FAA DS-67-14

TECHNIQUE FOR DEVELOPING NOISE EXPOSURE FORECASTS

TECHNICAL REPORT

AUGUST 1967

By

SAE RESEARCH PROJECT COMMITTEE R2.5,
DOCUMENTATION OF NOISE EXPOSURE AROUND AIRPORTS

Society of Automotive Engineers, Inc.
485 Lexington Avenue
New York, New York

Under Contract FA67WA-1706
For
DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
AIRCRAFT DEVELOPMENT SERVICE
Washington, D. C. 20590

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ABSTRACT

A methodology called Noise Exposure Forecasts (NEF) is developed for describing aircraft noise exposure in the vicinity of the takeoff and approach flight paths of an airport. In support of this methodology an improved measure of the subjective response to aircraft flyover noise called Effective Perceived Noise Level (EPNL) has been derived. This measure includes corrections for pure tone components and duration. Other elements necessary for the calculation of NEF are number of exposures and time of day. NEF contours are translated into guidelines for compatible land use.

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LIST OF SYMBOLS

SYMBOL	UNIT	
SPL	dB	sound pressure level in decibels (.0002 dynes/cm^2)
PNL	PNdB	perceived noise level (Reference 8)
EPNL	EPNdB	effective perceived noise level
T	sec	duration
D	dB	duration correction
M	-	number of flight movements for an individual runway for a given time period; it is an integer equal to or greater than unity
t	sec	time interval
NEF	-	noise exposure forecast
CNR	-	composite noise rating
log	-	common logarithm
N	Noy	subjective noise value in a one-third octave band
n	Noy	arithmetic sum of Noy values in all one-third octave bands
n_{max}	Noy	Noy value in noisiest band
$\underline{N}$	Noy	weighted Noy value - total noise contribution from all spectral bands as summed in a prescribed manner

1.0 INTRODUCTION

This report presents a method for describing quantitatively the aircraft noise in areas near aircraft takeoff and approach flight paths. This method is based on:

- the subjective level of aircraft flyover noise,
- the number of flyovers per unit of time, and
- the time of day of the flyovers.

This method can be used:

- by airport community planners for defining those areas where efforts should be concentrated to mitigate the noise problem,
- for determining the relative merits of possible engine/aircraft changes to reduce aircraft noise, and
- as a part of an aircraft/airport/community design procedure to limit noise exposures to specified values.

Several studies have been made (References 1, 2, 3, 4, 7, 9) to:

- determine the aircraft noise exposure of areas near takeoff and approach flight paths,
- relate this information to community reaction, and then
- use the results for community planning purposes.

Since these earlier studies were made there has been a considerable advance in the state of the art in establishing subjective noise levels on the ground under aircraft flight paths. This report presents the state of the art as of the Spring of 1967.

The calculation of noise exposure under these flight paths involves the use of weighting factors for number of flights and time of day. No new information is being presented regarding these weighting factors. Therefore the weighting factors previously used in the U.S. are used in this report.

A name, "Noise Exposure Forecast" (NEF), was coined by the FAA for a new noise exposure index. This report presents a procedure for calculating NEF's on the basis of:

- the takeoff and approach noise produced by each aircraft at its particular gross weight, using current operating procedures,

- the summation of the noise exposure contributions of a mix of many different types of aircraft and gross weights, and

- weighting for daytime or nighttime operations.

The procedures described in this report were designed for computer utilization. However, it is practical to make simple calculations of NEF's or to make calculations of NEF changes for simple changes in the system without the use of a computer.

The method used for aircraft noise evaluation in the NEF concept involves the effective perceived noise level (EPNL) in units of EPNdB. The EPNL scale is believed to rate aircraft noise quantitatively better than any other scale presently in use for this purpose. It is based on the PNL scale which was based on subjective reaction tests using broad band noise under steady state conditions. The EPNL scale also includes corrections for discrete frequencies in the spectrum, plus corrections for the duration of the noise when it is within 10 PNdB of the peak PNL during a given exposure. Methods used in the past for this purpose had been based only on the peak or composite PNL of the flyover noise cycle.

The method of calculating EPNL is not considered to be finalized at this date. It is believed to be a better scale for use in relating complete aircraft flyover noise cycles to each other than peak PNL. However, in order to get this work underway at this time it was necessary to make tentative assumptions regarding procedures. These procedures may require change when additional research has been completed. The evolution of the nomenclature is indicative of the state of the art. Perceived noise level in PNdB units was intended to define noise as "perceived" by the human system as compared with the physical air pressure fluctuations measured in decibels. When it became obvious that discrete frequency content and duration were important, the modifier "effective" was added. This nomenclature is redundant and poses questions as to the proper designation to be applied to future revisions which are now being contemplated. Although the term "effective perceived noise level" has been used widely during the past year, there is need for standardization in nomenclature.

The fluid condition of the PNL scale is pointed out in the introduction of this report to assist those who may wish to relate data in earlier or later reports. This report contains techniques which may be used to obtain an approximate conversion from peak PNL, which has been used in the past, to the newly-developed EPNL.

The above remarks about the fluidity of the scales used for measuring noise levels or noise exposures are not intended to be disparaging of the good work which has been and is being done in this area. Nor are they intended to discourage the use of these scales in present community planning studies. Either the earlier or current scales are valid for identifying areas of relatively high noise levels. They refer to the quantitative accuracy of the weighting factors. Therefore the absolute values of the noise levels and noise exposures may change from year to year as we obtain more detailed information on these weighting factors.

Finally, the NEF contours determined in this investigation are related to previously determined zones of compatible land use (Reference 1) to provide guidelines to be used by those responsible for planning land utilization and management.

2.0 CONTOURS OF EQUAL EFFECTIVE PERCEIVED NOISE LEVEL

This section describes the data from which contours of equal noise exposure can be determined for any single takeoff or landing operation of most commercial jet transports. Specific contours and a detailed discussion of their development are presented in a series of Appendices. Several sets of contours are supplied for four, three and two engine jet transports. Estimates of the noise exposure levels of most current and near future jet transport aircraft can be predicted with these contours. While detailed data are not available for all aircraft types the system is set up so that new information can be incorporated when it becomes available.

The development of meaningful contours of equal noise exposure requires the selection of a measure which best rates the noise disturbance and then a determination of the contours from the noise and flight characteristics of the airplane. As discussed in this section, the effective perceived noise level is considered to be the best available measure for this purpose at the present time.

2.1 Effective Perceived Noise Level - Aircraft noise levels in this document are expressed in terms of effective perceived noise level (EPNL) because this method is considered currently to produce the best prediction of subjective response to aircraft flyover noise. Definitions and procedures for the calculation of EPNL are described in detail in Appendix A. Briefly, the flyover noise history is analyzed in 0.5 second increments. One-third octave band sound pressure levels are obtained, and instantaneous perceived noise levels (PNL) are calculated for the spectrum at each of the 0.5 second sampling intervals. Pure tone corrections are determined from the one-third octave band data, and these corrections are added to each PNL to obtain tone corrected PNL. Based on the tone corrected PNL history, a duration is determined and a duration correction is calculated. The effective perceived noise level is the algebraic sum of the maximum tone corrected PNL and the duration correction.

It should be noted that, in the absence of supporting subjective test data, the selection of the method described for adding tone and duration corrections to perceived noise level is quite arbitrary. At such time as validated methods become available, the calculations used to determine EPNL should be updated.

The contract requirement to include tone and duration corrections was regarded as a mandate not only to use available correction data, but to use it in its most technically advanced form. Thus, the calculation procedure used herein reflects the consensus of many aircraft noise rating specialists in this country. It should be noted that even in its present form, the EPNL calculation procedure is not completely satisfactory. Further discussion of this point is given in Section 5.0. However, the EPNL concept is regarded as superior to the PNL concept for aircraft noise rating.

Examination of the EPNL calculation procedure indicates that there is no simple relationship between PNL and EPNL. Figure 3B shows differences between EPNL and PNL for specified conditions.

2.2 Aircraft Noise Characteristics - The EPNL of an aircraft at any given distance from the flight path is dependent on the number and type of engines and on the thrust level of those engines. Appendix B presents curves of EPNL with or without ground attenuation as a function of slant distance for a reference four engine jet transport and a reference two engine jet transport. For the four engine jet transport the reference engine is the JT3D-3B turbofan engine in a short fan discharge duct installation. For the two engine jet transport the reference engine is the JT8D-1 turbofan engine. In each case one curve is provided for takeoff thrust and one for landing thrust. Reference curves for a three engine jet transport can be obtained by adding 2 EPNdB to the reference curves for the two engine jet transport.

These reference curves were based on a number of magnetic tape recordings obtained from actual flyover operations. Ground to ground attenuation rates were based on methodology described in Reference 5. The method of developing these reference curves is described in Appendix B. Extensive data are not available at this time on the duration and tone corrections for other engine types. However, based on the limited data available, the differences in EPNL between the reference engines and other engines in use on most jet transports appear to be minor.

2.3 Aircraft Performance - In developing the takeoff and landing performance data for jet transport aircraft, every attempt has been made to provide data which are simple to use without compromising the general accuracy of the NEF procedure. Aircraft operating procedures vary with airline policy, pilot technique and environmental conditions. Consequently, the data presented are for typical operating procedures.

Appendix C presents takeoff and landing performance data for four engine, three engine and two engine jet transport aircraft. These data are combined with the noise characteristic data contained in Appendix B to develop noise contours.

TAKEOFF PROFILES

Appendix C contains a set of five takeoff profiles for jet transport aircraft (Figure 1C). These five profiles represent the range of profiles for all current jet aircraft types. Variations in thrust and aerodynamics in different aircraft types result in different climb capabilities for different gross weights. Figures 2C, 3C and 4C provide data for selection of the proper profile for any gross weight and aircraft type.

APPROACH

Approach performance data must include the approach profile and the approach thrust to permit the development of noise contours. An approach profile for a three degree glide slope is contained in Figure 5C.

2.4 Grid System and Contours of Effective Perceived Noise Level - Effective perceived noise level (EPNL) reference data are provided in Appendix D for two, three, and four engine jet aircraft for each reference flight profile described in paragraph 2.3. These data are required for the calculation of NEF contours as described in Section 3 of this report. These reference data in the form of EPNL values at locations on a quarter mile grid system and EPNL contours were calculated from the aircraft noise and performance characteristics introduced in paragraphs 2.2 and 2.3 and described in Appendices B and C respectively.

