES                                      *
C  *  DT         ANGLE INCREMENT                                       *
C  *  T          TEMPERATURE (DEGREES FAHRENHEIT)                      *
C  *  BAR        BAROMETER (INCHES HG)                                 *
C  *  PWL        POWER LEVEL RE 0.1 PICOWATT                           *
C  *  W          ACOUSTIC POWER, WATTS                                 *
C  *                                                                   *
C  * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
      DIMENSION A(27),AI(19)
      CONST=2.0*59.141053*1.0E-15
      SPHERE=4.0*3.1415927*R**2
      C=49.02*SQRT(T+459.67)
      RHO=0.0023769*518.688/(T+459.67)*BAR/29.92
      F=3.1415927/180.0
      NFT=1
      NLT=NM
      SUM=0.0
      IF (AI(1).GT.0.0) GO TO 1
      SUM=SUM+10.0**(A(1)/10.0)
      NFT=2
1     IF (AI(NM).LT.180.0) GO TO 2
      SUM=SUM+10.0**(A(NM)/10.0)
      NLT=NM-1
2     SUM=TAN(DT/4.0*F)*SUM/2.0
      DO 3 J=NFT,NLT
3     SUM=SUM+10.0**(A(J)/10.0)*SIN(AI(J)*F)
      W=CONST/(RHO*C)*SPHERE*SIN(DT/2.0*F)*SUM
      PWL=130.0+10.0*ALOG10(W)
      RETURN
      END
```

```
      SUBROUTINE SIDLAT (NM,AI,RSTD,SIDIST,SINAT,RADIST)
C                /SIDLAT - SIDLINE ATTENUATION/
C  * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C  *                                                                   *
C  *  UTILITY ROUTINE TO COMPUTE SIDELINE RADIAL DISTANCES AND         *
C  *  ATTENUATIONS FOR ALL ANGLES.                                     *
C  *                                                                   *
C  *  NM         NUMBER OF ANGLES                                      *
C  *  AI         ANGLES                                                *
C  *  RSTD       ARC RADIUS ABOUT SOURCE                               *
C  *  SIDIST     NORMAL DISTANCE, SOURCE CENTERLINE TO PARALLEL        *
C  *             SIDELINE                                              *
C  *  SINAT      INVERSE SQUARE ATTENUATIONS IN DECIBELS,              *
C  *             ARC TO SIDELINE                                       *
C  *  RADIST     RADIAL DISTANCES, SOURCE TO SIDELINE                  *
C  *                                                                   *
C  * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
```

```
      DIMENSION AI(19),SINAT(19),RADIST(19)
      F=3.1415927/180.0
      RSQ=20.0*ALOG10(SIDIST/RSTD)
      DO 2 J=1,NM
      ST=SIN(AI(J)*F)
      IF (ST.LE.0.0) GO TO 1
      SINAT(J)=RSQ-20.0*ALOG10(ST)
      RADIST(J)=SIDIST/ST
      GO TO 2
1     SINAT(J)=0.0
      RADIST(J)=0.0
2     CONTINUE
      RETURN
      END
```

```
      SUBROUTINE TABLE (RSTD,SD)
C               /TABLE - TABLE OF DATA FOR REPORTING/
C  * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C  *                                                                     *
C  *  READS WORKING DATA AND PREPARES A TABLE OF NOISE DATA IN A         *
C  *  FORMAT SUITABLE FOR REPORTING PURPOSES.  DATA INCLUDES             *
C  *  STANDARD-DAY 1/3-OCTAVE BAND AND OVERALL SOUND PRESSURE            *
C  *  LEVELS ON AN ARC, OVERALL POWER LEVEL AND POWER SPECTRUM,          *
C  *  CORRESPONDING SIMPLE SOURCE SOUND PRESSURE LEVELS, AND             *
C  *  OPTIONAL PERCEIVED NOISE LEVELS ON SELECTED SIDELINES.             *
C  *                                                                     *
C  *  NOTE                                                               *
C  *    PROGRAM LOGIC AND FORMAT STATEMENTS CODED FOR NB = 3, AND        *
C  *    NM = 16.  CODING MUST BE REVISED FOR OTHER CONDITIONS.           *
C  *                                                                     *
C  *  RSTD       RADIUS FOR WHICH DATA TO BE PREPARED                    *
C  *  SD         OPTIONAL SIDELINE DISTANCES FOR PERCEIVED NOISE         *
C  *                                                                     *
C  *  CALLS       ASMBL,  AVSLR,  DBSUM,  FARDTA,   PNDB,   WDATA        *
C  *                                                                     *
C  * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
      COMMON /WD/A(20,4),NCONF,RPM,PCS,NF,NM,NB,PWL,SUMN,PSM(27),DT,
     1 AI(19),NFIL(27),DI(27,19)
C  * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C  *                                                                     *
C  *  VARIABLES IN COMMON BLOCK /WD/                                     *
C  *                                                                     *
C  *  A(20,4)    FOUR CARDS OF ID (WORD LENGTH 4)                        *
C  *  NCONF      CONFIGURATION NUMBER                                    *
C  *  RPM        SPEED IN RPM                                            *
C  *  PCS        PERCENT SPEED                                           *
C  *  NF         NUMBER OF FREQUENCY BANDS                               *
C  *  NM         NUMBER OF ANGLES                                        *
C  *  NB         1/NB-OCTAVE BANDS                                       *
C  *  PWL        OVERALL ACOUSTIC POWER LEVEL                            *
C  *  SUMN       DECIBEL SUM OF NORMALIZED POWER SPECTRUM                *
C  *  PSM(27)    NORMALIZED POWER SPECTRUM                               *
C  *  DT         ANGLE INCREMENT                                         *
C  *  AI(19)     ANGLES                                                  *
C  *  NFIL(27)   BAND CENTER FREQUENCIES                                 *
C  *  DI(27,19)  DIRECTIVITY INDEX                                       *
C  *                                                                     *
C  * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
```

```
      DIMENSION SL(27,19),OASPL(19),SLR(27,19),PW(27),AVSPL(27),
     1SLS(27,19),PNL(19),B(19),OASL(19)
      DIMENSION IAI(19),SD(5)
C
      CALL WDATA
C     * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C     *                                                                   *
C     *  INPUT DATA REQUIRED                                              *
C     *                                                                   *
C     *           ONE SET OF WORKING DATA FOR EACH SUBROUTINE CALL.       *
C     *                                                                   *
C     * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
      CALL ASMBL (RSTD,SL)
      DO 2 I=1,NF
      DO 1 J=1,NM
1     B(J)=SL(I,J)
2     CALL AVSLR (B,AI,DT,NM,AVSPL(I))
      DO 3 J=1,NM
3     CALL DBSUM (SL(1,J),NF,OASL(J))
      CALL AVSLR (OASL,AI,DT,NM,AVGOA)
      CALL FARDTA (SL,RSTD,NF,NB,NM,AI,59.0,70.0,RSTD,0,SLR)
      DO 4 J=1,NM
4     CALL DBSUM (SLR(1,J),NF,OASPL(J))
      DO 5 I=1,NF
5     PW(I)=PWL-SUMN+PSM(I)
      WRITE (6,6)
6     FORMAT (1H0,23X,87HDATA ADJUSTED TO STANDARD DAY OF 15 DEGREES C,
     170 PERCENT RELATIVE HUMIDITY
      WRITE (6,7)
7     FORMAT (1H ,35X,20HSPL RE .00002 N/SQ M,10X,18HPWL RE .1 PICOWATT)
      DO 8 I=1,NM
8     IAI(I)=AI(I)
      WRITE (6,9)
9     FORMAT (1H0,1X,9HFREQUENCY,46X,10HANGLE, DEG,45X,6HSIMPLE,2X,5HPOW
     1ER/112X,6HSOURCE,2X,5HLEVEL)
      WRITE (6,10) (IAI(I),I=1,NM)
10    FORMAT (1H ,10X,17I6)
      RMETER=RSTD*0.3048
      WRITE (6,11) RMETER
11    FORMAT (1H+,113X,3HSPL,3X,5H(PWL)//30X,46H1/3-OCTAVE BAND SOUND PR
     1ESSURE LEVELS (SPL) ON,F6.1,13H METER RADIUS//)
      DO 13 I=1,NF
      WRITE (6,12) NFIL(I),(SLR(I,J),J=1,NM),AVSPL(I),PW(I)
12    FORMAT (1H ,1X,I8,2X,16F6.1,1X,2F8.1)
13    IF (MOD(I,3).EQ.0) WRITE (6,14)
14    FORMAT (1H )
      WRITE (6,15) (OASPL(J),J=1,NM),AVGOA,PWL
15    FORMAT (1H ,3X,7HOVERALL,1X,16F6.1,1X,2F8.1)
      DO 16 I=1,5
      IF (SD(I).LE.0.0) GO TO 17
16    CONTINUE
      IS=5
      GO TO 18
17    IS=I-1
      IF (IS.LE.0) RETURN
18    CONTINUE
      WRITE (6,19)
19    FORMAT (1H0,2X,8HDISTANCE,35X,31HSIDELINE PERCEIVED NOISE LEVELS//
     1)
      DO 21 I=1,IS
      CALL FARDTA (SL,RSTD,NF,NB,NM,AI,59.0,70.0,SD(I),1,SLS)
      DO 20 J=1,NM
```

```
20    CALL PNDB (NB,SLS(1,J),PNL(J),0)
      SDM=SU(I)*0.3048
21    WRITE (6,22) SDM,(PNL(J),J=1,NM)
22    FORMAT (1H ,F6.1,2H M,3X,19F6.1)
      RETURN
      END
```

```
      SUBROUTINE TBLOP (A,NF,NFIL,NM,NEG)
C               /TBLOP - TABLE OUTPUT/
C  * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C  *                                                                   *
C  *  UTILITY ROUTINE TO OUTPUT DATA ARRAY.                            *
C  *                                                                   *
C  *  A          DATA ARRAY                                            *
C  *  NF         NUMBER OF FREQUENCY BANDS                             *
C  *  NFIL       BAND CENTER FREQUENCIES                               *
C  *  NM         NUMBER OF ANGLES                                      *
C  *  NEG        OUTPUT CONTROL.  IF NEG EQUALS ZERO, ALL NEGATIVE     *
C  *             VALUES IN ARRAY A WILL BE REPLACED WITH ZERO FOR      *
C  *             EASE OF READING.  IF NEG IS OTHER THAN ZERO, ARRAY    *
C  *             IS UNAFFECTED.                                        *
C  *                                                                   *
C  * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
      DIMENSION A(27,19)
      DIMENSION NFIL(27)
      IF (NEG.NE.0) GO TO 2
      DO 1 J=1,NM
      DO 1 I=1,NF
      IF (A(I,J).LT.0.0) A(I,J)=0.0
1     CONTINUE
2     WRITE (6,3)
3     FORMAT (15H BAND FREQUENCY)
      DO 4 I=1,NF
4     WRITE (6,5) I,NFIL(I),(A(I,J),J=1,NM)
5     FORMAT (1H ,I3,I8,3X,19F6.1)
      WRITE (6,6)
6     FORMAT (//)
      RETURN
      END
```

```
      SUBROUTINE TITLE (A,NCONF,RPM,PCS)
C               /TITLE - TITLE OUTPUT/
C  * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C  *                                                                   *
C  *  UTILITY ROUTINE TO OUTPUT ID INFORMATION.                        *
C  *                                                                   *
C  *  A          FOUR ID CARDS                                         *
C  *  NCONF      CONFIGURATION NUMBER                                  *
C  *  RPM        SPEED IN RPM                                          *
C  *  PCS        PERCENT SPEED                                         *
C  *                                                                   *
C  * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
```

```
      DIMENSION A(20,4)
      WRITE (6,1)
1     FORMAT (1H1)
2     FORMAT (1H ,20A4)
      WRITE (6,3) (A(J,1),J=1,20),NCONF
3     FORMAT (1H ,20A4,17X,16HCONFIGURATION NO,I5)
      WRITE (6,4) (A(J,2),J=1,20),RPM
4     FORMAT (1H ,20A4,17X,7HSPEED =,F6.0,4H RPM)
      WRITE (6,5) (A(J,3),J=1,20),PCS
5     FORMAT (1H ,20A4,17X,15HPERCENT SPEED =,F6.1)
      WRITE (6,2) (A(J,4),J=1,20)
      WRITE (6,6)
6     FORMAT (//)
      RETURN
      END
```

```
      SUBROUTINE TITLE2
C               /TITLE2 - TITLE OUTPUT/
C   * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C   *                                                                   *
C   *  UTILITY ROUTINE TO OUTPUT ID INFORMATION.                        *
C   *                                                                   *
C   * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
      COMMON A(20,4,2),AI(19,2),NFIL(27,2),NCONF(2),RPM(2),PCS(2),
     1 NB(2),NF(2),NM(2),DT(2)
      DIMENSION SET(2),AIL(2),IFIL(2)
      DATA SET(1),SET(2)/3HONE,3HTWO/
      DO 1 K=1,2
      J=NF(K)
      IFIL(K)=NFIL(J,K)
      J=NM(K)
1     AIL(K)=AI(J,K)
      WRITE (6,2)
2     FORMAT (1H ,36X,53HC O M P A R I S O N   O F   T W O   D A T A   S
     1 E T S////)
      DO 3 K=1,2
3     WRITE (6,4) SET(K),(A(I,1,K),I=1,20),(A(I,2,K),I=1,20),NCONF(K),PC
     1S(K),RPM(K),(A(I,3,K),I=1,20),NF(K),NB(K),NFIL(1,K),IFIL(K),(A(I,4
     2,K),I=1,20),NM(K),DT(K),AI(1,K),AIL(K)
4     FORMAT (10H DATA SET ,A3,/1H ,20A4,5X,38HCONFIGURATION     PERCENT
     1 SPEED    RPM/1H ,20A4,I12,F20.1,F13.0/1H ,20A4,I7,5H - 1/,I1,18H
     2OCTAVE BANDS FROM,I5,3H TO,I6,6H HERTZ/1H ,20A4,I7,13H ANGLES EVER
     3Y,F4.0,13H DEGREES FROM,F5.0,3H TO,F5.0//)
      RETURN
      END
```

```
      SUBROUTINE WDATA
C               /WDATA - WORKING DATA/
C   * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C   *                                                                   *
C   *  READS ONE SET OF WORKING DATA FROM CARDS INTO STORAGE            *
C   *  COMMON BLOCK /WD/.                                               *
C   *                                                                   *
C   * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
```