This was done for each flight profile: A, B, C, D, E and Approach for the four engine jet aircraft; A, B, C, D and Approach for three engine jet aircraft; and A, B, C and Approach for two engine jet aircraft. The procedure for developing grid values and contours for the flight profile for each aircraft type is as follows:

(1) For each grid point determine the minimum distance or minimum slant range and elevation angle (β), between the grid point and the aircraft flight path.

(2) Determine the EPNL at that grid point for that minimum distance for the appropriate aircraft and thrust level from the curves in Appendix B. Where appropriate the grid EPNL values are adjusted to account for ground to ground attenuation and the effect of engine shielding by the aircraft fuselage. The following ground attenuation weighting function has been chosen arbitrarily to allow a smooth transition between locations with and without ground attenuation benefits: Ground to ground attenuation at a given slant

distance and angle of elevation (β), equals the ground to ground attenuation at that distance and a 0^{o} angle of elevation times the factor $e^{-\sqrt{\tan 3\beta}}$. Thus, ground to ground attenuation decreases as β increases, and when β is 15^{o} or greater no ground attenuation benefits are included. The effect of the engines being shielded from an observer by the fuselage has been included arbitrarily by the following relationship which provides the decrease in noise level due to shielding: Reduction in EPNL = $3(1 - \sqrt{\sin \beta})$. Thus, when the angle of elevation is 0^{o}, it is assumed that the fuselage is shielding one-half of the engines from the observer (-3 EPNdB). The effects of both ground to ground attenuation and fuselage shielding are included where appropriate, and EPNL grid values and contours are provided in Appendix D.

(3) Plot contours of equal EPNL by interpolating between EPNL values at the grid points.

All turbojet and turbofan aircraft in current use by airlines and which make a significant contribution to the noise exposure around an airport are represented by the reference data. The purpose of these data is not to determine the EPNL at a given point for a specific operation of a specific aircraft. More precise engineering data for each individual aircraft would be required for that purpose. However, in terms of providing data which represent the average levels resulting from a variety of operations of different aircraft types the accuracy of these contours should be on the order of the difference between two adjacent contour sets which is about ± EPNdB.

In evaluating noise exposure forecasts for future time periods, additional aircraft types such as jumbo jet and SST must be included in traffic estimates. Jumbo jets are expected to generate EPNL's lower than current aircraft having the same number of engines. In the absence of EPNL data for these future aircraft, reference contours for the current aircraft may be used in this procedure for jumbo jet aircraft. Any error resulting from this procedure will be small since the number of jumbo jets will represent a minority of total air transport traffic within the next decade. By the time that the jumbo jets represent a significant portion of the air transport fleet, the noise characteristics of these aircraft will have been well documented and EPNL data can be obtained to allow the determination of more accurate NEF's. The number of U. S. SST aircraft in the next decade will represent a very small minority of the total traffic. Also, measurements of actual aircraft flyovers will be required to accurately document the noise characteristics of this unique aircraft type. Therefore, this aircraft will not be included in NEF estimates at this time.

Although foreign SST aircraft are scheduled to be included in airline fleets, the lack of noise and performance data on these aircraft precludes their consideration in current NEF estimates.

2.5 Selection of Appropriate Effective Perceived Noise Level Contours - The information in Appendices C and D is sufficient to permit the selection of the appropriate noise contours or grid values for any operation of current jet aircraft provided gross takeoff weight information is available. When weight information is not available reasonably accurate EPNL contours may be obtained using the operating ranges of the different aircraft at any airport. Appendix E describes this method of approximation.

3.0 DEVELOPMENT OF CONTOURS OF EQUAL NOISE EXPOSURE FORECAST

In Section 2 aircraft noise characteristics and aircraft performance were combined to obtain contours of equal EPNL for any given takeoff or landing operation of current jet transport aircraft. The purpose of this section is to provide techniques for combining the EPNL's from different operations with airport traffic data to obtain the NEF's for any combination of operations at any given airport. As NEF's are intended to represent the cumulative noise exposure in areas surrounding an airport, the cumulative effect of multiple operations as well as the time period in which the operations occur must be considered. Thus, in order to develop NEF's, information must be obtained on traffic at the airport of interest in adequate detail to allow: (1) the identification of flight operations by the proper aircraft-engine flight profile category (reference Section 2); (2) the separation of daytime and nighttime operations; and (3) the number of flight operations for each runway.

3.1 Effect of Number of Flight Movements - Social surveys and subjective tests in a number of countries indicate that there is a relationship between the number of aircraft heard and the annoyance expressed by the listeners. Efforts to establish a numerical value for this relationship have resulted in a variety of answers. Some of these studies are discussed in Appendix H. Available data are far from conclusive and additional tests and surveys should be conducted to provide more reliable information.

For the purpose of this study, a factor of 10 log M is used, where M equals the number of flight movements for a given time period. This assumes that doubling the number of flight movements is equivalent to an increase of three EPNdB in the noise exposure. The selection of this factor is somewhat arbitrary and is subject to change as the results of additional research become available.

3.2 Runway Utilization - Total jet movements for an airport, on an annual basis are divided by 365 to obtain average daily movements. The daily average for each individual runway is determined by multiplying the average daily movements by annual percentage runway utilization. It has been assumed that the distribution of aircraft types and takeoff gross weights (or stage lengths) is the same for all runways at a given airport. The use of average daily figures involves the questionable assumption that the noise exposure in a given area would be the same whether the percentage of flights operating there occurred in one concentrated period of a few days with no flights during the rest of the year or if that same volume of traffic were evenly spread throughout the year.

3.3 Effect of Time of Day - Studies have indicated that community tolerances for noise appears to be lower at night than during the day. The definition of day and night hours varies a great deal from one study to another as indicated in Appendix I. Here again an arbitrary decision had to be made for the purpose of this study. Nighttime operations are considered to be those which occur between the hours of 10 P.M. and 7 A.M. (2200 to 0700). A number of studies have indicated general differences for tolerance of about ten decibels in ambient community noise levels between day and night. A figure of 10 EPNdB has been used in this report as a correction factor to represent the apparent increase in annoyance resulting from flight operations at night.

3.4 Calculation of Contours of Equal Noise Exposure Forecast - As described in Section 2.4 sets of reference contours of equal EPNL have been developed for appropriate reference flight profiles for each current jet aircraft type. EPNL values have also been calculated for the reference profiles for locations on a 1/4 mile X 1/4 mile grid which extends 4 miles to either side of the flight path and approximately 18 miles along the projection of the flight path. These reference contours and tabulations of EPNL are presented in Appendix D.

To calculate NEF contours from the reference EPNL data, adequate aircraft movement data must be obtained. The number of aircraft movements in each category in an average day must be further divided into nighttime and daytime movements (reference Section 3.3). A suggested data tabulation form is shown in Table 1. The distribution of aircraft movements into proper EPNL contour categories is based on the distribution of flights for each runway end.

An NEF contour is developed by the following procedure which is also the basis for the computer program described in Appendix F.

1. The EPNL value at each grid point for each reference EPNL contour set is corrected for the total number of flights by adding the total correction factor (see Table 1).

2. The corrected EPNL values at each grid point for each EPNL contour set are then combined by summing logarithmically.

TABLE 1 Data Sheet for Tabulating the Number of Aircraft Movements Associated with each Reference Contour

AIRPORT________________

RUNWAY END: TAKEOFF __________

APPROACH __________

(1) Reference Contour	(2)	(3) Number of Flights (M)	(4)	(5) Correction Factor (db)	(6)	(7)
Aircraft Type	Flight Profile	Daytime 0700-2200	Nighttime 2200-0700	Daytime 10 log M	Nighttime 10 + 10 log M	Total Correction-Logarithmic Sum of Columns (5) and (6)
4 Engine	A					
	B					
	C					
	D					
	E					
	Approach					
3 Engine	A					
	B					
	C					
	D					
	Approach					
2 Engine	A					
	B					
	C					
	Approach					

3. The factor 100 is then subtracted from each of the resulting grid values obtained from step 2. This value was arbitrarily chosen so that the NEF values obtained would not be confused with any other indices which have been used in previous studies for rating the disturbance of aircraft flyover noise.

4. Equal NEF contours can then be plotted from interpolations of the values at each grid point.

5. NEF contours for the entire airport are obtained by combining the contours for the individual runways on a scaled map. Where contours overlap, the NEF values are summed logarithmically.

An example of an NEF contour calculation is presented in Appendix G.

In view of the vast number of calculations required to delineate NEF's, the desirability of using a computer program is obvious. A computer program that can be used to perform all the required calculations is described in Appendix F.

3.5 Modifications for Flight Paths with Turns - Arrivals at and departures from a runway may not be straight in or straight out due to terrain, noise abatement procedures, or routing of aircraft. Thus, flight procedures and traffic patterns often involve turns. The influence of aircraft turns can be accounted for in an NEF determination by first making the determination for all aircraft which do not turn. Then, for runways which involve turns for a portion of, or for all operations, a separate NEF determination is made and the NEF's with and without turns are combined as in step 5 of Section 3.4.

Actually, a separate determination should be made for each individual curved path. However, if many different curved paths are involved expediency may require considering only several categories of turns. If turns were initiated for all aircraft at a given distance from brake release, the calculation would be fairly simple since all aircraft would follow approximately the same curved path. When turns are initiated at a given altitude, each flight profile results in a horizontal projection (ground track) that follows a different curved path. Considering the five generalized flight profiles of Appendix C, there will be five corresponding curved ground tracks.

In reality, with a mix of aircraft types, the area covered by a specified turn procedure would be a sweeping sector bounded by the paths of the lightest and heaviest aircraft involved. An NEF contour for each curved flight path is calculated using the procedure described in Section 3.4 by first assuming that the flight path is straight. If the contour for a curved ground track is plotted, it will resemble the example shown in Figure 1.

TECHNIQUE FOR PLOTTING NEF CONTOURS

FOR CURVED FLIGHT PATHS

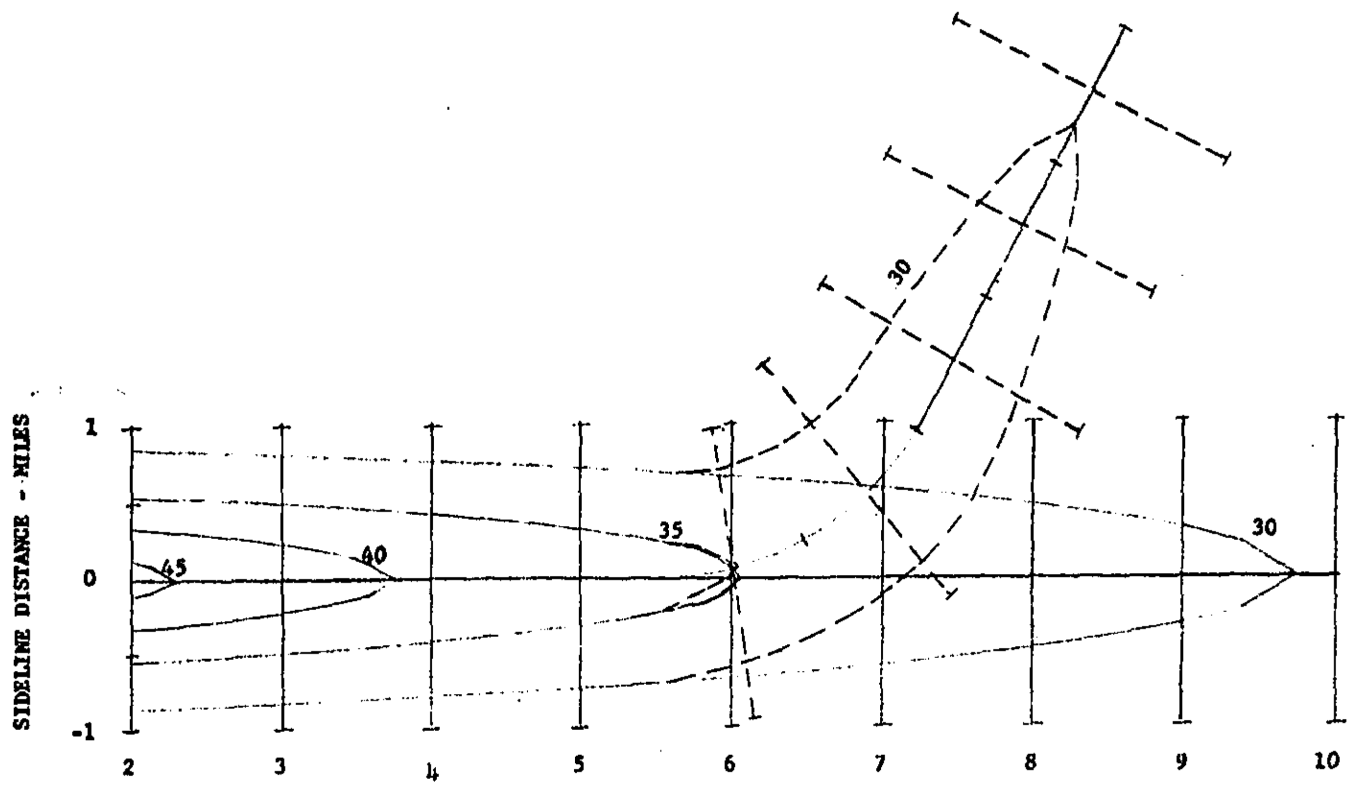


FIGURE 1

Observers on the inside of the curved ground track will hear the aircraft noise for a longer time and observers on the outside of the curved ground track will hear the noise for a shorter time. However, the effect on EPNL resulting from changes of time duration will in general be small and are neglected in this report.

4.0 LAND USE PLANNING

The Noise Exposure Forecast (NEF) contours described in Section 3.0 have been developed for use in delineating aircraft noise exposure levels in areas near airports. This delineation of aircraft noise exposure levels is for the purpose of aircraft/airport/community planning. The relationship between engine/aircraft characteristics and NEF contours has been presented in the previous sections. This section will deal with the relationship between NEF contours and guidelines for compatible land use.

This contractor has not made studies of compatible land use as a function of aircraft noise exposure. Information contained in this report on this subject has been obtained from a review of work done by others (Reference 6, 7). The purpose of incorporating this material in this report is to permit the contractor to explain certain procedures and precautions which are needed to relate compatible land uses as described in other studies to NEF contours developed by techniques described in this report.

4.1 The concept of composite noise rating (CNR) was developed several years ago based on information relating community response to perceived noise level (PNL) and the number of exposures (1). The CNR unit is by definition equal to PNL plus correction factors for the number of exposures, time of day and duration of ground run up operations. This unit was then related to land use categories as shown in Tables 2 and 3. NEF, developed in this report, is related to effective perceived noise level (EPNL) plus correction factors for number of exposures and for time of day. The effect of ground run up operations is not included in the NEF's in this report. This relationship of NEF to community response has not been developed. This relationship should also be established in order to assist in analyses where ground run-up operations are significant. NEF can be related to the above mentioned land use tables only under those special conditions where NEF equals CNR for flight operations. Those conditions occur only where EPNL equals PNL. Referring to Figure 3B, we can see that they are equal when an observer is about 900 to 1200 ft. from current aircraft. At these distances the EPNL time duration and pure tone corrections which differentiate EPNL from PNL tend to cancel one another.

In Figure 2 the differences between EPNL and PNL are shown for current aircraft as a function of altitude. At locations where the aircraft passes very near the community, the EPNL values are as much as 5 db below the PNL values. Therefore, substituting NEF in place of CNR in Tables 2 and 3 under such conditions might underestimate the severity of the response to the noise. Conversely, at

TABLE 2

Chart for Estimating Response of Residential Communities from Composite Noise Rating

Composite Noise Rating			
Takeoffs and Landings	Runups	Zone	Description of Expected Response
Less than 100	Less than 80	1	Essentially no complaints would be expected. The noise may, however, interfere occasionally with certain activities of the residents.
100 to 115	80 to 95	2	Individuals may complain, perhaps vigorously. Concerted group action is possible.
Greater than 115	Greater than 95	3	Individual reactions would likely include repeated, vigorous complaints. Concerted group action might be expected.

TABLE 3

LAND USE COMPATIBILITY CHART FOR AIRCRAFT NOISE

Noise Sensitivity Zone	Composite Noise Rating (CNR)		LAND USE COMPATIBILITY								
	Takeoffs and Landings	Ground Runups	Residential	Commercial	Hotel, Motel	Offices, Public Buildings	Schools, Hospitals Churches	Theaters, Auditoriums	Outdoor Amphi-Theaters, Theaters	Outdoor Recreational (Non-spectator)	Industrial
I	Less Than 90	Less Than 70	yes	yes	yes	yes	yes	Note (A)	Note (A)	yes	yes
II	90-100	70-80	yes	yes	yes	yes	Note (C)	Note (C)	no	yes	yes
III	100-115	80-95	Note (B)	yes	Note (C)	Note (C)	no	no	no	yes	yes
IV	Greater Than 115	Greater Than 95	no	Note (C)	no	no	no	no	no	yes	Note (C)

NOTE (A) - A detailed noise analysis by qualified personnel should be undertaken for all indoor or outdoor music auditoriums and all outdoor theaters.

(B) - Case history experience indicates that individuals in private residences may complain, perhaps vigorously. Concerted group action is possible. New single dwelling construction should generally be avoided. For high density dwellings (apartments) construction, Note (C) will apply.

(C) - Avoid construction unless a detailed analysis of noise reduction requirements is made and needed noise control features are included in building design.

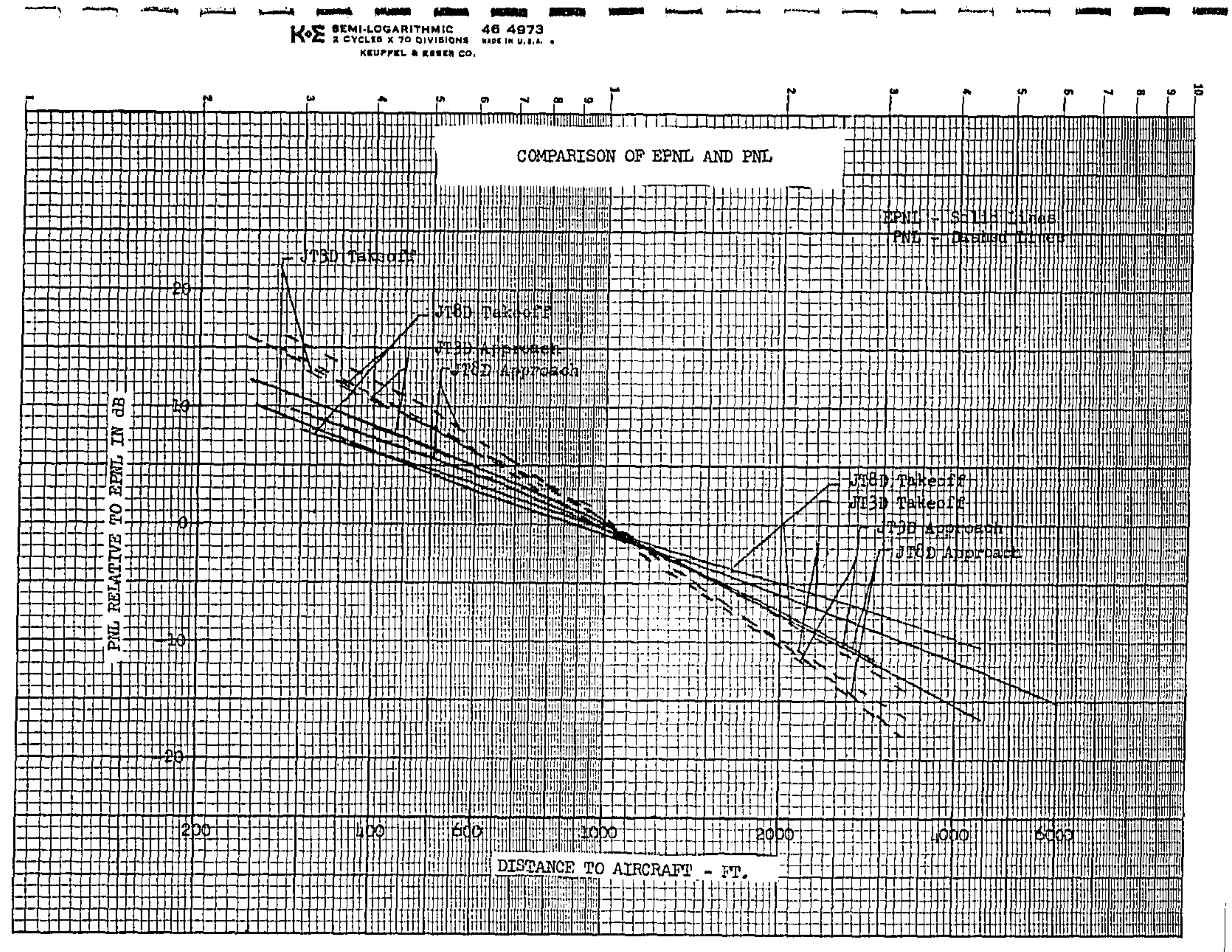

K+E SEMI-LOGARITHMIC 46 4973
2 CYCLES X 70 DIVISIONS MADE IN U.S.A.
KEUFFEL & ESSER CO.
COMPARISON OF EPNL AND PNL
EPNL - Solid Lines
PNL - Dashed Lines
JT3D Takeoff
JT8D Takeoff
JT3D Approach
JT8D Approach
JT8D Takeoff
JT3D Takeoff
JT3D Approach
JT8D Approach
PNL RELATIVE TO EPNL IN dB
20
10
0
-10
-20
200
400
600
1000
2000
4000
6000
DISTANCE TO AIRCRAFT - FT.