```
      COMMON /WD/A(20,4),NCONF,RPM,PCS,NF,NM,NB,PWL,SUMN,PSM(27),DT,
     1 AI(19),NFIL(27),DI(27,19)
C    * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C    *                                                                 *
C    *  VARIABLES RESULTING IN COMMON BLOCK /WD/                       *
C    *                                                                 *
C    *  A(20,4)    FOUR CARDS OF ID (WORD LENGTH 4)                    *
C    *  NCCNF      CONFIGURATION NUMBER                                *
C    *  RPM        SPEED IN RPM                                        *
C    *  PCS        PERCENT SPEED                                       *
C    *  NF         NUMBER OF FREQUENCY BANDS                           *
C    *  NM         NUMBER OF ANGLES                                    *
C    *  NB         1/NB-OCTAVE BANDS                                   *
C    *  PWL        OVERALL ACOUSTIC POWER LEVEL                        *
C    *  SUMN       DECIBEL SUM OF NORMALIZED POWER SPECTRUM            *
C    *  PSM(27)    NORMALIZED POWER SPECTRUM                           *
C    *  DT         ANGLE INCREMENT                                     *
C    *  AI(19)     ANGLES                                              *
C    *  NFIL(27)   BAND CENTER FREQUENCIES                             *
C    *  DI(27,19)  DIRECTIVITY INDEX                                   *
C    *                                                                 *
C    * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
      DO 1 J=1,4
1     READ (5,2) (A(I,J),I=1,20)
2     FORMAT (20A4)
      READ (5,3) NCONF,RPM,PCS,NF,NM,NB
3     FORMAT (I4,2F8.1,3I3)
      IF (NF.EQ.10) GO TO 5
      READ (5,4) PWL,SUMN,(PSM(I),I=1,NF)
4     FORMAT (12F6.1/(12X,10F6.1))
      GO TO 7
5     READ (5,6) PWL,SUM,(PSM(I),I=1,NF)
6     FORMAT (12F6.1)
7     READ (5,6) DT,(AI(J),J=1,NM)
      DO 11 I=1,NF
      IF (NM.EQ.10) GO TO 9
      READ (5,8) NFIL(I),(DI(I,J),J=1,NM)
8     FORMAT (6X,I6,10F6.1/(12X,10F6.1))
      GO TO 11
9     READ (5,10) NFIL(I),(DI(I,J),J=1,NM)
10    FORMAT (6X,I6,10F6.1)
11    CONTINUE
      RETURN
      END
```

```
      SUBROUTINE WODAG
C                /WODAG - WORKING DATA GENERATION/
C    * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C    *                                                                 *
C    *  STANDARDIZES MEASURED DATA.  PREPARES DATA LISTINGS.  PUNCHES  *
C    *  WORKING DATA.                                                  *
C    *                                                                 *
C    *  CALLS        ANGLE,  APNDB,  AVSLR, BASPAT,  DBSUM,  GRAPH,    *
C    *               OASPL,  POWER,  SIDLAT,  TBLOP,  TITLE            *
C    *                                                                 *
C    * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
      COMMON /WODA/A(20,4),NCONF,RPM,PCS,SL(27,19),T,RH,BAR,AO,DT,R(19),
     1NM,NF,NB,RSTD,SD(5)
```

```
C  * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C  *                                                                     *
C  *   VARIABLES NECESSARY IN COMMON BLOCK /WODA/                        *
C  *                                                                     *
C  *   A(20,4)    FOUR CARUS OF ID (WORD LENGTH 4)                       *
C  *   NCCNF      CONFIGURATION NUMBER                                   *
C  *   RPM        SPEED IN RPM                                           *
C  *   PCS        PERCENT SPEED                                          *
C  *   SL(27,19)  MEASURED ARRAY (TEST DAY SOUND PRESSURE LEVELS)        *
C  *   T          TEST TEMPERATURE (DEGREES FAHRENHEIT)                  *
C  *   RH         TEST RELATIVE HUMIDITY                                 *
C  *   BAR        TEST BAROMETER (INCHES HG)                             *
C  *   AO         FIRST MICROPHONE ANGLE                                 *
C  *   DT         MICROPHONE ANGLE INCREMENT                             *
C  *   R(19)      MICROPHONE RADII                                       *
C  *   NM         NUMBER OF MICROPHONES                                  *
C  *   NF         NUMBER OF FREQUENCY BANDS                              *
C  *   NB         KIND OF FRACTIONAL-OCTAVE BANDS (1 OR 3)               *
C  *   RSTD       STANDARD RADIUS FOR DATA LISTINGS                      *
C  *   SD(5)      OPTIONAL SIDELINE DISTANCES FOR DATA EXTRAPOLATIONS    *
C  *                                                                     *
C  * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
      DIMENSION BUF(27,19),TFA(27,19)
      DIMENSION AI(19),AM(19)
      DIMENSION B(27),C(27),D(27),E(27),NFIL(27),SLR(27)
      DIMENSION DS(6)
      INTEGER FREQ(27)
      DATA FREQ/50,63,80,100,125,160,200,250,315,400,500,630,800,1000,
     1 1250,1600,2000,2500,3150,4000,5000,6300,8000,10000,12500,16000,
     2 20000/
C
C        DEFINE NUMBER OF SIDELINE DISTANCES
C
      DO 1 I=1,5
      IF (SD(I).LE.0.0) GO TO 2
1     CONTINUE
      NR=5
      GO TO 3
2     CONTINUE
      NR=I-1
3     CONTINUE
C
C        DEFINE BAND CENTER FREQUENCIES
C
      DO 4 I=1,NF
      J=I
      IF (NB.EQ.1) J=3*I-1
4     NFIL(I)=FREQ(J)
C
C        DEFINE MICROPHONE ANGLES
C
      DO 5 I=1,NM
5     AI(I)=AO+DT*FLOAT(I-1)
C
C        SIMPLY ADJUST TO CONSTANT RADIUS FOR REVIEW ONLY
C
      DO 6 J=1,NM
      DL=20.0*ALOG10(R(J)/RSTD)
      DO 6 I=1,NF
6     SL(I,J)=SL(I,J)+DL
C
C
C        PAGE ONE
```

```
C          MEASURED ARRAY
C
      WRITE (6,7)
7     FORMAT (1H1)
      DO 8 J=1,4
8     WRITE (6,9) (A(I,J),I=1,20)
9     FORMAT (26X,20A4//)
      WRITE (6,10) NCONF,RPM,PCS
10    FORMAT (16X,16HCONFIGURATION NO,I5,10X,7HSPEED =,F6.0,4H RPM,10X,1
     15HPERCENT SPEED =,F6.1///)
      WRITE (6,11) T,RH,BAR
11    FORMAT (10X,17HTEST CONDITIONS -,7X,13HTEMPERATURE =,F5.1,2H F,6X,
     119HRELATIVE HUMIDITY =,F5.1,3H PC,6X,11HBAROMETER =,F6.2,6H IN HG/
     2//)
      WRITE (6,12) RSTD
12    FORMAT (52X,27HM E A S U R E D   A R R A Y,//37X,41HMEASURED DATA
     1SIMPLY ADJUSTED TO CONSTANT,F6.1,10H FT RADIUS//)
      CALL ANGLE (AI,NM)
      CALL OASPL (SL,NM,NF,B)
      WRITE (6,13) (B(I),I=1,NM)
13    FORMAT (15H COMPUTED OASPL,19F6.1)
      WRITE (6,14)
14    FORMAT (/)
      CALL TBLOP (SL,NF,NFIL,NM,1)
      WRITE (6,15) (R(I),I=1,NM)
15    FORMAT (48X,31HORIGINAL MICROPHONE RADII, FEET//15X,19F6.1)
C
C
C       PAGE TWO
C         TEST DAY ATMOSPHERIC ABSORPTION
C
      CALL TITLE (A,NCONF,RPM,PCS)
      DO 16 J=1,NM
      CALL BASPAT (SL(1,J),RSTD,NF,NB,T,RH,B,RSTD,C)
      DO 16 I=1,NF
      BUF(I,J)=B(I)*R(J)/1000.0
16    SL(I,J)=SL(I,J)+BUF(I,J)
      WRITE (6,17) T,RH
17    FORMAT (27X,77HT E S T   D A Y   E X C E S S   A T M O S P H E R I
     1 C   A T T E N U A T I O N//34X,62HADDITIONS TO UNADJUSTED MEASURE
     2D DATA TO OBTAIN REFERRED ARRAY//49X,33HTEMPERATURE     RELATIVE H
     3UMIDITY/46X,F10.0,2H F,12X,F5.1,3H PC//)
      CALL ANGLE (AI,NM)
      CALL TBLOP (BUF,NF,NFIL,NM,1)
C
C
C       PAGE THREE
C         REFERRED ARRAY
C
      CALL TITLE (A,NCONF,RPM,PCS)
      WRITE (6,18) RSTD
18    FORMAT (52X,27HR E F E R R E D   A R R A Y//38X,7HDATA AT,F6.1,42H
     1 FT RADIUS WITH NO ATMOSPHERIC ATTENUATION/45X,40H(FOR POWER AND D
     2IRECTIVITY COMPUTATIONS)//)
      CALL ANGLE (AI,NM)
      CALL OASPL (SL,NM,NF,E)
      WRITE (6,13) (E(I),I=1,NM)
      WRITE (6,14)
      CALL TBLOP (SL,NF,NFIL,NM,1)
C
C
C       PAGE FOUR
C         ACOUSTIC POWER COMPUTATIONS
```

```
C
C        COMPUTE TOTAL POWER
C
      CALL POWER (E,RSTD,AI,NM,DT,T,BAR,PWL,W)
      CALL AVSLR (E,AI,DT,NM,SLRO)
C
C        COMPUTE POWER SPECTRUM
C
      DO 20 I=1,NF
      DO 19 J=1,NM
19    B(J)=SL(I,J)
      CALL POWER (B,RSTD,AI,NM,DT,T,BAR,PW,D)
20    C(I)=PW
      CMAX=0.0
      DO 21 I=1,NF
      IF (C(I).GE.CMAX) CMAX=C(I)
21    CONTINUE
      DO 22 I=1,NF
22    B(I)=C(I)-CMAX
      CALL DBSUM (B,NF,SUM)
      DO 24 I=1,NF
      DO 23 J=1,NM
23    D(J)=SL(I,J)
24    CALL AVSLR (D,AI,DT,NM,SLR(I))
      CALL TITLE (A,NCONF,RPM,PCS)
      WRITE (6,25) RSTD
25    FORMAT (40X,53HA C O U S T I C   P O W E R   C O M P U T A T I O N
     1 S//,73X,10HNORMALIZED,10X,6HSIMPLE/29X,4HBAND,8X,9HFREQUENCY,4X,3
     21HPOWER SPECTRUM   POWER SPECTRUM,5X,15HSOURCE SPL, R =,F6.1,3H FT
     3//)
      DO 26 I=1,NF
26    WRITE (6,27) I,NFIL(I),C(I),B(I),SLR(I)
27    FORMAT (30X,I2,I16,3F17.1)
      WRITE (6,28) SUM,SLRO
28    FORMAT (/75X,F7.1,8H OVERALL,F9.1,8H OVERALL)
      WRITE (6,29)
29    FORMAT (/,55X,20HTOTAL ACOUSTIC POWER/72X,3H-13)
      WRITE (6,30) PWL,W
30    FORMAT (52X,5HPWL =,F6.1,16H DB RE 10   WATT//58X,3HW =,F7.1,6H WA
     1TTS/)
C
C        PUNCH HEADER AND POWER DATA
C
      DO 31 J=1,4
31    PUNCH 32, (A(I,J),I=1,20)
32    FORMAT (20A4)
      PUNCH 33, NCONF,RPM,PCS,NF,NM,NB
33    FORMAT (I4,2F8.1,3I3)
      IF (NF.EQ.10) GO TO 35
      PUNCH 34, PWL,SUM,(B(I),I=1,NF)
34    FORMAT (12F6.1/(12X,10F6.1))
      GO TO 36
35    PUNCH 41, PWL,SUM,(B(I),I=1,NF)
36    CONTINUE
C
C
C        PAGE FIVE
C          NORMALIZED POWER SPECTRUM (GRAPH)
C
      CALL TITLE (A,NCONF,RPM,PCS)
      CALL GRAPH (B,NF)
```

```
C
C
C        PAGE SIX
C          DIRECTIVITY INDEX.
C
      CALL TITLE (A,NCONF,RPM,PCS)
      WRITE (6,37)
37    FORMAT (50X,33HD I R E C T I V I T Y   I N D E X//)
      CALL ANGLE (AI,NM)
      DO 38 I=1,NF
      DO 38 J=1,NM
38    BUF(I,J)=SL(I,J)-SLR(I)
      CALL TBLOP (BUF,NF,NFIL,NM,1)
      CALL AVSLR (E,AI,DT,NM,DIO)
      DO 39 J=1,NM
39    E(J)=E(J)-DIO
      WRITE (6,40) (E(J),J=1,NM)
40    FORMAT (8X,7HOVERALL,19F6.1)
C
C        PUNCH ANGLES, DIRECTIVITY INDEX
C
      PUNCH 41, DT,(AI(J),J=1,NM)
41    FORMAT (12F6.1)
      DO 45 I=1,NF
      IF (NM.EQ.10) GO TO 43
      PUNCH 42, I,NFIL(I),(BUF(I,J),J=1,NM)
42    FORMAT (2I6,10F6.1/12X,10F6.1)
      GO TO 45
43    PUNCH 44, I,NFIL(I),(BUF(I,J),J=1,NM)
44    FORMAT (2I6,10F6.1)
45    CONTINUE
C
C
C        PAGE SEVEN
C          ATMOSPHERIC ATTENUATION
C
C        COMPUTE THOUSAND FOOT EXCESS ATTENUATION
C
      DO 46 J=1,NM
46    CALL BASPAT (SL(1,J),RSTD,NF,NB,59.0,70.0,TFA(1,J),RSTD,8)
C
      CALL TITLE (A,NCONF,RPM,PCS)
      WRITE (6,47)
47    FORMAT (43X,45HA T M O S P H E R I C   A T T E N U A T I O N//35X,
     161HSTANDARD DAY EXCESS ATMOSPHERIC ATTENUATION PER THOUSAND FEET//
     237X,56HCOMPUTED FROM REFERRED ARRAY CONSIDERING SPECTRUM SHAPES//)
      CALL ANGLE (AI,NM)
      CALL TBLOP (TFA,NF,NFIL,NM,1)
C
C
C        PAGE EIGHT
C          STANDARD DAY DATA ATMOSPHERIC ABSORPTION
C
      CALL TITLE (A,NCONF,RPM,PCS)
      WRITE (6,48) RSTD
48    FORMAT (16X,95HS T A N D A R D   D A Y   D A T A   E X C E S S   A
     1T M O S P H E R I C   A T T E N U A T I O N//26X,60HADJUSTMENTS T
     20 REFERRED ARRAY TO OBTAIN STANDARD DAY DATA AT,F6.0,10H FT RADIUS
     3//)
      DO 49 J=1,NM
      DO 49 I=1,NF
49    BUF(I,J)=TFA(I,J)*RSTD/1000.0
      CALL ANGLE (AI,NM)
```