FIGURE 2

greater distances from the aircraft the EPNL is as much as 5 db above the PNL. Under these conditions, use of NEF values in Tables 2 and 3 might overestimate the severity of the response.

A review of the work of References 6 and 7, particularly that contained in Tables 2 and 3, suggests that the land use planning significance of NEF zones is as shown in Table 4. This classification is necessarily tentative because it presumes correspondence exists between CNR and NEF contours, whereas such correspondence may not generally exist, as explained above.

The land use zones defined in Table 4 attempt to provide the land use planner with categories of compatible land use as defined by NEF contours for an airport community. In their present form these categories contain the effects of the inaccuracies of measurement and extrapolation characteristic of the zones based on CNR together with the approximations required to translate from this earlier concept to that of NEF.

Table 3 was based on CNR's which for daytime operations are based on a reference number of operations of 20 movements per day.

$$\begin{aligned} \text{CNR} &= \text{PNL} + 10 \log_{10} M/20 \\ &= \text{PNL} + 10 \log_{10} M - 13 \end{aligned}$$

Table 4 is based on NEF's which for daytime operations are based on the same reference number of operations to facilitate reference to Table 3 and have the number 100 subtracted so that CNR's and NEF's will not be confused.

$$\begin{aligned} \text{daytime NEF's} &= \text{EPNL} + 10 \log_{10} M/20 - 100 \\ &= \text{EPNL} + 10 \log_{10} M - 113 \end{aligned}$$

These noise exposures of nighttime operations, from 10 p.m. to 7 a.m., is weighted 10 EPNL higher than daytime operations. This is similar to the weighting given to nighttime operations in the determination of CNR.

$$\begin{aligned} \text{nighttime NEF's} &= (\text{EPNL} + 10) + 10 \log_{10} M/20 - 100 \\ &= (\text{EPNL} + 10) + 10 \log_{10} M - 113 \end{aligned}$$

The total NEF is of course the daytime NEF plus the nighttime NEF.

From the above relationships it will be noted that where PNL and EPNL are approximately equal NEF is approximately equal to CNR - 100. Thus in Table 4 the boundaries between zones A and B and between zones B and C are O NEF and 15 NEF respectively instead of 100 CNR and 115 CNR as in Table 3, considering zones I and II combined and zones III and IV.

TABLE 4

Land Use Compatibility Related to NEF Zones

	ZONE A (less than 0 NEF)	ZONE B (0 to 15 NEF)	ZONE C (Over 15 NEF)
Extensive design precautions to avoid serious noise interference:	----	Theaters and auditoriums hospitals, churches and schools	Theaters and auditoriums hospitals, churches and schools, offices and public bldgs. hotels, motels residential
Analysis and noise control features included in design:	Theaters and auditoriums, hospitals, churches and schools	Offices and public bldgs. motels, hotels, residential	Commercial Industrial
No adverse effects:	Offices and public bldgs. hotels, motels residential commercial industrial recreational	commercial industrial recreational	recreational

Outdoor theaters require extensive design precautions to avoid serious noise interference regardless of NEF zone.

The land use categories, as well as the NEF concept is subject to further refinement and adjustment as additional data becomes available. Therefore, NEF values assigned to the various categories of land use (Table 4) should be considered as representing current state-of-art and subject to future changes.

5.0 SUGGESTED AREAS FOR ADDITIONAL STUDIES

Despite increasing concern and activity of cognizant authorities directed toward the control of aircraft noise, attempts to establish accurate criteria for acceptable noise levels in the airport community continue to be frustrated by the lack of valid data relating man's subjective response to the measurable parameters of a complex sound such as that produced by an aircraft engine. The more difficult problems in establishing valid criteria for acceptable noise levels would appear to derive from the complexity and elusiveness of the variables which determine man's subjective response to a given noise source depending on the situation in which it is heard. However, the problem of deriving a reliable descriptive measure of complex sounds, such as those produced by jet engines alone is far from simple and has not yet been solved to the satisfaction of responsible researchers and operations people in the field. When attempting to establish the ultimate criterion indices (or standards) for acceptable noise levels, one must combine the problems and inaccuracies derived from these measurement approximations and the estimates of subjective response. It is clear that definitive data and methodologies must be developed before accurate and practical noise criteria can be established.

EPNL as described in this report provides a more comprehensive measure of the subjective response to aircraft noise. Therefore, it is expected that the guidelines for land use planning suggested in Section 4.0 are more realistic than those based on earlier approximation techniques. However, until both EPNL and NEF techniques have been validated empirically, these guidelines must be interpreted and used with caution.

Two kinds of studies are necessary to furnish the data currently lacking. They are: 1) basic psycho-acoustics studies including both laboratory (psychophysical) and sociological (survey) investigations designed to firmly establish the effects of spectral composition, number or frequency of exposures, duration of exposure, situational conditions such as time of day or correlative type of activity, and last but not least "level," on population response to noise, and 2) acoustical analysis and methodological studies designed to establish valid and acceptable methods for measuring and describing a noise source and its critical parameters and to develop a technique for combining the effects of these parameters into a consistent meaningful index of noise exposure from which standards of acceptability can be derived.

Although the techniques and immediate objectives of the two types of studies can be differentiated for descriptive purposes, it is clear that the results and conclusions derived from them are so interdependent that they cannot be undertaken separately. Rather, both types of study should be carried out as complementary efforts within an integrated program of investigation.

This report has included weighting factors which have been used previously in this country. Future research may indicate that these weighting factors should be changed.

The NEF delineation procedure may be improved by the results of studies designed to explore the following:

1. Discrete frequency correction - Specific items worthy of further study are (a) the magnitude of the correction (currently the average of available data), (b) the effects of multiple tones closely spaced in frequency (currently assumed accounted for by the tone amplitude calculation procedure), (c) the effects of tone modulation (currently unaccounted for), (d) the effects of background spectrum shape (currently assumed to be zero), and (e) the proper application of the tone correction values to the total perceived noise level (currently a subject of discussion between two approaches which so far appear to produce similar results).

2. Duration correction - The magnitude of the duration correction, the method of deriving it, and the proper application to perceived noise level all need validation. There is even reason to believe that an entirely new concept is needed, if, for example, the effects of background noise are to be considered.

3. Effective Perceived Noise Level - The validity of this concept is open to question in two respects: a - Does the presently used method properly combine the effects of PNL, tones, and duration? b - Does the EPNL concept provide a valid method for assessing subjective reaction to aircraft flyover noise?

4. Effect of number of flyovers - The method of correcting for the number of movements used in this report is supported by only one type of experimental study (community survey). The magnitude of the correction is not supported by any experimental evidence. Further study of this variable should include the effect of adding events of different EPNL and frequency of movements.

5. Time of day - There is strong reason to believe that community reaction depends on the time of day; however, there is only technical judgment to support the choice of time correction factors. This item is closely related to item 4 above and the interaction of the two effects requires study.

6. Season - There are reasons to believe that seasonal effects are substantial. It is not known whether the effect is a complex bio-psychological one, or is simply due to the fact that noise levels in a house are higher with the windows open (as in the summer) than with windows closed. At the present, there is no reliable method of assigning a magnitude to this effect.

APPENDIX A

DEFINITIONS AND CALCULATION PROCEDURES FOR EFFECTIVE PERCEIVED NOISE LEVEL

DEFINITIONS

Perceived Noisiness - Noise, in acoustics, is defined as "unwanted" sound. Of course, whether a sound is unwanted is determined to some extent, by the meaning a particular sound has to a particular listener; but it is also determined by the characteristics of man's auditory and perceptual system. It has been found that for sounds having about equal meaning to a group of people, the intensity, band-width, spectral content, and duration of the sound determine in a systematic and consistent way, the subjectively-judged unacceptability, or noisiness of the sound. This attribute of sound is called perceived noisiness.

A scale has been developed expressing a measure of the relative perceived noisiness of occurrences of sounds of equal duration; the quantity is called the Perceived Noise Level (PNL). The perceived noise level of a given sound is numerically equal to a reference sound that is judged by listeners to be as acceptable or objectionable as the given sound. The reference sound is a band of random noise one octave in width centered at 1000 Hz and of comparable temporal characteristics to the given sound, i.e., rise and decay times and total duration. The perceived noise level of a given sound, can be approximated from certain calculations to be outlined below, performed on spectral analysis measures made of the sound.

Maximum Perceived Noise Level (PNL) - It has been the practice to express the perceived noisiness of a sound by reference to the maximum perceived noise level of that sound. The maximum level is calculated according to recommended procedures from the maximum level reached in each spectral band used in the physical analysis of the sound, as follows:

$$\text{peak PNL} = 40 + 33.3 \log \underline{N}$$

(where $\underline{N}$ represents the total noise contribution from all spectral bands as summed in Procedure 1).

This maximum or peak level can be approximated by performing the above calculations using the spectral band levels that occur at the given point in time when it is estimated that the perceived noise level thus calculated will be at its peak or maximum.

Effective Perceived Noise Level (EPNL) - Tests have shown that when subjective comparisons are made of sounds which differ markedly in their temporal pattern and/or discrete frequency content, their perceived noise levels, as calculated according to the formula given above, do not match the responses of the subjects in the test. It has been proposed tentatively that the perceived noisiness of such sounds can be estimated by applying tone and duration corrections to the calculated PNL's to derive a new number called effective perceived noise level. Thus, the EPNL represents the contribution of three factors to the total perceived noisiness of an aircraft flyover:

1. Perceived Noise Level.
2. A correction for Discrete Frequency Components.
3. A correction for Time Duration.

CALCULATION PROCEDURES USED TO DETERMINE EPNL'S

Effective Perceived Noise Level - The EPNL at a specific location is derived from a time history of the noise from an aircraft flyover as follows:

1. Perceived noise levels are determined from 1/3rd octave band spectra for a continuous sequence of one-half second time intervals throughout the time period of the flyover noise. The perceived noise levels for each time interval between times t_1 and t_2 are assumed to apply at the center time for the interval as given by $\frac{t_1 + t_2}{2}$. These perceived noise levels are calculated according to Procedure 1.
2. Tone corrections are determined for each 1/3rd octave band spectrum according to Procedure 2.
3. The tone correction determined in step 2 is added algebraically to the perceived noise level determined in step 1 for each half-second interval of the flyover noise. The result is called the tone-corrected perceived noise level.
4. The results of step 3 are plotted to display the tone-corrected perceived noise level as a function of flyover time. This plot is called the tone-corrected perceived noise level time history.
5. The maximum value of the tone corrected perceived noise level time history computed in step 4 is determined.

6. The duration (T) is determined in seconds of the tone-corrected perceived noise level history between the time at which the tone-corrected perceived noise level first reaches a value of 10 dB below its maximum value and the time at which it last decreases 10 dB below its maximum value. A duration correction (D) is as follows:

$$D = 10 \log \frac{T}{15}$$

7. The duration correction obtained from step 6 is added algebraically to the maximum calculated tone corrected perceived noise level of step 5 to obtain the effective perceived noise level. An expression for the determination of Effective PNL is as follows:

$$\text{EPNL} = \text{peak PNL} + D$$

PROCEDURE 1 - APPENDIX A

CALCULATION OF INSTANTANEOUS PERCEIVED NOISE LEVEL

Note: The following steps and data have been derived from Reference 8.

Step 1

The value of sound pressure level in each 1/3rd octave band of a spectrum is converted to a noy value by entering Table 1A at the appropriate band center frequency.

Step 2

The noy values found in step 1 are combined in the manner prescribed in the following formula:

$$\underline{N} = n_{max} + 0.15 (n - n_{max})$$

where n_{max} is the number of noys in the noisiest band and n is the sum of the noy values in all the bands.

Step 3

$\underline{N}$ is converted into a perceived noise level, in PNdB, by the use of Table 2A which expresses the relation:

$$PNL = 40 + 33.3 \log \underline{N}$$

PROCEDURE 2 - APPENDIX A

CALCULATION OF DISCRETE FREQUENCY OR TONE

CORRECTION FOR EACH 1/3RD OCTAVE BAND SPECTRUM OF INTEREST

Step 1

Compute for each 1/3rd octave band a value composed of an average of the nearest two bands above the given band and the nearest two bands below.

Note.

The value for the two lowest frequency bands and the two highest bands is based on only the average of available adjacent bands.

Step 2

Mark all bands that exceed this computed value by 5 dB or more. Recompute for all bands a second average value as in step 1, omitting the marked bands in calculation of the average. (The average may now be based on several non-contiguous bands.) A discrete frequency is said to exist if the SPL in any marked band exceeds this recomputed average value by 5 dB or more.

Step 3

The difference in dB between the second computed average value and actual SPL in each marked band should be used as the number to enter the tone correction table (Table 3A), or the tone correction curves shown in Figure 1A. Thus, a tone correction would be determined for each 1/3rd octave band that exceeds its "average" by 5dB or more.

Step 4

The final tone correction for any 1/3rd octave band spectrum is taken to be only the maximum tone correction determined in step 3. Thus, the final value of discrete frequency correction for any 1/3rd octave band spectrum is determined by only the "worst" 1/3rd octave band.

TABLE 1A

Noys (N) as a Function of Sound Pressure Level (SPL)

(preferred frequencies for octave band filters marked by heavy lines.

Band Center Frequency in Hz(c/s)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Lp	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10,000	12,500
29																			1.0	1.0					
30																		1.0	1.0	1.1					
31																		1.1	1.1	1.1	1.0				
32																	1.0	1.1	1.2	1.2	1.1				
33																	1.1	1.2	1.3	1.3	1.2	1.0			
34																1.0	1.2	1.3	1.4	1.4	1.3	1.1			
35																1.1	1.3	1.4	1.5	1.5	1.4	1.2			
36																1.2	1.3	1.5	1.6	1.6	1.5	1.4			
37																1.3	1.4	1.6	1.8	1.8	1.6	1.5	1.0		
38															1.0	1.3	1.5	1.8	1.9	1.9	1.7	1.6	1.1		
39															1.1	1.4	1.6	1.9	2.0	2.0	1.9	1.8	1.2		
40										1.0	1.0	1.0	1.0	1.0	1.2	1.5	1.7	2.0	2.2	2.2	2.0	1.9	1.4		
41										1.1	1.1	1.1	1.1	1.1	1.3	1.6	1.8	2.2	2.4	2.4	2.2	2.0	1.5	1.0	
42									1.0	1.1	1.1	1.1	1.1	1.1	1.3	1.7	2.0	2.4	2.6	2.6	2.4	2.2	1.7	1.1	
43									1.1	1.2	1.2	1.2	1.2	1.2	1.4	1.8	2.2	2.6	2.8	2.8	2.6	2.4	1.8	1.2	
44								1.0	1.1	1.3	1.3	1.3	1.3	1.3	1.5	2.0	2.4	2.8	3.0	3.0	2.8	2.6	2.0	1.4	
45								1.1	1.2	1.4	1.4	1.4	1.4	1.4	1.6	2.1	2.5	3.0	3.2	3.2	3.0	2.8	2.2	1.5	
46							1.0	1.2	1.3	1.5	1.5	1.5	1.5	1.5	1.7	2.3	2.8	3.2	3.4	3.4	3.2	3.0	2.4	1.7	1.0
47							1.1	1.3	1.4	1.6	1.6	1.6	1.6	1.6	1.8	2.4	3.0	3.4	3.6	3.6	3.4	3.2	2.6	1.8	1.1
48						1.0	1.2	1.4	1.5	1.7	1.7	1.7	1.7	1.7	2.0	2.6	3.2	3.6	3.9	3.9	3.6	3.4	2.8	2.0	1.2
49						1.1	1.3	1.5	1.6	1.9	1.9	1.9	1.9	1.9	2.1	2.8	3.4	3.9	4.1	4.1	3.9	3.6	3.0	2.2	1.4
50						1.2	1.4	1.6	1.7	2.0	2.0	2.0	2.0	2.0	2.3	3.0	3.6	4.1	4.4	4.4	4.1	3.9	3.2	2.4	1.5
51					1.0	1.3	1.5	1.7	1.9	2.1	2.1	2.1	2.1	2.1	2.4	3.2	3.9	4.4	4.7	4.7	4.4	4.1	3.4	2.6	1.7
52					1.1	1.4	1.6	1.9	2.0	2.3	2.3	2.3	2.3	2.3	2.6	3.5	4.1	4.7	5.0	5.0	4.7	4.4	3.6	2.8	1.8
53				1.0	1.2	1.5	1.7	2.0	2.1	2.5	2.5	2.5	2.5	2.5	2.8	3.7	4.4	5.0	5.3	5.3	5.0	4.7	3.9	3.0	2.0
54				1.1	1.3	1.6	1.9	2.1	2.3	2.6	2.6	2.6	2.6	2.6	3.0	4.0	4.7	5.3	5.7	5.7	5.3	5.0	4.1	3.2	2.2
55				1.2	1.4	1.7	2.0	2.3	2.4	2.8	2.8	2.8	2.8	2.8	3.2	4.3	5.0	5.7	6.1	6.1	5.7	5.3	4.4	3.5	2.3
56			1.0	1.3	1.5	1.9	2.2	2.4	2.6	3.0	3.0	3.0	3.0	3.0	3.5	4.6	5.3	6.1	6.5	6.5	6.1	5.7	4.7	3.7	2.5
57			1.1	1.4	1.7	2.0	2.4	2.6	2.8	3.2	3.2	3.2	3.2	3.2	3.7	5.0	5.7	6.5	7.0	7.0	6.5	6.1	5.0	4.0	2.8
58			1.2	1.5	1.8	2.2	2.6	2.8	3.0	3.5	3.5	3.5	3.5	3.5	4.0	5.3	6.1	7.0	7.5	7.5	7.0	6.5	5.3	4.3	3.0
59			1.3	1.7	2.0	2.4	2.8	3.0	3.2	3.7	3.7	3.7	3.7	3.7	4.3	5.7	6.5	7.5	8.0	8.0	7.5	7.0	5.7	4.6	3.3
60		1.0	1.4	1.8	2.2	2.6	3.0	3.2	3.5	4.0	4.0	4.0	4.0	4.0	4.6	6.1	7.0	8.0	8.7	8.7	8.0	7.5	6.1	5.0	3.6
61		1.1	1.5	2.0	2.4	2.8	3.2	3.5	3.7	4.3	4.3	4.3	4.3	4.3	5.0	6.5	7.5	8.7	9.3	9.3	8.7	8.0	6.5	5.3	3.9
62		1.2	1.7	2.2	2.6	3.0	3.5	3.7	4.0	4.6	4.6	4.6	4.6	4.6	5.3	7.0	8.0	9.3	10	10	9.3	8.7	7.0	5.7	4.2
63		1.3	1.8	2.4	2.8	3.2	3.7	4.0	4.3	4.9	4.9	4.9	4.9	4.9	5.7	7.5	8.7	10	11	11	10	9.3	7.5	6.1	4.6
64	1.0	1.5	2.0	2.6	3.0	3.5	4.0	4.3	4.6	5.3	5.3	5.3	5.3	5.3	6.1	8.0	9.3	11	11	11	11	10	8.0	6.5	5.0
65	1.1	1.6	2.2	2.8	3.2	3.7	4.3	4.6	5.0	5.7	5.7	5.7	5.7	5.7	6.6	8.7	10	11	12	12	11	11	8.7	7.0	5.3
66	1.2	1.8	2.4	3.0	3.5	4.0	4.6	5.0	5.4	6.1	6.1	6.1	6.1	6.1	7.0	9.3	11	12	13	13	12	11	9.3	7.5	5.7
67	1.4	2.0	2.6	3.3	3.7	4.3	5.0	5.4	5.9	6.5	6.5	6.5	6.5	6.5	7.5	10	11	13	14	14	13	12	10	8.0	6.1
68	1.6	2.2	2.8	3.6	4.0	4.6	5.4	5.9	6.4	7.0	7.0	7.0	7.0	7.0	8.0	11	12	14	15	15	14	13	11	8.7	6.5
69	1.8	2.3	3.0	3.9	4.3	5.0	5.9	6.4	6.9	7.5	7.5	7.5	7.5	7.5	8.7	71	13	15	16	16	16	14	11	9.3	7.0
70	2.0	2.5	3.3	4.2	4.6	5.4	6.4	6.9	7.5	8.0	8.0	8.0	8.0	8.0	9.3	12	14	16	17	17	16	15	12	10	7.5
71	2.2	2.8	3.6	4.6	5.0	5.9	6.9	7.5	8.0	8.6	8.6	8.6	8.6	8.6	10	13	15	17	19	19	17	16	13	11	8.0
72	2.3	3.0	3.9	5.0	5.4	6.4	7.5	8.0	8.7	9.2	9.2	9.2	9.2	9.2	11	14	16	19	20	20	19	17	14	11	8.7
73	2.5	3.3	4.2	5.4	5.9	6.9	8.0	8.7	9.3	9.8	9.8	9.8	9.8	9.8	11	15	17	20	21	21	20	19	15	12	9.3
74	2.6	3.7	4.6	5.9	6.4	7.5	8.7	9.3	10	10.6	10.6	10.6	10.6	10.6	12	16	19	21	23	23	21	20	16	13	10
75	3.0	4.1	5.0	6.4	6.9	8.0	9.3	10	11	11.3	11.3	11.3	11.3	11.3	13	17	20	23	24	24	23	21	17	14	11
76	3.3	4.5	5.4	6.9	7.5	8.7	10	11	11	12	12	12	12	12	14	19	21	24	26	26	24	23	19	15	11
77	3.7	5.0	5.9	7.5	8.3	9.3	11	11	12	13	13	13	13	13	15	20	23	26	28	28	26	24	20	16	12
78	4.1	5.4	6.4	8.3	9.1	10	11	12	13	14	14	14	14	14	16	21	24	28	30	30	28	26	21	17	13
79	4.5	5.9	6.9	9.1	10	11	12	13	14	15	15	15	15	15	17	23	26	30	32	32	30	28	23	19	14
80	5.0	6.4	7.5	10	11	11	13	14	15	16	16	16	16	16	19	24	28	32	35	35	32	30	24	20	15
81	5.5	6.9	8.3	11	11	12	14	15	16	17	17	17	17	17	20	26	30	35	37	37	35	32	26	21	16
82	6.1	7.5	9.1	11	12	13	15	16	17	18	18	18	18	18	21	28	32	37	40	40	37	35	28	23	17
83	6.8	8.3	10	12	13	14	16	17	19	20	20	20	20	20	23	30	35	40	42	42	40	37	30	24	19
84	7.5	9.1	12	13	14	16	17	19	20	21	21	21	21	21	24	32	37	42	45	45	42	40	32	26	20
85	8.3	10	13	14	15	16	19	20	21	23	23	23	23	23	26	35	40	45	47	47	45	42	35	28	21
86	9.1	12	13	16	16	17	20	21	23	24	24	24	24	24	28	37	42	47	50	50	47	45	37	30	23
87	10	13	14	16	17	19	21	23	24	26	26	26	26	26	30	40	45	50	55	55	50	47	40	32	24
88	11	13	15	17	19	20	23	24	26	28	28	28	28	28	32	42	47	55	60	60	55	50	42	35	26
89	12	14	16	19	20	21	24	26	28	30	30	30	30	30	35	46	50	60	63	63	60	55	45	37	28