```
      CALL TBLOP (BUF,NF,NFIL,NM,1)
C
C
C        PAGE NINE
C          STANDARD DAY DATA
C
      CALL TITLE (A,NCONF,RPM,PCS)
      WRITE (6,50) RSTD
 50   FORMAT (48X,33HS T A N D A R D   D A Y   D A T A//43X,7HDATA AT,F6
     1.1,30H FT RADIUS ON 59F, 70PC RH DAY//)
      DO 51 J=1,NM
      DO 51 I=1,NF
 51   BUF(I,J)=SL(I,J)-BUF(I,J)
      CALL ANGLE (AI,NM)
      CALL OASPL (BUF,NM,NF,B)
      WRITE (6,13) (B(I),I=1,NM)
      WRITE (6,14)
      CALL TBLOP (BUF,NF,NFIL,NM,1)
      WRITE (6,14)
      WRITE (6,52) RSTD
 52   FORMAT (44X,18HPERCEIVED NOISE ON,F8.1,17H FT  RADIUS, PNDB//)
      CALL ANGLE (AI,NM)
      CALL APNDB (BUF,NB,NM,B)
      WRITE (6,53) (B(I),I=1,NM)
 53   FORMAT (15X,19F6.1)
C
C
C        PAGE TEN AND FOLLOWING
C          SIDELINE EXTRAPOLATED DATA
C
C        DELETE ON-AXIS DATA
C
      MM=NM
      DO 54 J=1,MM
 54   AM(J)=AI(J)
      IF (AM(1).GT.0.0) GO TO 56
      MM=MM-1
      DO 55 J=1,MM
      AM(J)=AM(J+1)
      DO 55 I=1,NF
 55   SL(I,J)=SL(I,J+1)
 56   IF (AM(MM).LT.180.0) GO TO 57
      MM=MM-1
 57   CONTINUE
C
      KK=NR+1
      DO 58 I=2,KK
 58   DS(I)=SD(I-1)
      DS(1)=RSTD
      DO 64 K=1,KK
      CALL TITLE (A,NCONF,RPM,PCS)
      WRITE (6,59) DS(K)
 59   FORMAT (40X,52HS I D E L I N E   E X T R A P O L A T E D   D A T A
     1 //23X,20HSTANDARD DAY DATA ON,F7.0,59H FT  SIDELINE, INCORPORATIN
     2G EXCESS ATMOSPHERIC ATTENUATION//)
      CALL SIDLAT (MM,AM,RSTD,DS(K),B,C)
      DO 60 J=1,MM
      DO 60 I=1,NF
 60   BUF(I,J)=SL(I,J)-B(J)-TFA(I,J)*C(J)/1000.0
      CALL ANGLE (AM,MM)
      CALL OASPL (BUF,MM,NF,C)
      WRITE (6,13) (C(I),I=1,MM)
      WRITE (6,14)
```