TABLE 1A - (CONT'D.)

Noys (N) as a Function of Sound Pressure Level (SPL) - Cont'd.

Band Center Frequency in Hz(c/s)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Lp	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10,000	12,500
90	14	15	17	20	21	23	26	28	30	32	32	32	32	32	37	47	55	63	67	67	63	60	47	40	30
91	15	16	19	21	23	24	28	30	32	34	34	34	34	34	40	50	60	67	71	71	67	63	50	42	32
92	16	17	20	23	24	26	30	32	35	37	37	37	37	37	42	55	63	71	75	71	71	67	55	45	35
93	17	19	21	24	26	28	32	35	37	39	39	39	39	39	45	60	67	75	80	80	75	71	60	47	37
94	19	20	23	26	28	30	35	37	40	42	42	42	42	42	47	63	71	80	86	86	80	75	63	50	40
95	20	21	24	28	30	32	37	40	42	45	45	45	45	45	50	67	75	86	93	93	86	80	67	55	43
96	21	23	26	30	32	35	40	42	45	49	49	49	49	49	55	71	80	93	100	100	93	86	71	60	46
97	23	24	28	32	35	37	42	45	47	52	52	52	52	52	60	75	86	100	108	108	100	93	75	63	50
98	24	26	30	35	37	40	45	47	50	56	56	56	56	56	64	80	93	108	116	116	108	100	80	67	55
99	26	28	32	37	40	42	47	50	55	60	60	60	60	60	69	86	100	116	125	125	116	108	86	71	60
100	28	30	35	40	42	45	50	55	60	64	64	64	64	64	74	93	108	125	133	133	125	116	93	75	63
101	30	32	37	42	45	47	55	60	64	69	69	69	69	69	79	100	116	133	142	142	133	125	100	80	67
102	32	35	40	45	47	50	60	64	69	74	74	74	74	74	84	108	125	142	150	150	142	133	108	86	71
103	35	37	42	47	50	55	64	69	74	79	79	79	79	79	91	116	133	150	162	162	150	142	116	93	75
104	37	40	45	50	55	60	69	74	79	84	84	84	84	84	97	125	142	162	173	173	162	150	125	100	80
105	40	42	47	55	60	64	74	79	84	91	91	91	91	91	104	133	150	173	186	186	173	162	133	108	86
106	42	45	50	60	64	69	79	84	91	97	97	97	97	97	111	142	162	186	200	200	186	173	142	116	93
107	45	47	55	64	69	74	84	91	97	104	104	104	104	104	119	150	173	200	215	215	200	186	150	125	100
108	47	50	60	69	74	79	91	97	104	111	111	111	111	111	128	162	186	215	232	232	215	200	162	133	108
109	50	55	64	74	79	84	97	104	111	119	119	119	119	119	137	173	200	232	250	250	232	215	173	142	116
110	55	60	69	79	84	91	104	111	119	128	128	128	128	128	147	186	215	250	266	266	250	232	186	150	125
111	60	64	74	84	91	97	111	119	128	137	137	137	137	137	158	200	232	266	284	284	200	250	200	162	133
112	64	69	79	91	97	104	119	128	137	147	147	147	147	147	169	215	250	284	300	300	284	266	215	173	142
113	69	74	84	97	104	111	128	137	147	158	158	158	158	158	181	232	266	300	324	324	300	284	232	186	150
114	74	79	91	104	111	119	137	147	158	169	169	169	169	169	194	250	284	324	346	346	324	300	250	200	162
115	79	84	97	111	119	128	147	158	169	181	181	181	181	181	208	266	300	346	372	372	346	324	266	215	173
116	84	91	104	119	128	137	158	169	181	194	194	194	194	194	223	284	324	372	400	400	372	346	284	232	186
117	91	97	111	128	137	147	169	181	194	208	208	208	208	208	239	300	346	400	430	430	400	372	300	250	200
118	97	104	119	137	147	158	181	194	208	223	223	223	223	223	256	324	372	430	464	464	430	400	324	266	215
119	104	111	128	147	158	169	194	208	223	239	239	239	239	239	274	346	400	464	500	500	464	430	346	284	232
120	111	119	137	158	169	181	208	223	239	256	256	256	256	256	294	372	430	500	532	532	500	464	372	300	250
121	119	128	147	169	181	194	223	239	260	274	274	274	274	274	315	400	464	532	568	568	532	500	400	324	266
122	128	137	158	181	194	208	239	256	274	294	294	294	294	294	338	430	500	568	600	600	568	532	430	346	284
123	137	147	169	194	208	223	256	274	294	315	315	315	315	315	362	464	532	600	648	648	600	568	464	372	300
124	147	158	181	208	223	239	274	294	315	338	338	338	338	338	388	500	568	648	692	692	648	600	500	400	324
125	158	169	194	223	239	256	294	315	338	362	362	362	362	362	416	532	600	692	744	744	692	648	532	430	346
126	169	181	208	239	256	274	315	338	362	388	388	388	388	388	446	568	648	744	800	800	744	692	568	464	372
127	181	194	223	256	274	294	338	362	388	416	416	416	416	416	478	600	692	800	860	860	800	744	600	500	400
128	194	208	239	274	294	315	362	388	416	446	446	446	446	446	512	648	744	860	928	928	860	800	648	532	430
129	208	223	256	294	315	338	388	416	446	478	478	478	478	478	549	692	800	928	1000	1000	928	860	692	568	464
130	223	239	274	315	338	362	416	446	478	512	512	512	512	512	588	744	860	1000	1064	1064	1000	928	744	600	500
131	239	256	294	338	362	388	446	478	512	549	549	549	549	549	630	800	928	1064	1136	1136	1064	1000	800	648	532
132	256	274	315	362	388	416	478	512	549	588	588	588	588	588	676	860	1000	1136	1200	1200	1136	1064	860	692	568
133	274	294	338	388	416	446	512	549	588	630	630	630	630	630	724	928	1064	1200	1296	1296	1200	1136	928	744	600
134	294	315	362	416	446	478	549	588	630	676	676	676	676	676	776	1000	1136	1296	1384	1384	1296	1200	1000	800	648
135	315	338	388	446	478	512	588	630	676	724	724	724	724	724	832	1064	1200	1384	1488	1488	1384	1296	1064	860	692
136	338	362	416	478	512	549	630	676	724	776	776	776	776	776	891	1136	1296	1488	1600	1600	1488	1384	1136	928	744
137	362	388	446	512	549	588	676	724	776	832	832	832	832	832	955	1200	1384	1600	1720	1720	1600	1488	1200	1000	800
138	388	416	478	549	588	630	724	776	832	891	891	891	891	891	1024	1296	1488	1720	1856	1856	1720	1600	1296	1064	860
139	416	446	512	588	630	676	776	832	891	955	955	955	955	955	1098	1384	1600	1856	2000	2000	1856	1720	1384	1136	928
140	446	478	549	630	676	724	832	891	955	1024	1024	1024	1024	1024	1176	1488	1720	2000			2000	1856	1488	1200	1000
141	478	512	588	676	724	776	891	955	1024	1098	1098	1098	1098	1098	1261	1600	1856					2000	1600	1296	1064
142	512	549	630	724	776	832	955	1024	1098	1176	1176	1176	1176	1176	1351	1720	2000						1720	1384	1136
143	549	588	676	776	832	891	1024	1098	1176	1261	1261	1261	1261	1261	1448	1856							1856	1488	1200
144	588	630	724	832	891	955	1098	1176	1261	1351	1351	1351	1351	1351	1552	2000							2000	1600	1296
145	630	676	776	891	955	1024	1176	1261	1351	1448	1448	1448	1448	1448	1663									1720	1384
146	676	724	832	955	1024	1098	1261	1351	1448	1552	1552	1552	1552	1552	1783									1856	1488
147	724	776	891	1024	1098	1176	1351	1448	1552	1663	1663	1663	1663	1663	1911									2000	1600
148	776	832	955	1098	1176	1261	1448	1552	1663	1783	1783	1783	1783	1783											1720
149	832	891	1024	1176	1261	1351	1552	1663	1783	1911	1911	1911	1911	1911											2000
150	891	955	1098	1261	1351	1448	1663	1783	1911																

TABLE 2A

Conversion of N to PNL

N, Noys Lower	N, Noys Mid	N, Noys Upper	PNL PNdB
1.0	1.0	1.0	40
1.1	1.1	1.1	41
1.1	1.1	1.2	42
1.2	1.2	1.3	43
1.3	1.3	1.4	44
1.4	1.4	1.5	45
1.5	1.5	1.6	46
1.6	1.6	1.7	47
1.7	1.7	1.8	48
1.8	1.9	1.9	49
2.0	2.0	2.1	50
2.1	2.1	2.2	51
2.3	2.3	2.4	52
2.5	2.5	2.5	53
2.6	2.6	2.7	54
2.8	2.8	2.9	55
3.0	3.0	3.1	56
3.2	3.2	3.4	57
3.5	3.5	3.6	58
3.7	3.7	3.9	59
4.0	4.0	4.1	60
4.2	4.3	4.4	61
4.5	4.6	4.7	62
4.8	4.9	5.1	63
5.2	5.3	5.5	64
5.6	5.6	5.8	65
5.9	6.1	6.3	66
6.4	6.5	6.7	67
6.8	7.0	7.2	68
7.3	7.5	7.7	69
7.8	8.0	8.3	70
8.4	8.6	8.9	71
9.0	9.2	9.5	72
9.6	9.8	10.2	73
10.3	10.6	10.9	74
11.0	11.3	11.7	75
11.8	12.1	12.5	76
12.6	13.0	13.5	77
13.6	13.9	14.4	78
14.5	14.9	15.4	79

N, Noys Lower	N, Noys Mid	N, Noys Upper	PNL PNdB
15.5	16.0	16.6	80
16.7	17.1	17.7	81
17.8	18.4	19.0	82
19.1	19.7	20.4	83
20.5	21.1	21.8	84
21.9	22.6	23.4	85
23.5	24.2	25.1	86
25.2	26.0	26.9	87
27.0	27.9	28.8	88
28.9	29.9	30.9	89
31.0	32.0	33.1	90
33.2	34.3	35.5	91
35.6	36.8	38.1	92
38.2	39.4	40.8	93
40.9	42.2	43.7	94
43.8	45.2	46.8	95
46.9	48.5	50.2	96
50.3	52.0	53.8	97
53.9	55.7	57.7	98
57.8	59.7	61.8	99
61.9	64.0	66.3	100
66.4	68.6	71.0	101
71.1	73.5	76.1	102
76.2	78.8	81.6	103
81.7	84.4	87.4	104
87.5	90.5	93.7	105
93.8	97.0	100.4	106
100.5	104.0	107.6	107
107.7	111.4	115.3	108
115.4	119.4	123.6	109
123.7	128.0	132.5	110
132.6	137.2	142.0	111
142.1	147.0	152.2	112
152.3	157.6	163.1	113
163.2	168.9	174.8	114
174.9	181.0	187.4	115
187.5	194.0	200.8	116
200.9	207.9	215.3	117
215.4	222.8	230.7	118
230.8	238.8	247.3	119

N, Noys Lower	N, Noys Mid	N, Noys Upper	PNL PNdB
247.4	256.0	265.0	120
265.1	274.4	284.0	121
284.1	294.0	304.4	122
304.5	315.2	326.3	123
326.4	337.8	349.7	124
349.8	362.0	374.8	125
374.9	388.0	401.7	126
401.8	415.8	430.5	127
430.6	445.7	461.4	128
461.5	477.7	494.5	129
494.6	512.0	530.0	130
530.1	548.7	568.1	131
568.2	588.1	608.9	132
609.0	630.3	652.6	133
652.7	675.6	699.4	134
699.5	724.1	749.6	135
749.7	776.0	803.3	136
803.4	831.7	861.1	137
861.2	891.4	922.9	138
923.0	955.4	989.1	139
989.2	1024.0	1060.1	140
1060.2	1097.5	1136.1	141
1136.2	1176.2	1217.7	142
1217.8	1260.6	1305.1	143
1305.2	1351.1	1398.8	144
1398.9	1448.2	1499.1	145
1499.2	1552.1	1606.7	146
1606.8	1663.4	1722.1	147
1722.2	1782.8	1845.7	148
1845.8	1910.7	1978.2	149

Table 3A - Corrections to be Added* to Perceived Noise Levels to Account for Discrete Frequency Components

Band Center Frequency, H_z	Differences in SPL of Toned Band Above Non-Toned Adjacent Bands - dB													
	1	2	3	4	6	8	10	12	14	16	18	20	25	30
100	0.0	0.0	0.0	0.0	.1	.4	.6	.8	.9	1.1	1.2	1.4	1.8	2.3
125	0.0	0.0	0.0	0.0	.4	.7	.9	1.1	1.2	1.4	1.6	1.8	2.4	3.1
160	0.0	0.0	0.0	.3	.7	.9	1.2	1.4	1.6	1.[illegible]	2.1	2.4	3.2	4.2
200	0.0	.3	.4	.6	.9	1.2	1.4	1.7	2.0	1.3	1.7	3.1	4.2	5.4
250	0.0	.5	.7	.9	1.1	1.4	1.7	2.0	2.4	2.8	3.2	3.7	5.0	6.5
315	0.0	.8	.9	1.1	1.3	1.7	2.0	2.4	2.8	3.3	2.8	4.4	6.0	7.8
400	0.0	.9	1.1	1.2	1.5	1.9	2.3	2.8	3.3	3.9	4.5	5.2	7.0	9.2
500	0.0	1.1	1.2	1.4	1.8	2.2	2.7	3.3	3.9	4.5	5.3	6.0	8.2	10.7
630	0.0	1.2	1.3	1.5	2.0	2.4	3.0	3.6	4.3	5.0	5.8	6.7	9.1	11.9
700	0.0	1.2	1.4	1.6	2.0	2.5	3.1	3.7	4.4	4.2	6.0	6.9	9.4	12.2
800	0.0	1.2	1.4	1.6	2.0	2.5	3.1	3.7	4.4	5.2	6.0	6.9	9.4	12.2
1000	0.0	1.1	1.3	1.5	1.9	2.4	3.0	3.6	4.2	5.0	5.8	6.6	9.0	11.8
1250	0.0	1.1	1.2	1.4	1.8	2.3	2.8	3.4	4.0	4.7	5.4	6.2	8.4	11.0
1600	.4	1.1	1.2	1.4	1.8	2.3	2.8	3.4	4.0	4.7	5.4	6.2	8.5	11.0
2000	.8	1.1	1.3	1.5	1.9	2.4	2.9	3.5	4.1	4.8	5.6	6.4	8.8	11.5
2500	1.1	1.2	1.4	1.6	2.1	2.6	3.2	3.9	4.6	5.4	6.3	7.2	9.8	12.8
3150	1.2	1.4	1.6	1.9	2.4	3.0	3.8	4.5	5.4	6.3	7.4	8.5	11.5	15.1
3300	1.2	1.4	1.6	1.9	2.4	3.1	3.8	4.6	5.4	6.4	7.4	8.5	11.6	15.2
4000	1.1	1.3	1.5	1.8	2.3	2.8	3.5	4.2	5.0	5.9	6.9	7.9	10.7	14.1
5000	.6	1.1	1.3	1.5	1.9	2.4	3.0	3.6	4.2	5.0	5.8	6.6	9.0	11.8
6300	0.0	0.0	1.1	1.3	1.6	2.0	2.4	2.9	3.4	4.0	4.7	5.4	7.3	9.5
8000	0.0	0.0	0.0	0.0	1.2	1.5	1.8	2.2	2.5	3.0	3.4	3.9	5.3	6.9
10000	0.0	0.0	0.0	0.0	0.0	0.0	1.2	1.5	1.7	2.0	2.3	2.6	3.5	4.5

* Corrections for tones are added <u>after</u> usual PNL calculation

CORRECTIONS TO BE ADDED* TO CALCULATED PERCEIVED NOISE LEVELS TO ACCOUNT FOR DISCRETE FREQUENCY COMPONENTS

*Corrections for tones are added after usual PNL calculation.