```
      CALL TBLOP (BUF,NF,NFIL,MM,0)
      WRITE (6,14)
      WRITE (6,61) DS(1),DS(K),(B(I),I=1,MM)
61    FORMAT (30X,35HINVERSE SQUARE LAW ATTENUATION FROM,F7.0,14H FT   RA
     1DIUS TO,F7.0,13H FT  SIDELINE//15X,19F6.1//)
      WRITE (6,14)
      CALL APNDB (BUF,NB,NM,B)
      WRITE (6,62) DS(K)
62    FORMAT (45X,18HPERCEIVED NOISE ON,F7.0,19H FT  SIDELINE, PNDB//)
      CALL ANGLE (AM,MM)
      WRITE (6,63) (B(I),I=1,MM)
63    FORMAT (15X,19F6.1)
      IF (NR.LE.0) GO TO 65
64    CONTINUE
65    WRITE (6,7)
C
      RETURN
      END
```

REFERENCES

1. Montegani, Francis J.: Noise Generated by Quiet Engine Fans. I - Fan B. NASA TM X-2528, 1972.

2. Anon.: Standard Values of Atmospheric Absorption as a Function of Temperature and Humidity for Use in Evaluating Aircraft Flyover Noise. Aerospace Recommended Practice No. 866, SAE, Aug. 1964.

3. Anon.: Definitions and Procedures for Computing the Perceived Noise Level of Aircraft Noise. Aerospace Recommended Practice No. 865A, SAE, Aug. 1969.

4. Anon.: Federal Aviation Regulations. Vol. III, pt. 36 - Noise Standards: Aircraft Type Certification.

TABLE I. - SAMPLE OUTPUT FROM WORKING DATA GENERATION SUBROUTINE WODAG

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

LEWIS RESEARCH CENTER

PROPULSION SYSTEMS ACOUSTICS BRANCH

SAMPLE NOISE DATA

CONFIGURATION NO 100   SPEED = 1800. RPM   PERCENT SPEED = 75.0

TEST CONDITIONS -   TEMPERATURE = 50.0 F   RELATIVE HUMIDITY = 60.0 PC   BAROMETER = 30.00 IN HG

M E A S U R E D   A R R A Y

MEASURED DATA SIMPLY ADJUSTED TO CONSTANT 100.0 FT RADIUS

	ANGLE	10.	20.	30.	40.	50.	60.	70.	80.	90.	100.	110.	120.	130.	140.	150.	160.
	COMPUTED OASPL	90.9	92.1	92.6	93.8	91.6	89.8	89.2	89.0	91.8	92.6	93.7	94.8	95.3	94.0	93.6	91.1
BAND	FREQUENCY																
1	50	69.0	66.1	64.9	65.9	68.6	67.6	67.2	68.9	66.4	68.7	69.6	70.6	73.1	74.4	77.9	77.9
2	63	64.3	65.6	65.1	63.8	65.0	65.0	65.8	66.1	66.3	66.8	69.3	71.4	74.1	76.1	79.0	80.0
3	80	65.3	65.8	64.0	64.1	64.8	65.3	65.1	66.8	68.5	70.3	72.8	74.0	77.0	79.3	83.0	83.3
4	100	68.7	69.2	69.2	70.6	68.9	68.4	70.6	71.6	71.9	74.7	75.2	77.5	79.6	81.9	84.4	83.6
5	125	70.0	69.5	69.1	69.6	70.1	71.6	72.1	73.3	74.1	75.3	76.5	78.1	79.1	81.0	83.6	80.5
6	160	70.0	71.0	71.0	71.3	72.5	72.8	73.1	73.3	74.3	74.8	75.1	76.5	77.8	79.6	81.1	78.0
7	200	69.7	70.6	70.4	70.2	70.1	69.6	69.7	70.1	71.4	72.2	74.1	75.8	78.2	79.4	80.9	76.8
8	250	69.3	69.8	69.6	69.8	69.6	70.1	70.6	71.8	72.8	74.3	75.8	77.4	78.6	80.0	81.0	77.9
9	315	69.0	69.3	70.6	71.3	70.5	71.0	71.1	72.0	73.3	73.8	75.1	76.6	78.5	79.3	79.5	76.2
10	400	68.5	69.5	70.0	71.0	70.5	71.8	70.8	71.3	72.8	73.8	75.1	76.9	78.3	79.1	78.8	74.5
11	500	71.1	72.2	71.4	71.9	72.7	71.2	70.9	71.9	72.9	73.9	74.7	76.0	77.6	77.9	77.6	73.3
12	630	69.6	70.7	71.7	73.2	72.4	71.5	71.9	72.4	73.4	73.9	74.9	75.6	77.0	76.7	75.7	71.8
13	800	74.8	74.0	73.5	77.5	75.2	72.2	73.0	74.4	73.7	75.0	75.4	76.1	77.7	77.0	76.0	72.7
14	1000	75.0	74.6	76.2	75.5	78.5	74.4	74.4	73.0	73.7	74.5	75.7	76.8	78.0	77.9	76.4	72.6
15	1250	75.7	77.2	77.6	78.7	77.0	75.2	75.1	74.4	74.2	75.2	76.9	76.7	77.2	77.1	75.9	72.3
16	1600	75.6	76.1	75.9	75.9	75.1	74.2	73.4	73.0	74.0	75.4	76.5	77.7	78.5	75.5	74.2	70.8
17	2000	86.3	87.4	87.8	88.8	86.1	84.2	81.6	78.9	81.7	80.1	84.6	83.7	83.1	79.1	77.2	74.7
18	2500	77.9	78.9	79.2	79.4	77.9	76.4	74.4	74.9	76.4	76.9	78.9	80.0	79.4	76.9	74.9	71.0
19	3150	77.0	78.6	79.3	80.1	78.1	76.8	75.6	76.3	78.5	79.3	80.8	82.8	82.3	78.1	75.8	72.4
20	4000	80.5	82.1	82.7	83.7	81.9	79.4	80.2	79.4	85.1	85.2	85.4	86.0	86.7	84.6	80.1	77.4
21	5000	78.2	79.7	79.7	80.7	79.5	76.7	76.4	77.2	79.2	80.2	81.0	83.0	84.4	82.0	78.7	74.2
22	6300	77.5	79.2	80.9	83.4	78.7	77.1	76.9	77.1	81.9	81.3	82.3	83.4	83.4	80.6	77.7	73.1
23	8000	77.4	79.2	80.0	81.8	79.0	77.4	77.5	78.4	81.2	83.9	83.4	84.4	84.7	81.5	78.2	73.4
24	10000	77.4	78.8	79.6	81.4	77.9	76.6	76.6	76.1	79.9	81.6	82.6	84.7	84.3	81.8	79.0	73.0
25	12500	76.9	77.7	78.4	80.2	77.7	74.9	75.1	75.6	77.9	79.4	80.4	82.3	82.7	80.4	77.7	71.5
26	16000	75.2	76.9	78.4	79.7	76.5	74.0	74.0	74.2	77.9	79.2	79.7	81.8	81.9	79.2	76.2	70.5
27	20000	75.6	76.9	77.9	78.0	76.5	73.9	75.4	73.5	76.5	78.3	79.5	81.1	81.4	79.0	76.2	70.9

ORIGINAL MICROPHONE RADII, FEET

100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

TABLE I. - Continued. SAMPLE OUTPUT FROM WORKING DATA GENERATION SUBROUTINE WODAG

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LEWIS RESEARCH CENTER
PROPULSION SYSTEMS ACOUSTICS BRANCH
SAMPLE NOISE DATA

CONFIGURATION NO 100
SPEED = 1800. RPM
PERCENT SPEED = 75.0

T E S T   D A Y   E X C E S S   A T M O S P H E R I C   A T T E N U A T I O N

ADDITIONS TO UNADJUSTED MEASURED DATA TO OBTAIN REFERRED ARRAY

TEMPERATURE 50. F   RELATIVE HUMIDITY 60.0 PC

BAND	FRECUENCY / ANGLE	10.	20.	30.	40.	50.	60.	70.	80.	90.	100.	110.	120.	130.	140.	150.	160.
1	50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	63	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	80	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	125	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	160	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	315	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	400	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
11	500	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
12	630	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
13	800	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
14	1000	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
15	1250	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
16	1600	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
17	2000	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
18	2500	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
19	3150	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
20	4000	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.2	1.2	1.2	1.1
21	5000	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
22	6300	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
23	8000	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.3	3.3	3.3	3.3	3.3	3.3	3.2
24	10000	4.6	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.6	4.5
25	12500	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3
26	16000	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8
27	20000	12.2	12.2	12.1	12.1	12.2	12.1	12.2	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.2	12.2

TABLE I. - Continued. SAMPLE OUTPUT FROM WORKING DATA GENERATION SUBROUTINE WODAG

NATICNAL AERCNAUTICS AND SPACE ACMINISTRATION
LEWIS RESEARCH CENTER
FROPULSICN SYSTEMS ACOUSTICS BRANCH
SAMPLE NCISE CATA

CONFIGURATION NO 100
SPEED = 1800. RPM
PERCENT SPEED = 75.0

R E F E R R E D   A R R A Y

DATA AT 100.0 FT RADIUS WITH NO ATMOSPHERIC ATTENUATION
(FCR PCWER AND DIRECTIVITY COMPUTATIONS)

	ANGLE	10.	20.	30.	40.	50.	60.	70.	80.	90.	100.	110.	120.	130.	140.	150.	160.
CCMPUTED OASPL		94.0	95.2	96.0	97.1	94.8	92.7	92.8	92.3	95.3	96.5	97.5	99.0	99.3	97.3	95.7	92.4
BAND	FRECUENCY																
1	50	69.0	66.1	64.9	65.9	68.6	67.6	67.2	68.9	66.4	68.7	69.6	70.6	73.1	74.4	77.9	77.9
2	63	64.3	65.6	65.1	63.8	65.0	65.0	65.8	66.1	66.3	66.8	69.3	71.4	74.1	76.1	79.0	80.0
3	80	65.3	65.8	64.0	64.1	64.8	65.3	65.1	66.8	68.5	70.3	72.8	74.0	77.0	79.3	83.0	83.3
4	100	68.7	69.2	69.2	70.6	68.9	68.4	70.6	71.6	71.9	74.7	75.2	77.5	79.6	81.9	84.4	83.6
5	125	70.0	69.5	69.1	69.6	70.1	71.6	72.1	73.3	74.1	75.3	76.5	78.1	79.1	81.0	83.6	80.5
6	160	70.0	71.0	71.0	71.3	72.5	72.8	73.1	73.3	74.3	74.8	75.1	76.5	77.8	79.6	81.1	78.0
7	200	69.7	70.6	70.4	70.2	70.1	69.6	69.7	70.1	71.4	72.2	74.1	75.8	78.2	79.4	80.9	76.8
8	250	69.3	69.8	69.6	69.8	69.6	70.1	70.6	71.8	72.8	74.3	75.8	77.4	78.6	80.0	81.0	77.9
9	315	69.0	69.3	70.6	71.3	70.5	71.0	71.1	72.0	73.3	73.8	75.1	76.6	78.5	79.3	79.5	76.2
10	400	68.6	69.6	70.1	71.1	70.6	71.9	70.9	71.4	72.9	73.9	75.2	77.0	78.4	79.2	78.9	74.6
11	500	71.2	72.3	71.5	72.0	72.6	71.3	71.0	72.0	73.0	74.0	74.8	76.1	77.7	78.0	77.7	73.4
12	630	69.7	70.8	71.8	73.3	72.5	71.6	72.0	72.5	73.5	74.0	75.0	75.7	77.1	76.8	75.8	71.9
13	800	74.9	74.1	73.6	77.6	75.3	72.3	73.1	74.5	73.8	75.1	75.5	76.2	77.8	77.1	76.1	72.8
14	1000	75.1	74.7	76.3	75.6	78.6	74.5	74.5	73.1	73.8	74.6	75.8	76.9	78.1	78.0	76.5	72.7
15	1250	75.9	77.4	77.8	78.9	77.2	75.4	75.3	74.6	74.4	75.4	77.1	76.9	77.4	77.3	76.1	72.5
16	1600	75.9	76.4	76.2	76.2	75.4	74.5	73.7	73.3	74.3	75.7	76.8	78.0	78.8	75.8	74.5	71.1
17	2000	86.7	87.8	88.2	89.2	86.5	84.6	82.0	79.3	82.1	80.5	85.0	84.1	83.5	79.5	77.6	75.1
18	2500	78.4	79.4	79.7	79.9	78.4	76.9	74.9	75.4	76.9	77.4	79.4	80.5	79.9	77.4	75.4	71.5
19	3150	77.8	79.4	80.1	80.9	78.9	77.6	76.4	77.1	79.3	80.1	81.6	83.6	83.1	78.9	76.6	73.2
20	4000	81.6	83.2	83.8	84.8	83.0	80.5	81.3	80.5	86.2	86.3	86.5	87.1	87.9	85.8	81.3	78.5
21	5000	79.8	81.3	81.3	82.3	81.1	78.3	78.0	78.8	80.8	81.8	82.6	84.6	86.0	83.6	80.3	75.8
22	6300	79.8	81.5	83.2	85.7	81.0	79.4	79.2	79.4	84.2	83.6	84.6	85.7	85.7	82.9	80.0	75.4
23	8000	80.6	82.4	83.2	85.0	82.2	80.6	80.7	81.6	84.4	87.2	86.7	87.7	88.0	84.8	81.5	76.6
24	10000	82.0	83.3	84.1	85.9	82.4	81.1	81.1	80.6	84.4	86.1	87.1	89.2	88.8	86.3	83.6	77.5
25	12500	83.2	84.0	84.7	86.5	84.0	81.2	81.4	81.9	84.2	85.7	86.7	88.6	89.0	86.7	84.0	77.8
26	16000	84.0	85.7	87.2	88.5	85.3	82.8	82.8	83.0	86.7	88.0	88.5	90.6	90.7	88.0	85.0	79.3
27	20000	87.8	89.1	90.0	90.1	88.7	86.0	87.6	85.6	88.6	90.4	91.6	93.2	93.5	91.1	88.4	83.1

TABLE I. - Continued. SAMPLE OUTPUT FROM WORKING DATA GENERATION SUBROUTINE WODAG

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LEWIS RESEARCH CENTER
PROPULSION SYSTEMS ACOUSTICS BRANCH
SAMPLE NOISE DATA

CONFIGURATION NO 100
SPEED = 1800. RPM
PERCENT SPEED = 75.0

A C O U S T I C P O W E R C O M P U T A T I O N S

BAND	FREQUENCY	POWER SPECTRUM	NORMALIZED POWER SPECTRUM	SIMPLE SOURCE SPL, R = 100.0 FT
1	50	118.5	-18.9	71.1
2	63	119.1	-18.3	71.7
3	80	122.2	-15.2	74.8
4	100	124.4	-13.0	77.0
5	125	124.0	-13.3	76.7
6	160	123.0	-14.4	75.6
7	200	122.0	-15.4	74.6
8	250	122.8	-14.6	75.4
9	315	122.3	-15.1	75.0
10	400	122.1	-15.3	74.7
11	500	121.7	-15.7	74.4
12	630	121.4	-15.9	74.1
13	800	122.7	-14.7	75.3
14	1000	123.3	-14.1	75.9
15	1250	123.7	-13.6	76.4
16	1600	123.1	-14.2	75.8
17	2000	131.7	-5.7	84.3
18	2500	125.5	-11.9	78.1
19	3150	127.4	-10.0	80.0
20	4000	132.2	-5.2	84.8
21	5000	129.2	-8.1	81.9
22	6300	130.5	-6.9	83.1
23	8000	132.1	-5.3	84.8
24	10000	132.7	-4.7	85.3
25	12500	132.7	-4.6	85.4
26	16000	134.6	-2.8	87.2
27	20000	137.4	0.	90.0
			6.1 OVERALL	96.2 OVERALL

TOTAL ACOUSTIC POWER

PWL = 143.5 DB RE 10^{-13} WATT

W = 22.5 WATTS

TABLE I. - Continued. SAMPLE OUTPUT FROM WORKING DATA GENERATION SUBROUTINE WODAG

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LEWIS RESEARCH CENTER
PROPULSION SYSTEMS ACOUSTICS BRANCH
SAMPLE NOISE DATA

CONFIGURATION NO 100
SPEED = 1800. RPM
PERCENT SPEED = 75.0

NORMALIZED POWER SPECTRUM

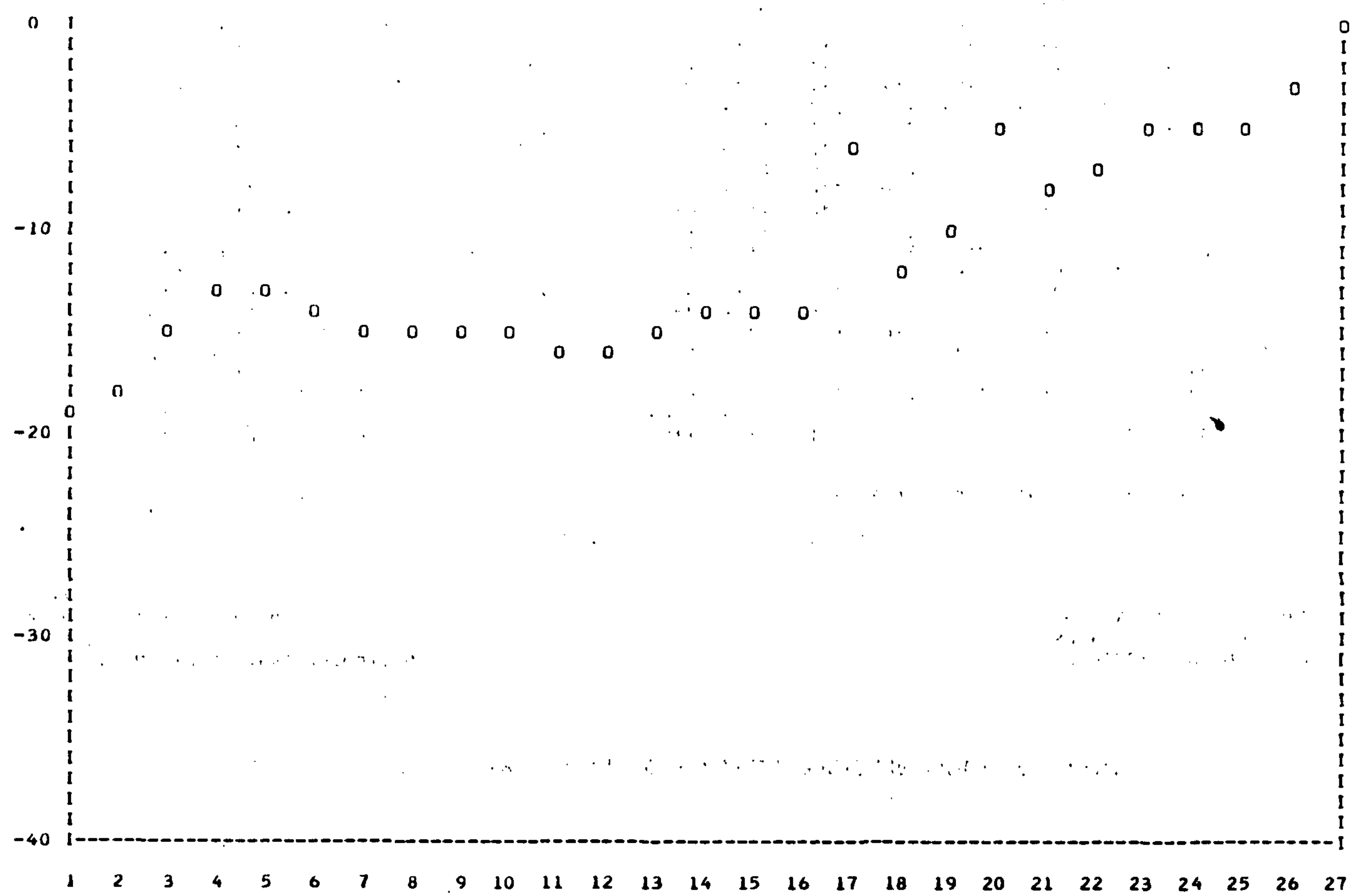

TABLE I. - Continued. SAMPLE OUTPUT FROM WORKING DATA GENERATION SUBROUTINE WODAG

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LEWIS RESEARCH CENTER
PROPULSION SYSTEMS ACOUSTICS BRANCH
SAMPLE NOISE DATA

CONFIGURATION NO 100
SPEED = 1800. RPM
PERCENT SPEED = 75.0

DIRECTIVITY INDEX

BAND	FREQUENCY \ ANGLE	10.	20.	30.	40.	50.	60.	70.	80.	90.	100.	110.	120.	130.	140.	150.	160.
1	50	-7.1	-5.0	-6.2	-5.2	-2.5	-3.5	-3.9	-2.2	-4.7	-2.4	-1.5	-0.5	2.0	3.3	6.8	6.8
2	63	-7.4	-6.1	-6.6	-7.9	-6.7	-6.7	-5.9	-5.6	-5.4	-4.9	-2.4	-0.3	2.4	4.4	7.3	8.3
3	80	-9.5	-9.0	-10.8	-10.7	-10.0	-9.5	-9.7	-8.0	-6.3	-4.5	-2.0	-0.8	2.2	4.5	8.2	8.5
4	100	-8.3	-7.6	-7.8	-6.4	-8.1	-8.6	-6.4	-5.4	-5.1	-2.3	-1.8	0.5	2.6	4.9	7.4	6.6
5	125	-6.7	-7.2	-7.6	-7.1	-6.0	-5.1	-4.6	-3.4	-2.6	-1.4	-0.2	1.4	2.4	4.3	6.9	3.8
6	160	-5.6	-4.6	-4.6	-4.5	-3.1	-2.8	-2.5	-2.3	-1.3	-0.8	-0.5	0.9	2.2	4.0	5.5	2.4
7	200	-4.9	-4.0	-4.2	-4.4	-4.5	-5.0	-4.9	-4.5	-3.2	-2.4	-0.5	1.2	3.6	4.8	6.3	2.2
8	250	-6.1	-5.6	-5.8	-5.6	-5.6	-5.3	-4.8	-3.6	-2.6	-1.1	0.4	2.0	3.2	4.6	5.6	2.5
9	315	-5.9	-5.6	-4.3	-3.6	-4.4	-3.9	-3.8	-2.9	-1.6	-1.1	0.2	1.7	3.6	4.4	4.6	1.3
10	400	-6.2	-5.2	-4.7	-3.7	-4.2	-2.9	-3.9	-3.4	-1.9	-0.9	0.4	2.2	3.6	4.4	4.1	-0.2
11	500	-3.2	-2.1	-2.9	-2.4	-1.6	-3.1	-3.4	-2.4	-1.4	-0.4	0.4	1.7	3.3	3.6	3.3	-1.0
12	630	-4.4	-3.3	-2.3	-0.8	-1.6	-2.5	-2.1	-1.6	-0.6	-0.1	0.9	1.6	3.0	2.7	1.7	-2.2
13	800	-0.4	-1.2	-1.7	2.3	0.0	-3.0	-2.2	-0.8	-1.5	-0.2	0.2	0.9	2.5	1.8	0.8	-2.5
14	1000	-0.8	-1.2	0.4	-0.3	2.7	-1.4	-1.4	-2.8	-2.1	-1.3	-0.1	1.0	2.2	2.1	0.6	-3.2
15	1250	-0.5	1.0	1.4	2.5	0.8	-1.0	-1.1	-1.8	-2.0	-1.0	0.7	0.5	1.0	0.9	-0.3	-3.9
16	1600	0.1	0.6	0.4	0.4	-0.4	-1.3	-2.1	-2.5	-1.5	-0.1	1.0	2.2	3.0	-0.0	-1.3	-4.7
17	2000	2.4	3.5	3.9	4.9	2.2	-0.3	-2.3	-5.0	-2.2	-3.8	0.7	-0.2	-0.8	-4.8	-6.7	-9.2
18	2500	0.5	1.3	1.6	1.8	0.3	-1.2	-3.2	-2.7	-1.2	-0.7	1.3	2.4	1.8	-0.7	-2.7	-6.6
19	3150	-2.2	-0.6	0.1	0.9	-1.1	-2.4	-3.6	-2.9	-0.7	0.1	1.6	3.6	3.1	-1.1	-3.4	-6.8
20	4000	-3.2	-1.6	-1.0	0.0	-1.8	-4.3	-3.5	-4.3	1.4	1.5	1.7	2.3	3.0	0.9	-3.6	-6.3
21	5000	-2.1	-0.6	-0.6	0.4	-0.8	-3.6	-3.9	-3.1	-1.1	-0.1	0.7	2.7	4.1	1.7	-1.6	-6.1
22	6300	-3.3	-1.6	0.1	2.6	-2.1	-3.7	-3.9	-3.7	1.1	0.5	1.5	2.6	2.6	-0.2	-3.1	-7.7
23	8000	-4.1	-2.3	-1.5	0.3	-2.5	-4.1	-4.0	-3.1	-0.3	2.4	1.9	2.9	3.2	0.0	-3.3	-8.1
24	10000	-3.4	-2.0	-1.2	0.6	-2.9	-4.2	-4.2	-4.7	-0.9	0.8	1.8	3.9	3.5	1.0	-1.8	-7.8
25	12500	-2.2	-1.4	-0.7	1.1	-1.4	-4.2	-4.0	-3.5	-1.2	0.3	1.3	3.2	3.6	1.3	-1.4	-7.6
26	16000	-3.2	-1.5	0.0	1.3	-1.9	-4.4	-4.4	-4.2	-0.5	0.8	1.3	3.4	3.5	0.8	-2.2	-7.9
27	20000	-2.3	-1.0	0.0	0.1	-1.4	-4.0	-2.4	-4.4	-1.4	0.4	1.6	3.2	3.5	1.1	-1.7	-7.0
	OVERALL	-2.2	-0.9	-0.1	0.9	-1.3	-3.5	-3.4	-3.9	-0.8	0.4	1.3	2.8	3.1	1.1	-0.4	-3.8

TABLE I. - Continued. SAMPLE OUTPUT FROM WORKING DATA GENERATION SUBROUTINE WODAG

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LEWIS RESEARCH CENTER
PROPULSION SYSTEMS ACOUSTICS BRANCH
SAMPLE NOISE DATA

CONFIGURATION NO 100
SPEED = 1800. RPM
PERCENT SPEED = 75.0

A T M O S P H E R I C   A T T E N U A T I O N

STANDARD DAY EXCESS ATMOSPHERIC ATTENUATION PER THOUSAND FEET

COMPUTED FROM REFERRED ARRAY CONSIDERING SPECTRUM SHAPES

BAND	FREQUENCY \ ANGLE	10.	20.	30.	40.	50.	60.	70.	80.	90.	100.	110.	120.	130.	140.	150.	160.
1	50	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
2	63	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
3	80	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
4	100	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
5	125	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
6	160	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
7	200	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
8	250	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
9	315	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
10	400	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
11	500	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
12	630	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
13	800	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
14	1000	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
15	1250	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9
16	1600	2.5	2.5	2.5	2.5	2.5	2.5	2.4	2.4	2.5	2.4	2.5	2.4	2.4	2.4	2.4	2.4
17	2000	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1
18	2500	4.0	4.0	4.0	4.0	4.0	4.0	4.1	4.1	4.1	4.2	4.1	4.2	4.2	4.2	4.1	4.1
19	3150	5.7	5.7	5.7	5.7	5.7	5.7	5.8	5.7	5.8	5.8	5.8	5.8	5.8	5.8	5.7	5.8
20	4000	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.9	7.9	7.8
21	5000	10.9	10.9	10.9	11.0	10.8	10.9	10.8	10.9	10.8	10.8	10.8	10.9	10.8	10.8	10.9	10.8
22	6300	15.7	15.7	15.8	15.8	15.7	15.8	15.8	15.8	15.9	16.0	15.9	15.9	15.8	15.7	15.7	15.7
23	8000	22.7	22.7	22.6	22.5	22.6	22.7	22.7	22.6	22.5	22.8	22.7	22.8	22.8	22.8	22.8	22.7
24	10000	32.6	32.4	32.4	32.4	32.4	32.3	32.3	32.2	32.2	32.0	32.3	32.4	32.4	32.5	32.6	32.4
25	12500	46.3	46.3	46.4	46.3	46.5	46.2	46.2	46.4	46.3	46.2	46.1	46.1	46.2	46.2	46.2	46.2
26	16000	66.0	66.2	66.3	66.0	66.1	66.1	66.4	65.9	66.1	66.2	66.2	66.1	66.1	66.0	66.0	66.2
27	20000	94.2	94.0	93.7	93.1	94.0	93.9	94.8	93.6	93.3	93.5	93.9	93.6	93.7	93.9	94.0	94.2

TABLE I. - Continued. SAMPLE OUTPUT FROM WORKING DATA GENERATION SUBROUTINE WODAG

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LEWIS RESEARCH CENTER
PROPULSION SYSTEMS ACOUSTICS BRANCH
SAMPLE NOISE DATA

CONFIGURATION NO 100
SPEED = 1800. RPM
PERCENT SPEED = 75.0

S T A N D A R D   D A Y   D A T A   E X C E S S   A T M O S P H E R I C   A T T E N U A T I O N

ADJUSTMENTS TO REFERRED ARRAY TO OBTAIN STANDARD DAY DATA AT 100. FT RADIUS

BAND	FREQUENCY \ ANGLE	10.	20.	30.	40.	50.	60.	70.	80.	90.	100.	110.	120.	130.	140.	150.	160.
1	50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	63	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	80	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	125	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	160	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	315	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	400	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
11	500	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
12	630	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
13	800	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
14	1000	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
15	1250	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
16	1600	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
17	2000	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
18	2500	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
19	3150	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
20	4000	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
21	5000	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
22	6300	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
23	8000	2.3	2.3	2.3	2.2	2.3	2.3	2.3	2.3	2.2	2.3	2.3	2.3	2.3	2.3	2.3	2.3
24	10000	3.3	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.3	3.3	3.2
25	12500	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6
26	16000	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6
27	20000	9.4	9.4	9.4	9.3	9.4	9.4	9.5	9.4	9.3	9.4	9.4	9.4	9.4	9.4	9.4	9.4

TABLE I. - Continued. SAMPLE OUTPUT FROM WORKING DATA GENERATION SUBROUTINE WODAG

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LEWIS RESEARCH CENTER -
PROPULSION SYSTEMS ACOUSTICS BRANCH
SAMPLE NOISE DATA

CONFIGURATION NO 100
SPEED = 1800. RPM
PERCENT SPEED = 75.0

S T A N D A R D   D A Y   D A T A

DATA AT 100.0 FT RADIUS ON 59F, 70PC RH DAY

	ANGLE	10.	20.	30.	40.	50.	60.	70.	80.	90.	100.	110.	120.	130.	140.	150.	160.
COMPUTED OASPL		91.4	92.0	93.2	94.4	92.2	90.3	89.8	89.6	92.5	93.4	94.4	95.6	96.1	94.5	93.9	91.3
BAND	FREQUENCY																
1	50	69.0	66.1	64.9	65.9	68.6	67.6	67.2	68.9	66.4	68.7	69.6	70.6	73.1	74.4	77.9	77.9
2	63	64.3	65.6	65.1	63.8	65.0	65.0	65.8	66.1	66.3	66.8	69.3	71.4	74.1	76.1	79.0	80.0
3	80	65.3	65.8	64.0	64.1	64.8	65.3	65.1	66.8	68.5	70.3	72.8	74.0	77.0	79.3	83.0	83.3
4	100	68.7	69.2	69.2	70.6	68.9	68.4	70.6	71.6	71.9	74.7	75.2	77.5	79.6	81.9	84.4	83.6
5	125	70.0	69.5	69.1	69.6	70.1	71.6	72.1	73.3	74.1	75.3	76.5	78.1	79.1	81.0	83.6	80.5
6	160	70.0	71.0	71.0	71.3	72.5	72.8	73.1	73.3	74.3	74.8	75.1	76.5	77.8	79.6	81.1	78.0
7	200	69.7	70.6	70.4	70.2	70.1	69.6	69.7	70.1	71.4	72.2	74.1	75.8	78.2	79.4	80.9	76.8
8	250	69.3	69.8	69.6	69.8	69.6	70.1	70.6	71.8	72.8	74.3	75.8	77.4	78.6	80.0	81.0	77.9
9	315	69.0	69.3	70.6	71.3	70.5	71.0	71.1	72.0	73.3	73.8	75.1	76.6	78.5	79.3	79.5	76.2
10	400	68.5	69.5	70.0	71.0	70.5	71.8	70.8	71.3	72.8	73.8	75.1	76.9	78.3	79.1	78.8	74.5
11	500	71.1	72.2	71.4	71.9	72.7	71.2	70.9	71.9	72.9	73.9	74.7	76.0	77.6	77.9	77.6	73.3
12	630	69.6	70.7	71.7	73.2	72.4	71.5	71.9	72.4	73.4	73.9	74.9	75.6	77.0	76.7	75.7	71.8
13	800	74.8	74.0	73.5	77.5	75.2	72.2	73.0	74.4	73.7	75.0	75.4	76.1	77.7	77.0	76.0	72.7
14	1000	75.0	74.6	76.2	75.5	78.5	74.4	74.4	73.0	73.7	74.5	75.7	76.8	78.0	77.9	76.4	72.6
15	1250	75.7	77.2	77.6	78.7	77.0	75.2	75.1	74.4	74.2	75.2	76.9	76.7	77.2	77.1	75.9	72.3
16	1600	75.6	76.1	75.9	75.9	75.1	74.2	73.4	73.0	74.0	75.4	76.5	77.7	78.5	75.5	74.2	70.8
17	2000	80.4	87.5	87.9	88.9	86.2	84.3	81.7	79.0	81.8	80.2	84.7	83.8	83.2	79.2	77.3	74.8
18	2500	78.0	79.0	79.3	79.5	78.0	76.5	74.5	75.0	76.5	77.0	79.0	80.1	79.5	77.0	75.0	71.1
19	3150	77.2	76.8	79.5	80.3	78.3	77.0	75.8	76.5	78.7	79.5	81.0	83.0	82.5	78.3	76.0	72.6
20	4000	80.9	82.5	83.1	84.1	82.3	79.8	80.6	79.8	85.5	85.6	85.8	86.4	87.1	85.0	80.5	77.8
21	5000	78.7	80.2	80.2	81.2	80.0	77.2	76.9	77.7	79.7	80.7	81.5	83.5	84.9	82.5	79.2	74.7
22	6300	78.2	79.9	81.6	84.1	79.4	77.8	77.6	77.8	82.6	82.0	83.0	84.1	84.1	81.3	78.4	73.8
23	8000	78.4	80.2	81.0	82.8	80.0	78.4	78.5	79.4	82.2	84.9	84.4	85.4	85.7	82.5	79.2	74.4
24	10000	78.7	80.1	80.9	82.7	79.2	77.9	77.9	77.4	81.2	82.9	83.9	86.0	85.6	83.1	80.3	74.3
25	12500	78.6	79.4	80.1	81.9	79.4	76.6	76.8	77.3	79.6	81.1	82.1	84.0	84.4	82.1	79.4	73.2
26	16000	77.4	79.1	80.6	81.9	78.7	76.2	76.2	76.4	80.1	81.4	81.9	84.0	84.1	81.4	78.4	72.7
27	20000	78.3	79.7	80.7	80.8	79.2	76.7	78.1	76.3	79.3	81.1	82.3	83.9	84.2	81.8	78.9	73.6

PERCEIVED NOISE ON 100.0 FT RADIUS, PNDB

ANGLE	10.	20.	30.	40.	50.	60.	70.	80.	90.	100.	110.	120.	130.	140.	150.	160.
	104.6	105.7	106.1	107.2	105.0	103.3	102.8	102.5	106.2	106.7	107.5	108.4	109.1	107.3	104.9	101.7

TABLE I. - Continued. SAMPLE OUTPUT FROM WORKING DATA GENERATION SUBROUTINE WODAG

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LEWIS RESEARCH CENTER
PROPULSION SYSTEMS ACOUSTICS BRANCH
SAMPLE NOISE DATA

CONFIGURATION NO 100
SPEED = 1800. RPM
PERCENT SPEED = 75.0

S I D E L I N E   E X T R A P O L A T E D   D A T A

STANDARD DAY DATA ON 100. FT SIDELINE, INCORPORATING EXCESS ATMOSPHERIC ATTENUATION

BAND	FREQUENCY \ ANGLE	10.	20.	30.	40.	50.	60.	70.	80.	90.	100.	110.	120.	130.	140.	150.	160.
COMPUTED OASPL		72.1	81.4	85.9	85.7	89.4	88.8	89.1	89.4	92.5	93.2	93.7	94.0	93.1	89.9	87.2	81.4
1	50	53.8	56.8	58.9	62.1	66.3	66.3	66.7	68.8	66.4	68.6	69.1	69.3	70.8	70.6	71.9	68.6
2	63	49.0	56.3	59.1	60.0	62.7	63.7	65.3	66.0	66.3	66.7	68.8	70.1	71.8	72.3	73.0	70.7
3	80	50.0	56.5	58.0	60.3	62.5	64.0	64.6	66.7	68.5	70.2	72.3	72.7	74.7	75.5	77.0	74.0
4	100	53.4	59.9	63.2	66.8	66.6	67.1	70.1	71.5	71.9	74.6	74.7	76.2	77.3	78.1	78.4	74.3
5	125	54.7	60.1	63.1	65.7	67.8	70.3	71.6	73.2	74.1	75.2	76.0	76.8	76.8	77.1	77.6	71.1
6	160	54.7	61.6	65.0	67.4	70.2	71.5	72.6	73.2	74.3	74.7	74.6	75.2	75.5	75.7	75.1	68.6
7	200	54.4	61.2	64.3	66.3	67.8	68.3	69.2	70.0	71.4	72.1	73.6	74.5	75.9	75.5	74.8	67.4
8	250	53.9	60.4	63.5	65.9	67.3	68.8	70.1	71.7	72.8	74.2	75.3	76.1	76.3	76.1	74.9	68.5
9	315	53.6	59.9	64.5	67.4	68.2	69.7	70.6	71.9	73.3	73.7	74.6	75.3	76.2	75.4	73.4	66.8
10	400	53.0	60.1	63.9	67.1	68.2	70.5	70.3	71.2	72.8	73.7	74.6	75.6	76.0	75.2	72.7	65.1
11	500	55.5	62.7	65.3	68.0	70.4	69.9	70.3	71.8	72.9	73.8	74.1	74.7	75.3	74.0	71.5	63.8
12	630	53.9	61.2	65.6	69.3	70.0	70.2	71.3	72.3	73.4	73.8	74.3	74.3	74.6	72.8	69.6	62.3
13	800	59.0	64.4	67.4	73.6	72.8	70.9	72.4	74.3	73.7	74.9	74.8	74.8	75.3	73.1	69.9	63.1
14	1000	59.1	65.0	70.0	71.6	76.1	73.1	73.8	72.9	73.7	74.4	75.1	75.5	75.6	74.0	70.2	63.0
15	1250	59.6	67.5	71.4	74.8	74.6	73.9	74.6	74.3	74.2	75.1	76.4	75.4	74.8	73.2	69.7	62.6
16	1600	59.3	66.3	69.7	72.0	72.7	73.0	72.9	72.9	74.0	75.3	76.0	76.4	76.1	71.6	68.0	61.1
17	2000	69.7	77.6	81.5	84.9	83.8	83.0	81.1	78.8	81.8	80.0	84.1	82.5	80.8	75.2	70.9	64.9
18	2500	60.9	68.9	72.9	75.5	75.6	75.2	74.0	74.9	76.5	76.9	78.5	78.8	77.1	73.0	68.6	61.0
19	3150	59.3	68.4	72.9	76.2	75.8	75.7	75.3	76.4	78.7	79.4	80.5	81.7	80.1	74.2	69.4	62.2
20	4000	61.9	71.6	76.3	79.8	79.7	78.4	80.0	79.6	85.5	85.4	85.2	85.0	84.5	80.7	73.7	66.9
21	5000	58.3	68.8	73.1	76.8	77.4	75.8	76.3	77.6	79.7	80.6	80.9	82.1	82.3	78.1	72.1	63.3
22	6300	59.6	67.6	74.0	79.4	76.6	76.3	77.0	77.7	82.6	81.9	82.4	82.6	81.3	76.6	70.8	61.5
23	8000	57.4	66.5	72.7	77.7	77.0	76.8	77.8	79.2	82.2	84.7	83.7	83.8	82.7	77.4	70.9	60.7
24	10000	48.0	64.5	71.6	77.1	75.9	76.1	77.1	77.2	81.2	82.7	83.1	84.2	82.3	77.5	71.0	58.7
25	12500	41.3	61.2	69.4	75.5	75.7	74.6	75.9	77.1	79.6	80.9	81.2	82.0	80.7	75.7	68.7	55.0
26	16000	30.8	57.0	67.9	74.4	74.3	73.9	75.2	76.1	80.1	81.1	80.9	81.7	79.7	73.9	65.8	50.6
27	20000	18.3	52.2	65.3	71.7	74.1	73.9	77.0	76.0	79.3	80.8	81.1	81.2	79.0	72.7	63.5	46.2

INVERSE SQUARE LAW ATTENUATION FROM 100. FT RADIUS TO 100. FT SIDELINE

15.2	9.3	6.0	3.8	2.3	1.2	0.5	0.1	-0.	0.1	0.5	1.2	2.3	3.8	6.0	9.3

PERCEIVED NOISE ON 100. FT SIDELINE, PNDB

ANGLE	10.	20.	30.	40.	50.	60.	70.	80.	90.	100.	110.	120.	130.	140.	150.	160.
	86.8	95.2	99.5	103.0	102.5	102.0	102.2	102.4	106.2	106.6	106.9	107.1	106.5	103.1	98.1	90.9

TABLE I. - Continued. SAMPLE OUTPUT FROM WORKING DATA GENERATION SUBROUTINE WODAG

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LEWIS RESEARCH CENTER
PROPULSION SYSTEMS ACOUSTICS BRANCH
SAMPLE NOISE DATA

CONFIGURATION NO 100
SPEED = 1800. RPM
PERCENT SPEED = 75.0

S I D E L I N E   E X T R A P O L A T E D   D A T A

STANDARD DAY DATA ON 370. FT SIDELINE, INCORPORATING EXCESS ATMOSPHERIC ATTENUATION

	ANGLE	10.	20.	30.	40.	50.	60.	70.	80.	90.	100.	110.	120.	130.	140.	150.	160.
COMPUTED OASPL		57.5	66.9	71.7	75.5	75.6	75.2	75.3	75.5	78.1	78.5	79.3	79.3	78.7	76.5	74.9	69.5
BAND	FREQUENCY																
1	50	42.3	45.3	47.5	50.7	54.9	55.0	55.3	57.4	55.0	57.2	57.7	58.0	59.4	59.2	60.5	57.1
2	63	37.5	44.8	47.7	48.6	51.3	52.4	53.9	54.6	54.9	55.3	57.4	58.8	60.4	60.9	61.6	59.2
3	80	38.5	45.0	46.5	48.8	51.1	52.6	53.2	55.3	57.1	58.8	60.9	61.3	63.3	64.0	65.5	62.5
4	100	41.8	48.4	51.7	55.3	55.2	55.7	58.7	60.1	60.5	63.2	63.3	64.8	65.9	66.6	66.9	62.8
5	125	43.1	48.6	51.6	54.3	56.3	58.9	60.1	61.6	62.7	63.8	64.5	65.4	65.4	65.7	66.1	59.6
6	160	43.0	50.1	53.5	56.0	58.7	60.1	61.1	61.7	62.9	63.2	63.1	63.8	64.0	64.3	63.6	57.1
7	200	42.5	49.6	52.8	54.9	56.3	56.9	57.7	58.5	60.0	60.6	62.1	63.1	64.4	64.1	63.3	55.8
8	250	42.0	48.8	52.0	54.4	55.8	57.4	58.6	60.2	61.3	62.7	63.8	64.7	64.8	64.6	63.4	56.9
9	315	41.5	48.2	52.9	55.9	56.6	58.2	59.1	60.4	61.8	62.2	63.1	63.8	64.6	63.9	61.8	55.1
10	400	40.7	48.2	52.2	55.5	56.6	59.0	58.7	59.6	61.3	62.1	63.0	64.1	64.4	63.6	61.0	53.2
11	500	43.0	50.6	53.5	56.3	58.7	58.3	58.8	60.2	61.3	62.2	62.6	63.1	63.6	62.3	59.7	51.9
12	630	41.1	49.1	53.7	57.5	58.4	58.6	59.7	60.6	61.8	62.1	62.7	62.7	63.0	61.0	57.7	50.2
13	800	45.8	57.1	55.3	61.7	61.1	59.2	60.7	62.6	62.0	63.2	63.1	63.1	63.6	61.2	57.9	50.9
14	1000	45.4	52.4	57.9	59.6	64.2	61.3	62.1	61.1	61.9	62.6	63.4	63.7	63.8	62.0	58.1	50.5
15	1250	45.3	54.7	59.0	62.6	62.6	62.0	62.7	62.4	62.3	63.2	64.5	63.5	62.8	61.0	57.3	49.8
16	1600	44.0	53.0	57.0	59.6	60.5	60.8	60.8	60.9	62.0	63.3	63.9	64.3	63.9	59.2	55.3	47.8
17	2000	53.4	63.7	66.5	72.2	71.3	70.6	68.9	66.6	69.6	67.8	71.9	70.1	68.3	62.5	57.9	51.0
18	2500	43.3	54.4	59.4	62.4	62.8	62.6	61.4	62.4	64.1	64.4	65.9	66.2	64.3	59.9	55.0	46.4
19	3150	39.1	52.6	58.5	62.4	62.5	62.6	62.2	63.5	65.8	66.4	67.4	68.5	66.6	60.4	55.0	46.3
20	4000	38.4	54.1	60.7	65.2	65.6	64.6	66.4	66.1	72.0	71.9	71.6	71.2	70.4	66.0	58.1	49.4
21	5000	30.1	48.9	55.8	60.8	62.2	61.0	61.8	63.2	65.4	66.2	66.4	67.3	67.1	62.2	54.9	43.4
22	6300	19.8	43.6	54.1	61.4	59.7	60.0	61.1	62.0	67.0	66.1	66.5	66.3	64.4	58.6	51.0	37.7
23	8000	5.7	37.2	49.2	56.9	57.6	58.4	59.9	61.6	64.7	67.1	65.8	65.3	63.3	56.4	47.2	31.4
24	10000	0.	27.6	42.7	52.1	53.1	54.7	56.5	57.0	61.1	62.6	62.5	62.8	59.5	52.4	42.0	21.8
25	12500	0.	13.2	33.0	44.6	47.9	48.9	51.3	53.0	55.7	56.8	56.6	56.3	53.0	44.9	32.4	7.1
26	16000	0.	0.	20.8	35.3	39.7	41.9	44.8	46.7	50.9	51.6	50.5	49.7	45.1	34.8	18.8	0.
27	20000	0.	0.	3.3	21.3	29.6	33.3	38.4	38.9	42.7	43.8	42.8	40.6	34.6	21.9	1.4	0.

INVERSE SQUARE LAW ATTENUATION FROM 100. FT RADIUS TO 370. FT SIDELINE

26.6	20.7	17.4	15.2	13.7	12.6	11.9	11.5	11.4	11.5	11.9	12.6	13.7	15.2	17.4	20.7

PERCEIVED NOISE ON 370. FT SIDELINE, PNDB

ANGLE	10.	20.	30.	40.	50.	60.	70.	80.	90.	100.	110.	120.	130.	140.	150.	160.
	69.3	80.1	85.3	89.3	89.2	88.9	88.7	88.9	92.7	93.0	93.3	93.3	92.5	88.7	83.2	74.8

TABLE I. - Concluded. SAMPLE OUTPUT FROM WORKING DATA GENERATION SUBROUTINE WODAG

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LEWIS RESEARCH CENTER
PROPULSION SYSTEMS ACOUSTICS BRANCH
SAMPLE NOISE DATA

CONFIGURATION NO 100
SPEED = 1800. RPM
PERCENT SPEED = 75.0

S I D E L I N E   E X T R A P O L A T E D   D A T A

STANDARD DAY DATA ON 1000. FT SIDELINE, INCORPORATING EXCESS ATMOSPHERIC ATTENUATION

	ANGLE	10.	20.	30.	40.	50.	60.	70.	80.	90.	100.	110.	120.	130.	140.	150.	160.
COMPUTED OASPL		44.1	53.9	59.4	63.0	64.3	64.3	64.4	64.8	66.6	67.0	68.0	68.1	67.8	66.5	65.5	60.2
BAND	FREQUENCY																
1	50	33.4	36.6	38.7	42.0	46.2	46.3	46.6	48.7	46.3	48.5	49.0	49.3	50.7	50.5	51.7	48.4
2	63	28.6	36.0	38.9	39.8	42.6	43.7	45.2	45.9	46.2	46.6	48.7	50.1	51.7	52.1	52.8	50.4
3	80	29.4	36.2	37.8	40.1	42.3	43.9	44.4	46.6	48.4	50.1	52.1	52.6	54.5	55.3	56.8	53.7
4	100	32.7	39.5	42.9	46.5	46.4	47.0	49.9	51.3	51.8	54.4	54.5	56.1	57.1	57.8	58.1	53.9
5	125	33.8	39.7	42.7	45.5	47.6	50.2	51.4	53.0	53.9	55.0	55.8	56.7	56.6	56.9	57.2	50.7
6	160	33.5	41.0	44.5	47.1	49.9	51.3	52.3	53.0	54.1	54.5	54.3	55.0	55.2	55.4	54.6	48.0
7	200	32.9	40.5	43.8	45.9	47.4	48.0	48.9	49.7	51.1	51.8	53.3	54.2	55.5	55.1	54.3	46.7
8	250	32.0	39.5	42.9	45.4	46.8	48.5	49.7	51.3	52.5	53.8	54.9	55.8	55.8	55.6	54.3	47.6
9	315	31.2	38.7	43.7	46.8	47.6	49.3	50.1	51.4	52.9	53.2	54.1	54.9	55.6	54.8	52.6	45.6
10	400	30.0	38.5	42.9	46.3	47.5	49.9	49.7	50.6	52.3	53.1	54.0	55.0	55.3	54.4	51.7	43.6
11	500	31.7	40.8	44.0	47.0	49.5	49.2	49.6	51.1	52.2	53.1	53.4	54.0	54.4	53.0	50.2	41.9
12	630	29.1	38.7	43.9	48.0	49.0	49.3	50.5	51.4	52.6	52.9	53.5	53.4	53.6	51.5	47.9	39.9
13	800	32.9	41.3	45.2	51.9	51.4	49.7	51.3	53.2	52.6	53.8	53.7	53.6	54.0	51.4	47.7	40.1
14	1000	31.4	41.1	47.3	49.5	54.4	51.6	52.4	51.5	52.4	53.0	53.7	54.0	53.9	51.9	47.6	39.1
15	1250	29.8	42.6	48.0	52.1	52.4	52.0	52.8	52.6	52.5	53.3	54.6	53.5	52.6	50.6	46.3	37.7
16	1600	26.4	39.8	45.2	46.5	49.8	50.4	50.5	50.7	51.8	53.1	53.6	53.9	53.3	48.2	43.7	34.7
17	2000	33.5	45.3	55.9	60.5	60.1	59.7	58.1	56.0	59.0	57.2	61.1	59.2	57.1	50.8	45.3	36.7
18	2500	20.1	38.4	45.7	49.8	50.8	51.0	50.1	51.1	52.8	53.1	54.5	54.5	52.2	47.1	41.1	30.1
19	3150	9.8	33.4	42.7	48.2	49.1	49.8	49.7	51.2	53.5	54.1	54.9	55.7	53.2	46.0	39.1	27.0
20	4000	1.5	31.1	42.2	48.9	50.5	50.3	52.5	52.5	58.5	58.3	57.7	56.9	55.3	49.6	39.5	26.3
21	5000	0.	20.2	33.5	41.4	44.6	44.5	45.9	47.6	50.0	50.7	50.5	50.8	49.5	42.9	32.5	14.9
22	6300	0.	6.2	25.6	37.2	38.2	39.9	41.8	43.2	48.3	47.2	47.1	46.2	42.8	34.6	22.5	0.2
23	8000	0.	0.	12.1	26.2	30.4	33.2	36.1	38.5	41.9	43.9	41.9	40.0	35.9	25.4	9.8	0.
24	10000	0.	0.	0.	11.6	17.8	22.6	26.2	27.8	32.2	33.4	32.3	30.6	24.2	11.9	0.	0.
25	12500	0.	0.	0.	0.	1.1	6.6	11.7	14.7	17.9	18.7	17.1	14.1	6.4	0.	0.	0.
26	16000	0.	0.	0.	0.	0.	0.	0.	0.	0.6	0.7	0.	0.	0.	0.	0.	0.
27	20000	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

INVERSE SQUARE LAW ATTENUATION FROM 100. FT RADIUS TO 1000. FT SIDELINE

35.2	29.3	26.0	23.8	22.3	21.2	20.5	20.1	20.0	20.1	20.5	21.2	22.3	23.8	26.0	29.3

PERCEIVED NOISE ON 1000. FT SIDELINE, PNDB

ANGLE	10.	20.	30.	40.	50.	60.	70.	80.	90.	100.	110.	120.	130.	140.	150.	160.
	49.5	65.0	71.7	76.4	76.9	76.9	76.6	76.2	79.7	79.9	80.3	79.8	78.6	74.3	69.2	60.3

TABLE II. - SAMPLE OUTPUT FROM SUBROUTINE TABLE

DATA ADJUSTED TO STANDARD DAY OF 15 DEGREES C, 70 PERCENT RELATIVE HUMIDITY
SPL RE .00002 N/SQ M   PWL RE .1 PICOWATT

FREQUENCY	ANGLE, DEG 10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	SIMPLE SOURCE SPL	POWER LEVEL (PWL)
	1/3-OCTAVE BAND SOUND PRESSURE LEVELS (SPL) ON 30.5 METER RADIUS																	
50	69.0	66.1	64.9	65.9	68.6	67.6	67.2	68.9	66.4	68.7	69.6	70.6	73.1	74.4	77.9	77.9	71.1	118.5
63	64.3	65.6	65.1	63.8	65.0	65.0	65.8	66.1	66.3	66.8	69.3	71.4	74.1	76.1	79.0	80.0	71.7	119.1
80	65.3	65.8	64.0	64.1	64.8	65.3	65.1	66.8	68.5	70.3	72.8	74.0	77.0	75.3	83.0	83.3	74.8	122.2
100	68.7	69.2	69.2	70.6	68.9	68.4	70.6	71.6	71.9	74.7	75.2	77.5	79.6	81.9	84.4	83.6	77.0	124.4
125	70.0	69.5	69.1	69.6	70.1	71.6	72.1	73.3	74.1	75.3	76.5	78.1	79.1	81.0	83.6	80.5	76.7	124.1
160	70.0	71.0	71.0	71.3	72.5	72.8	73.1	73.3	74.3	74.8	75.1	76.5	77.8	75.6	81.1	78.0	75.6	123.0
200	69.7	70.6	70.4	70.2	70.1	69.6	69.7	70.1	71.4	72.2	74.1	75.8	78.2	75.4	80.9	76.8	74.6	122.0
250	69.3	69.8	69.6	69.8	69.6	70.1	70.6	71.8	72.8	74.3	75.8	77.4	78.6	80.0	81.0	77.9	75.4	122.8
315	69.0	69.3	70.6	71.3	70.5	71.0	71.1	72.0	73.3	73.8	75.1	76.6	78.5	79.3	79.5	76.2	74.9	122.3
400	68.4	69.4	69.9	70.9	70.4	71.7	70.7	71.2	72.7	73.7	75.0	76.8	78.2	75.0	78.7	74.4	74.7	122.1
500	71.0	72.1	71.3	71.8	72.6	71.1	70.8	71.8	72.8	73.8	74.6	75.9	77.5	77.8	77.5	73.2	74.3	121.7
630	69.6	70.7	71.7	73.2	72.4	71.5	71.9	72.4	73.4	73.9	74.9	75.6	77.0	76.7	75.7	71.8	74.1	121.5
800	74.8	74.0	73.5	77.5	75.2	72.2	73.0	74.4	73.7	75.0	75.4	76.1	77.7	77.0	76.0	72.7	75.3	122.7
1000	75.0	74.6	76.1	75.5	78.5	74.4	74.4	73.0	73.7	74.5	75.7	76.8	78.0	77.9	76.4	72.6	75.9	123.3
1250	75.7	77.2	77.6	78.7	77.0	75.2	75.1	74.4	74.2	75.2	76.9	76.7	77.2	77.1	75.9	72.3	76.4	123.8
1600	75.7	76.2	76.0	76.0	75.2	74.3	73.5	73.1	74.1	75.5	76.6	77.8	78.6	75.6	74.3	70.9	75.8	123.2
2000	86.4	87.5	87.9	88.9	86.2	84.3	81.7	79.0	81.8	80.2	84.7	83.8	83.2	75.2	77.3	74.8	84.3	131.7
2500	78.0	79.0	79.3	79.5	78.0	76.5	74.5	75.0	76.5	77.0	79.0	80.1	79.5	77.0	75.0	71.1	78.1	125.5
3150	77.2	78.8	79.5	80.3	78.3	77.0	75.8	76.5	78.7	79.5	81.0	83.0	82.5	78.3	76.0	72.6	80.0	127.4
4000	80.8	82.4	83.0	84.0	82.2	79.7	80.5	79.7	85.4	85.5	85.7	86.3	87.0	84.9	80.4	77.7	84.8	132.2
5000	78.7	80.2	80.2	81.2	80.0	77.2	76.9	77.7	79.7	80.7	81.5	83.5	84.9	82.5	79.2	74.7	81.9	129.3
6300	78.2	79.9	81.6	84.1	79.4	77.8	77.6	77.8	82.6	82.0	83.0	84.1	84.1	81.3	78.4	73.8	83.1	130.5
8000	78.3	80.1	80.9	82.8	79.9	78.3	78.4	79.3	82.2	84.8	84.3	85.3	85.6	82.4	79.1	74.3	84.7	132.1
10000	78.6	80.1	80.9	82.7	79.2	77.9	77.9	77.4	81.2	82.9	83.9	86.0	85.6	83.0	80.2	74.3	85.3	132.7
12500	78.6	79.4	80.1	81.9	79.4	76.6	76.8	77.3	79.6	81.1	82.1	84.0	84.4	82.1	79.4	73.2	85.4	132.8
16000	77.4	79.1	80.6	81.9	78.7	76.2	76.2	76.4	80.1	81.4	81.9	84.0	84.1	81.4	78.4	72.7	87.2	134.6
20000	78.3	79.6	80.6	80.8	79.2	76.6	78.1	76.2	79.3	81.0	82.2	83.8	84.1	81.7	78.9	73.6	90.0	137.4
OVERALL	91.4	92.6	93.2	94.4	92.1	90.3	89.8	89.6	92.5	93.3	94.3	95.6	96.0	94.5	93.9	91.3	96.2	143.5
DISTANCE	SIDELINE PERCEIVED NOISE LEVELS																	
112.8 M	69.3	80.1	85.3	89.3	89.2	88.9	88.6	88.9	92.7	93.0	93.3	93.2	92.4	88.6	83.1	74.8		
304.8 M	49.5	65.0	71.7	76.4	76.9	76.9	76.6	76.2	79.7	79.9	80.3	79.8	78.6	74.3	69.2	60.3		

TABLE III. - SAMPLE OUTPUT FROM SUBROUTINE DADIFF

COMPARISON OF TWO DATA SETS

DATA SET ONE	CONFIGURATION	PERCENT SPEED	RPM
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION	100	75.0	1800.
LEWIS RESEARCH CENTER	27 - 1/3 OCTAVE BANDS FROM 50 TO 20000 HERTZ		
PROPULSION SYSTEMS ACOUSTICS BRANCH	16 ANGLES EVERY 10. DEGREES FROM 10. TO 160.		
SAMPLE NOISE DATA			
DATA SET TWO	CONFIGURATION	PERCENT SPEED	RPM
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION	101	50.0	1200.
LEWIS RESEARCH CENTER	27 - 1/3 OCTAVE BANDS FROM 50 TO 20000 HERTZ		
PROPULSION SYSTEMS ACOUSTICS BRANCH	16 ANGLES EVERY 10. DEGREES FROM 10. TO 160.		
SAMPLE NOISE DATA, SECOND SET			

POWER LEVEL DIFFERENCES

(DATA SET TWO MINUS DATA SET ONE)

BAND	FREQUENCY	TOTAL POWER SET TWO	TOTAL POWER SET ONE	TOTAL POWER DELTA PWL	FRONT QUADRANT SET TWO	FRONT QUADRANT SET ONE	FRONT QUADRANT DELTA PWL	REAR QUADRANT SET TWO	REAR QUADRANT SET ONE	REAR QUADRANT DELTA PWL
OVERALL		133.5	143.6	-10.0	131.0	138.9	-7.9	130.0	141.7	-11.8
1	50	106.2	118.5	-12.3	100.0	112.0	-11.9	105.0	117.4	-12.4
2	63	106.4	119.1	-12.7	99.1	109.8	-10.7	105.5	118.5	-13.0
3	80	108.5	122.2	-13.7	99.3	110.2	-10.9	107.9	121.9	-14.0
4	100	110.6	124.4	-13.8	102.5	114.7	-12.2	109.9	123.9	-14.0
5	125	111.2	124.1	-12.9	105.3	116.1	-10.9	109.9	123.3	-13.4
6	160	110.1	123.0	-12.9	105.4	117.1	-11.7	108.3	121.7	-13.4
7	200	108.7	122.0	-13.3	103.1	114.6	-11.5	107.3	121.1	-13.8
8	250	109.9	122.8	-12.9	104.3	115.1	-10.8	108.5	122.0	-13.5
9	315	109.7	122.3	-12.6	105.2	115.7	-10.5	107.8	121.2	-13.4
10	400	110.0	122.1	-12.1	105.6	115.5	-9.9	108.0	121.0	-13.0
11	500	110.4	121.7	-11.3	106.6	116.3	-9.6	108.0	120.2	-12.2
12	630	111.0	121.5	-10.5	107.8	116.7	-8.9	108.2	119.7	-11.6
13	800	113.6	122.7	-9.1	110.7	119.0	-8.2	110.4	120.3	-9.9
14	1000	117.0	123.3	-6.3	114.0	119.9	-5.9	114.0	120.6	-6.6
15	1250	120.3	123.8	-3.5	118.0	120.9	-2.9	116.5	120.7	-4.2
16	1600	121.0	123.2	-2.2	118.5	119.4	-0.8	117.4	120.9	-3.5
17	2000	121.2	131.7	-10.5	117.9	130.0	-12.1	118.5	126.8	-8.3
18	2500	123.2	125.5	-2.3	120.0	122.1	-2.2	120.4	122.8	-2.4
19	3150	124.2	127.4	-3.2	121.0	123.1	-2.0	121.3	125.4	-4.1
20	4000	124.5	132.2	-7.7	121.8	127.3	-5.5	121.1	130.5	-9.3
21	5000	123.3	129.3	-6.0	120.5	124.6	-4.1	120.1	127.5	-7.4
22	6300	122.3	130.5	-8.2	120.1	126.3	-6.2	118.2	128.4	-10.2
23	8000	122.0	132.1	-10.1	120.0	126.9	-6.9	117.8	130.5	-12.8
24	10000	120.9	132.7	-11.8	119.2	127.3	-8.1	115.9	131.2	-15.3
25	12500	120.1	132.8	-12.7	118.8	127.9	-9.2	114.3	131.1	-16.8
26	16000	119.4	134.6	-15.2	118.2	129.7	-11.5	113.2	132.9	-19.7
27	20000	119.4	137.4	-18.0	118.4	132.6	-14.2	112.4	135.7	-23.2

TABLE III. - Continued. SAMPLE OUTPUT FROM SUBROUTINE DADIFF

COMPARISON OF TWO DATA SETS

DATA SET ONE
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LEWIS RESEARCH CENTER
PROPULSION SYSTEMS ACOUSTICS BRANCH
SAMPLE NOISE DATA

CONFIGURATION	PERCENT SPEED	RPM
100	75.0	1800.

27 - 1/3 OCTAVE BANDS FROM 50 TO 20000 HERTZ
16 ANGLES EVERY 10. DEGREES FROM 10. TO 160.

DATA SET TWO
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LEWIS RESEARCH CENTER
PROPULSION SYSTEMS ACOUSTICS BRANCH
SAMPLE NOISE DATA, SECOND SET

CONFIGURATION	PERCENT SPEED	RPM
101	50.0	1200.

27 - 1/3 OCTAVE BANDS FROM 50 TO 20000 HERTZ
16 ANGLES EVERY 10. DEGREES FROM 10. TO 160.

DIFFERENCES OF REFERRED DATA

(DATA SET TWO MINUS DATA SET ONE)

BAND	FREQUENCY \ ANGLE	10.	20.	30.	40.	50.	60.	70.	80.	90.	100.	110.	120.	130.	140.	150.	160.
	OVERALL	-6.2	-5.6	-6.5	-6.6	-7.3	-9.1	-11.4	-11.5	-12.5	-12.5	-12.3	-11.9	-10.9	-10.9	-12.4	-12.8
1	50	-13.1	-12.4	-10.5	-11.2	-13.6	-11.7	-11.5	-12.4	-10.2	-11.0	-11.9	-9.8	-11.4	-13.2	-13.7	-14.2
2	63	-9.3	-10.6	-11.1	-10.1	-10.8	-10.3	-11.3	-10.9	-10.4	-9.1	-11.3	-11.0	-11.9	-13.2	-14.6	-15.1
3	80	-10.3	-10.6	-11.1	-10.7	-10.8	-10.6	-11.1	-10.8	-11.3	-11.6	-12.4	-11.2	-12.8	-13.6	-15.5	-15.9
4	100	-11.2	-9.7	-12.9	-14.3	-12.4	-11.7	-12.9	-12.6	-10.7	-12.5	-12.2	-12.6	-13.4	-15.1	-15.1	-14.9
5	125	-10.2	-8.7	-8.8	-10.1	-9.8	-11.1	-10.8	-12.2	-11.5	-11.9	-11.9	-12.5	-13.1	-14.9	-15.0	-13.2
6	160	-10.5	-9.8	-10.2	-11.5	-12.7	-11.8	-11.6	-11.8	-12.3	-12.1	-11.9	-12.6	-13.1	-14.8	-15.1	-14.1
7	200	-9.4	-9.8	-11.4	-11.4	-12.3	-11.6	-11.4	-11.9	-12.2	-12.0	-13.4	-12.7	-13.7	-15.1	-14.7	-13.3
8	250	-9.0	-8.3	-9.4	-10.1	-10.1	-11.3	-11.8	-11.6	-11.8	-12.1	-13.0	-12.6	-13.3	-14.7	-14.5	-14.3
9	315	-7.8	-7.1	-8.7	-10.3	-10.1	-11.5	-10.9	-11.5	-11.9	-12.4	-12.7	-12.6	-13.6	-14.4	-14.5	-14.3
10	400	-5.5	-5.6	-7.0	-8.8	-9.5	-12.1	-11.1	-11.6	-11.8	-11.9	-11.9	-12.4	-13.3	-14.2	-13.9	-13.1
11	500	-6.3	-7.1	-7.3	-8.5	-10.6	-10.4	-11.1	-10.8	-11.6	-11.4	-11.4	-11.5	-12.3	-13.1	-13.7	-12.8
12	630	-3.0	-4.0	-5.6	-8.3	-9.3	-10.3	-11.2	-11.8	-11.5	-10.4	-11.2	-11.6	-11.6	-12.3	-12.5	-12.4
13	800	-4.7	-4.3	-4.3	-9.4	-9.5	-8.5	-9.3	-11.2	-9.5	-9.8	-9.7	-9.6	-9.6	-10.1	-11.3	-11.6
14	1000	-2.3	-1.0	-3.5	-4.1	-8.9	-7.8	-8.5	-7.3	-7.1	-6.1	-6.5	-6.1	-5.9	-7.2	-8.8	-9.0
15	1250	-0.3	0.1	-0.7	-3.1	-3.1	-3.9	-5.7	-5.5	-5.1	-4.0	-3.8	-2.5	-3.4	-5.5	-7.1	-7.1
16	1600	0.3	1.7	1.4	0.4	-0.8	-2.6	-3.6	-3.7	-4.2	-3.5	-2.9	-3.6	-3.2	-3.6	-5.6	-5.3
17	2000	-10.4	-11.0	-11.4	-12.7	-12.7	-14.0	-12.9	-9.5	-11.6	-8.5	-11.4	-8.5	-6.2	-4.5	-6.6	-8.4
18	2500	-0.9	-0.4	-1.6	-1.1	-2.3	-3.8	-4.6	-3.6	-3.6	-2.6	-3.9	-2.6	-0.9	-1.3	-3.1	-3.6
19	3150	0.6	0.7	-0.4	-1.0	-1.5	-3.7	-5.5	-5.4	-5.1	-4.1	-5.7	-4.9	-2.2	-1.3	-3.2	-4.0
20	4000	-3.5	-2.7	-3.3	-3.7	-4.5	-5.9	-9.8	-9.0	-10.7	-11.7	-9.5	-8.8	-8.3	-8.4	-8.7	-10.2
21	5000	-2.9	-2.2	-3.1	-2.5	-3.0	-5.1	-8.1	-8.2	-8.4	-8.5	-7.5	-6.9	-7.3	-6.7	-7.9	-8.2
22	6300	-4.6	-3.5	-4.5	-4.7	-4.6	-7.0	-11.2	-12.2	-13.5	-11.7	-11.6	-10.7	-8.5	-7.7	-8.8	-10.2
23	8000	-5.8	-4.5	-4.9	-4.2	-5.6	-8.3	-13.3	-14.2	-14.3	-15.6	-13.8	-13.3	-11.3	-9.8	-10.5	-11.6
24	10000	-7.3	-5.9	-6.3	-5.8	-6.6	-9.8	-14.0	-15.9	-16.2	-16.5	-16.0	-16.4	-14.4	-13.2	-13.7	-14.3
25	12500	-8.6	-7.2	-7.9	-6.9	-8.0	-11.1	-13.3	-17.9	-17.9	-17.9	-17.8	-17.2	-16.2	-15.2	-15.2	-16.1
26	16000	-9.8	-9.1	-9.9	-10.0	-10.2	-13.7	-13.6	-20.9	-21.6	-20.4	-21.2	-20.4	-18.9	-17.9	-17.5	-18.5
27	20000	-11.9	-11.8	-12.3	-12.6	-13.2	-16.8	-15.6	-24.4	-24.6	-23.2	-24.7	-23.7	-22.6	-22.1	-21.6	-22.8

TABLE III. - Concluded. SAMPLE OUTPUT FROM SUBROUTINE DADIFF

C O M P A R I S O N   O F   T W O   D A T A   S E T S

DATA SET ONE
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LEWIS RESEARCH CENTER
PROPULSION SYSTEMS ACOUSTICS BRANCH
SAMPLE NOISE DATA

CONFIGURATION	PERCENT SPEED	RPM
100	75.0	1800.

27 - 1/3 OCTAVE BANDS FROM 50 TO 20000 HERTZ
16 ANGLES EVERY 10. DEGREES FROM 10. TO 160.

DATA SET TWO
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LEWIS RESEARCH CENTER
PROPULSION SYSTEMS ACOUSTICS BRANCH
SAMPLE NOISE DATA, SECOND SET

CONFIGURATION	PERCENT SPEED	RPM
101	50.0	1200.

27 - 1/3 OCTAVE BANDS FROM 50 TO 20000 HERTZ
16 ANGLES EVERY 10. DEGREES FROM 10. TO 160.

PERCEIVED AND TONE-CORRECTED PERCEIVED NOISE LEVELS AND DIFFERENCES ALONG SIDELINES

59.0 F, 70.0 PERCENT RH

370. FT SIDELINE

ANGLE	10.	20.	30.	40.	50.	60.	70.	80.	90.	100.	110.	120.	130.	140.	150.	160.
SET TWO PNDB	62.6	74.7	79.5	83.0	82.7	80.8	79.2	80.2	82.7	83.7	84.0	85.1	85.0	80.9	74.4	65.3
SET ONE PNDB	69.3	80.1	85.3	89.3	89.2	88.9	88.6	88.9	92.7	93.0	93.3	93.2	92.4	88.6	83.1	74.8
DELTA PNDB	-6.7	-5.4	-5.8	-6.4	-6.6	-8.1	-9.4	-8.7	-10.0	-9.2	-9.3	-8.1	-7.5	-7.8	-8.7	-9.5
SET TWO PNLT	62.6	74.7	79.5	83.0	82.7	80.8	79.2	80.2	82.7	83.7	84.0	85.1	85.0	80.9	74.4	65.3
SET ONE PNLT	72.6	83.4	88.8	93.0	92.5	91.9	91.2	90.6	94.9	94.6	95.6	94.9	93.9	90.2	84.2	76.3
DELTA PNLT	-10.0	-8.7	-9.2	-10.1	-9.8	-11.1	-12.0	-10.3	-12.2	-10.9	-11.6	-9.7	-8.9	-9.3	-9.8	-11.0

1000. FT SIDELINE

ANGLE	10.	20.	30.	40.	50.	60.	70.	80.	90.	100.	110.	120.	130.	140.	150.	160.
SET TWO PNDB	41.0	58.3	64.4	68.7	69.1	67.9	66.7	68.1	70.1	71.4	71.4	72.4	71.7	66.9	59.8	48.3
SET ONE PNDB	49.5	65.0	71.7	76.4	76.9	76.9	76.6	76.2	79.7	79.9	80.3	79.8	78.6	74.3	69.2	60.3
DELTA PNDB	-8.5	-6.7	-7.3	-7.8	-7.8	-9.0	-9.9	-8.0	-9.6	-8.5	-8.9	-7.4	-6.8	-7.4	-9.4	-12.0
SET TWO PNLT	41.0	58.3	64.4	68.7	69.1	67.9	66.7	68.1	70.1	71.4	71.4	72.4	71.7	66.9	59.8	48.3
SET ONE PNLT	52.9	68.4	75.2	80.2	80.2	79.9	79.2	77.9	81.9	81.6	82.6	81.4	80.0	76.0	70.4	61.7
DELTA PNLT	-11.9	-10.1	-10.8	-11.5	-11.1	-12.1	-12.5	-9.7	-11.8	-10.3	-11.2	-9.1	-8.3	-9.1	-10.6	-13.4

TABLE IV. - LISTING OF TYPICAL SET OF WORKING DATA

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LEWIS RESEARCH CENTER
PROPULSION SYSTEMS ACOUSTICS BRANCH
SAMPLE NOISE DATA
 100  1800.0     75.0 27 16  3
 143.5    6.1 -18.9 -18.5 -15.2 -15.0 -13.3 -14.4 -15.4 -14.6 -15.1 -15.3
              -15.7 -15.9 -14.7 -14.1 -13.6 -14.2  -5.7 -11.9 -10.0  -5.2
               -8.1  -6.9  -5.5  -4.7  -4.6  -2.8   0.
  10.0   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
     1     50  -2.1  -5.0  -6.2  -5.2  -2.5  -3.5  -3.9  -2.2  -4.7  -2.4
               -1.5  -0.5   2.0   3.3   6.8   6.8
     2     63  -7.4  -6.1  -6.6  -7.9  -6.7  -6.7  -5.9  -5.6  -5.4  -4.9
               -2.4  -0.5   2.4   4.4   7.3   8.3
     3     80  -9.5  -9.0 -10.8 -10.7 -10.0  -9.5  -9.7  -8.0  -6.3  -4.5
               -2.0  -0.8   2.2   4.5   8.2   8.5
     4    100  -8.3  -7.8  -7.8  -6.4  -6.1  -8.6  -6.4  -5.4  -5.1  -2.3
               -1.8   0.5   2.6   4.9   7.4   6.6
     5    125  -6.7  -7.2  -7.6  -7.1  -6.6  -5.1  -4.6  -3.4  -2.6  -1.4
               -0.2   1.4   2.4   4.3   6.9   3.8
     6    160  -5.6  -4.6  -4.6  -4.3  -3.1  -2.8  -2.5  -2.3  -1.3  -0.8
               -0.5   0.9   2.2   4.0   5.5   2.4
     7    200  -4.9  -4.0  -4.2  -4.4  -4.5  -5.0  -4.9  -4.5  -3.2  -2.4
               -0.5   1.2   3.6   4.8   6.3   2.2
     8    250  -6.1  -5.6  -5.8  -5.6  -5.8  -5.3  -4.8  -3.6  -2.6  -1.1
                0.4   2.0   3.2   4.6   5.6   2.5
     9    315  -5.9  -5.6  -4.3  -3.6  -4.4  -3.9  -3.8  -2.9  -1.6  -1.1
                0.2   1.7   3.6   4.4   4.6   1.3
    10    400  -6.2  -5.2  -4.7  -3.7  -4.2  -2.9  -3.9  -3.4  -1.9  -0.9
                0.4   2.2   3.6   4.4   4.1  -0.2
    11    500  -3.2  -2.1  -2.9  -2.4  -1.6  -3.1  -3.4  -2.4  -1.4  -0.4
                0.4   1.7   3.3   3.6   3.5  -1.0
    12    630  -4.4  -3.3  -2.3  -0.8  -1.6  -2.5  -2.1  -1.6  -0.6  -0.1
                0.9   1.6   3.0   2.7   1.7  -2.2
    13    800  -0.4  -1.2  -1.7   2.3   0.0  -3.0  -2.2  -0.8  -1.5  -0.2
                0.2   0.9   2.5   1.8   0.8  -2.5
    14   1000  -0.8  -1.2   0.4  -0.3   2.7  -1.4  -1.4  -2.8  -2.1  -1.3
               -0.1   1.0   2.2   2.1   0.6  -3.2
    15   1250  -0.5   1.0   1.4   2.5   0.8  -1.0  -1.1  -1.8  -2.0  -1.0
                0.7   0.5   1.0   0.9  -0.3  -3.9
    16   1600   0.1   0.6   0.4   0.4  -0.4  -1.3  -2.1  -2.5  -1.5  -0.1
                1.0   2.2   3.0  -0.0  -1.3  -4.7
    17   2000   2.4   3.5   3.9   4.9   2.2   0.3  -2.3  -5.0  -2.2  -3.8
                0.7  -0.2  -0.8  -4.6  -6.7  -9.2
    18   2500   0.3   1.3   1.6   1.8   0.5  -1.2  -3.2  -2.7  -1.2  -0.7
                1.3   2.4   1.8  -0.7  -2.7  -6.6
    19   3150  -2.2  -0.6   0.1   0.9  -1.1  -2.4  -3.6  -2.9  -0.7   0.1
                1.6   3.6   3.1  -1.1  -3.4  -6.8
    20   4000  -3.2  -1.6  -1.0   0.0  -1.6  -4.3  -3.5  -4.3   1.4   1.5
                1.7   2.3   3.0   0.9  -3.6  -6.3
    21   5000  -2.1  -0.6  -0.6   0.4  -0.6  -3.6  -3.9  -3.1  -1.1  -0.1
                0.7   2.7   4.1   1.7  -1.6  -6.1
    22   6300  -3.4  -1.6   0.1   2.6  -2.1  -3.7  -3.9  -3.7   1.1   0.5
                1.5   2.6   2.6  -0.2  -3.1  -7.7
    23   8000  -4.1  -2.5  -1.5   0.3  -2.5  -4.1  -4.0  -3.1  -0.3   2.4
                1.9   2.9   3.2   3.0  -3.3  -8.1
    24  10000  -3.4  -2.0  -1.2   0.6  -2.9  -4.2  -4.2  -4.7  -0.9   0.8
                1.8   3.9   3.5   1.0  -1.6  -7.8
    25  12500  -2.2  -1.4  -0.7   1.1  -1.4  -4.2  -4.0  -3.5  -1.2   0.3
                1.3   3.2   3.6   1.3  -1.4  -7.6
    26  16000  -3.2  -1.5   3.0   1.3  -1.9  -4.4  -4.4  -4.2  -0.5   0.8
                1.3   3.4   3.5   0.6  -2.2  -7.9
    27  20000  -2.3  -1.0   0.0   0.1  -1.4  -4.0  -2.4  -4.4  -1.4   0.4
                1.6   3.2   3.5   1.1  -1.7  -7.0
```

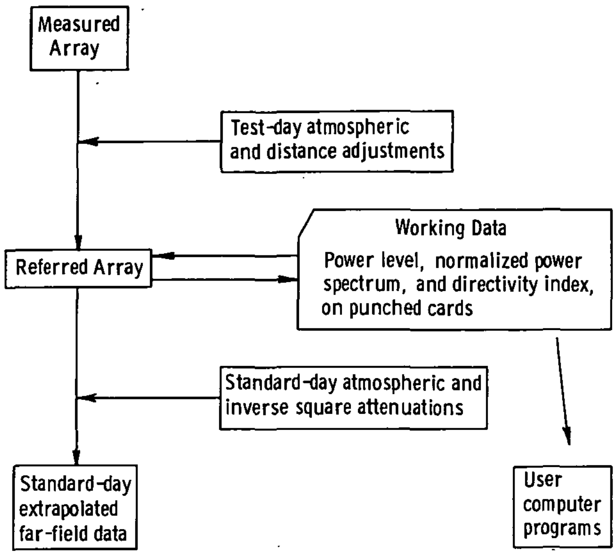

Figure I. - Major elements of data handling system.

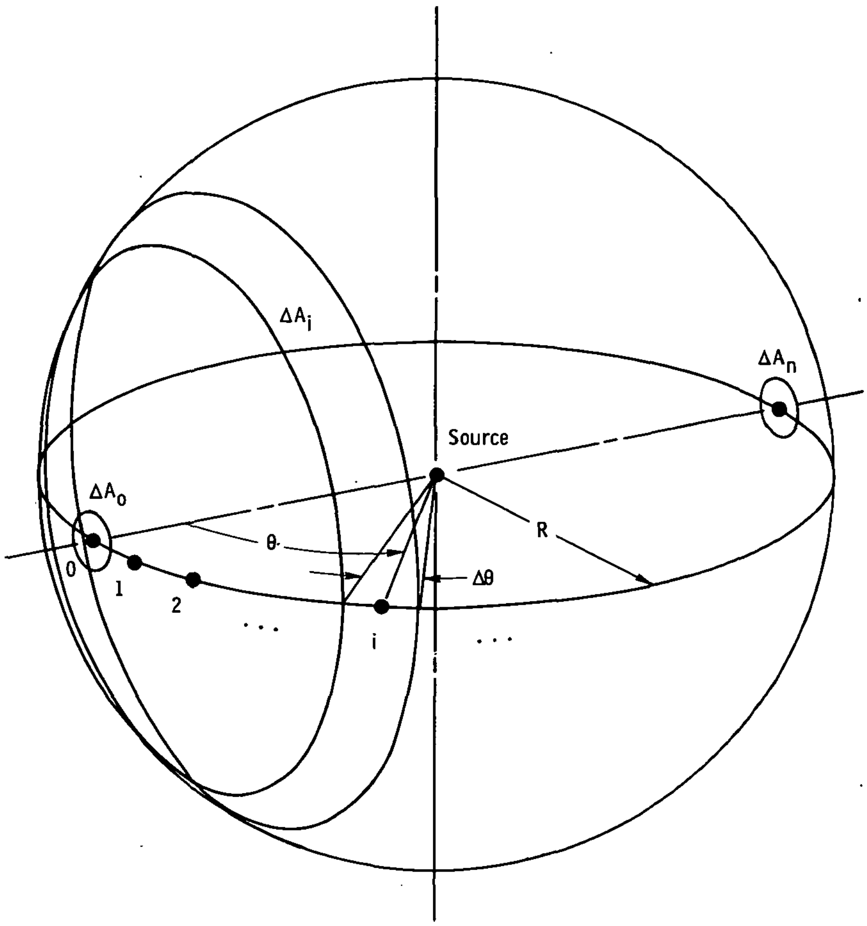

Figure 2. - Geometry of enclosing sphere for far-field acoustic measurements, showing elemental areas without ground plane.

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