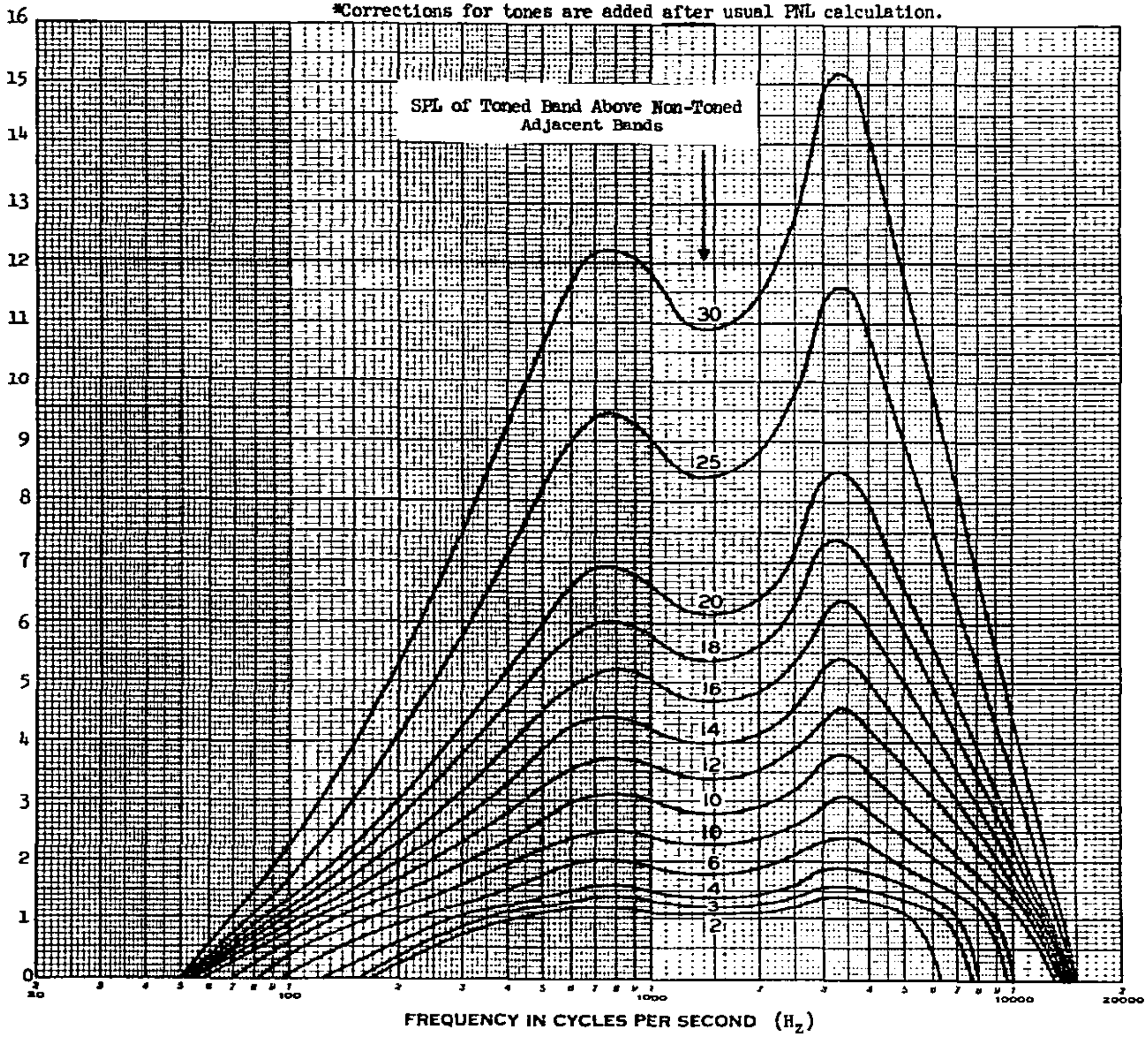


FIGURE 1A

APPENDIX B

AIRCRAFT NOISE CHARACTERISTICS

This appendix provides the takeoff and landing noise characteristics of current jet transport aircraft in terms of effective perceived noise levels as a function of number of engines and altitude or distance from the aircraft. These noise levels were calculated from data recorded during flyover operations of an aircraft powered by four JT3D turbofan engines and an aircraft powered by two JT8D turbofan engines. The techniques used to develop these data and the differences between the noise levels of these two aircraft types and other current aircraft types are discussed.

The basis for the calculations was data obtained from several magnetic tape recordings of flyover noise data at various engine power settings and various distances between the aircraft and the recording station. These tape recordings were analyzed with a data analysis system that samples instantaneous one-third octave band sound pressure levels (SPL's) at regular intervals during the flyover cycle. The system utilized an analog dc voltage readout proportional to the position of the writing pen on a graphic level recorder; the internal damping of the level recorder was adjusted so that the indicated SPL, at any given instant of time, would equal that which would be read on the meter of a precision sound level meter set for high damping, i.e., "slow" scale. The rate of sampling the trace on the level recorder was once every 0.5 seconds.

Instantaneous PNL's were determined at each 0.5 second interval. Each instantaneous PNL was then corrected for the presence of pure tones as discussed in Appendix A. Effective PNL's were determined by adding a duration correction developed in accordance with the procedures given in Appendix A to the maximum value of the tone corrected PNL. The calculation procedure was repeated for various flyover noise tape recordings at several engine power settings and altitudes. Curves of EPNL vs. altitude for several net thrust levels for four engine and two engine turbofan powered commercial jet transports were constructed by adding duration corrections and tone corrections (differences between peak tone corrected PNL and instantaneous PNL) for various altitude and power settings to existing curves of composite PNL that had been previously obtained for each type of aircraft. The data were extrapolated to different distances by applying corrections for spherical divergence and air attenuation for standard day conditions at 70% relative humidity. Additional curves of EPNL vs. distance were developed which include ground to ground attenuation as well as spherical divergence and extra air attenuation. These curves are shown in Figures 1B and 2B.

While the analysis procedure described above differs in minor respects from that discussed in Appendix A, it is believed to provide the most reliable estimates of effective PNL's possible with currently available data.

Similar determinations of the EPNL characteristics of other transport aircraft have not been made. However, assumptions based on octave band sound pressure level and PNL determinations which have been made for other aircraft permit a fairly reliable estimate of their EPNL characteristics relative to those of the aircraft which have been evaluated.

Most two and three engine jet transport aircraft in this country are powered by the JT8D engine. To obtain the EPNL's for a three engine aircraft one need only add 2 EPNdB to the levels for a two engine aircraft at any given thrust. The few aircraft in these two categories which use other engines may be approximated by the data for the JT8D engine without introducing serious error in the resulting NEF value.

In the case of four engine jet transports there are currently a number of aircraft which use engines other than the JT3D-3B with short fan discharge ducts. Those having noise characteristics which are significantly different in terms of PNL's from the levels of the JT3D-3B are those equippped with RCo 12 engines and those equipped with JT3D-3B engines in the long fan discharge duct installation. The RCo 12 engine generates PNL's which are about 4 PNdB higher than those of the JT3D-3B at takeoff thrust. However, since aircraft equipped with these engines are small in number, JT3D-3B noise data can be used without significant error. Long duct installations of the JT3D-3B engine currently in use have resulted in levels which are lower at takeoff and landing thrust than with the short duct installation. However, the relative number of aircraft so equipped will be small in the time period being considered, and the JT3D-3B short duct noise data can be used without significant error.

In the case of aircraft using other turbojet engines with suppressors such as the JT4A-3 and JT4A-9, the differences in noise level relative to the JT3D-3B appear to be small. Differences in performance are presented in Appendix C.

It should be re-emphasized that the EPNL's presented are not the equivalent of the more familiar PNL. The differences between them are dependent upon tone content and duration. The differences obtained for the JT3D-3B short duct engine and the JT8D-1 engine at takeoff thrust and at a typical landing thrust are illustrated in Figure 3B.

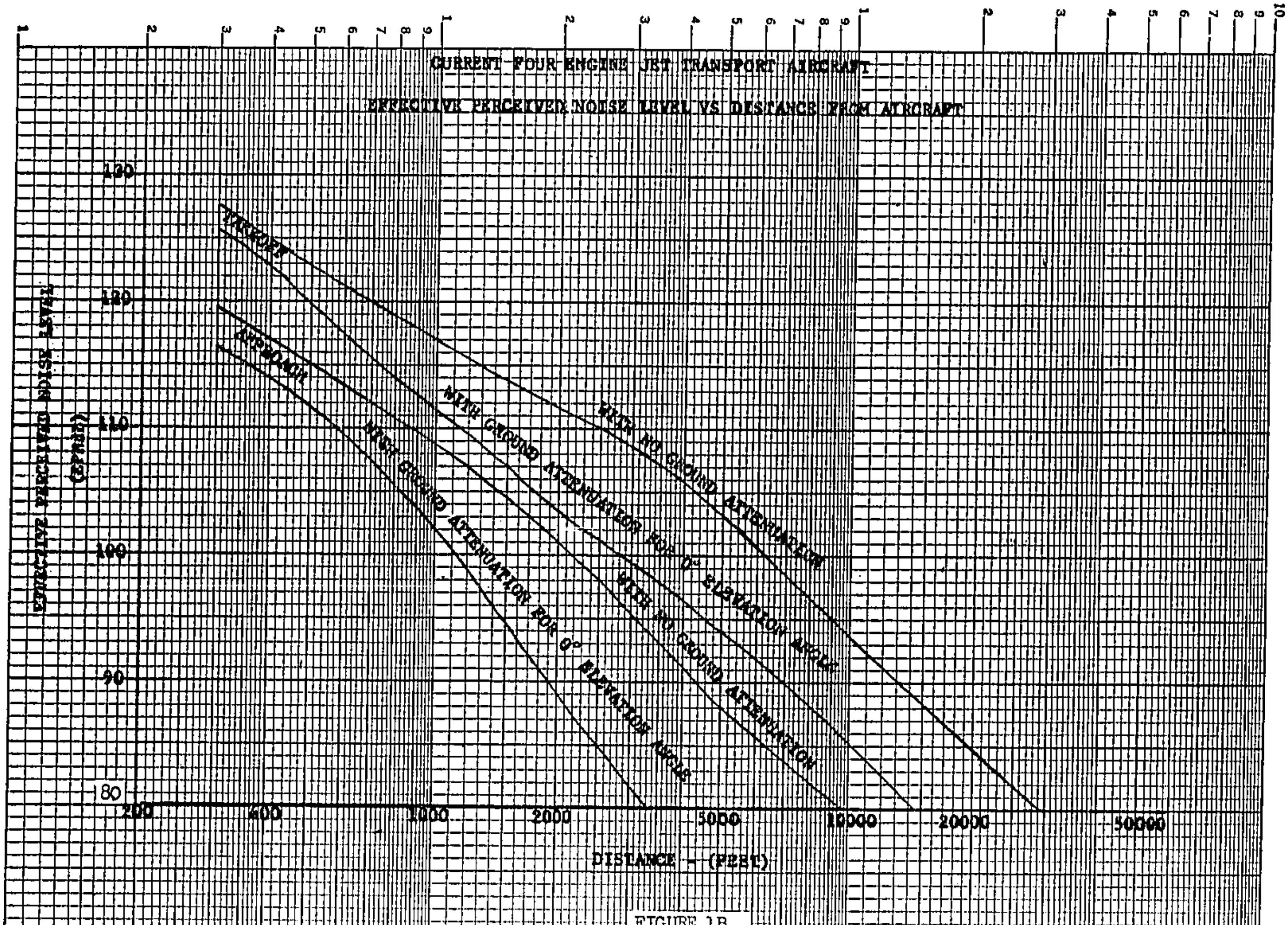
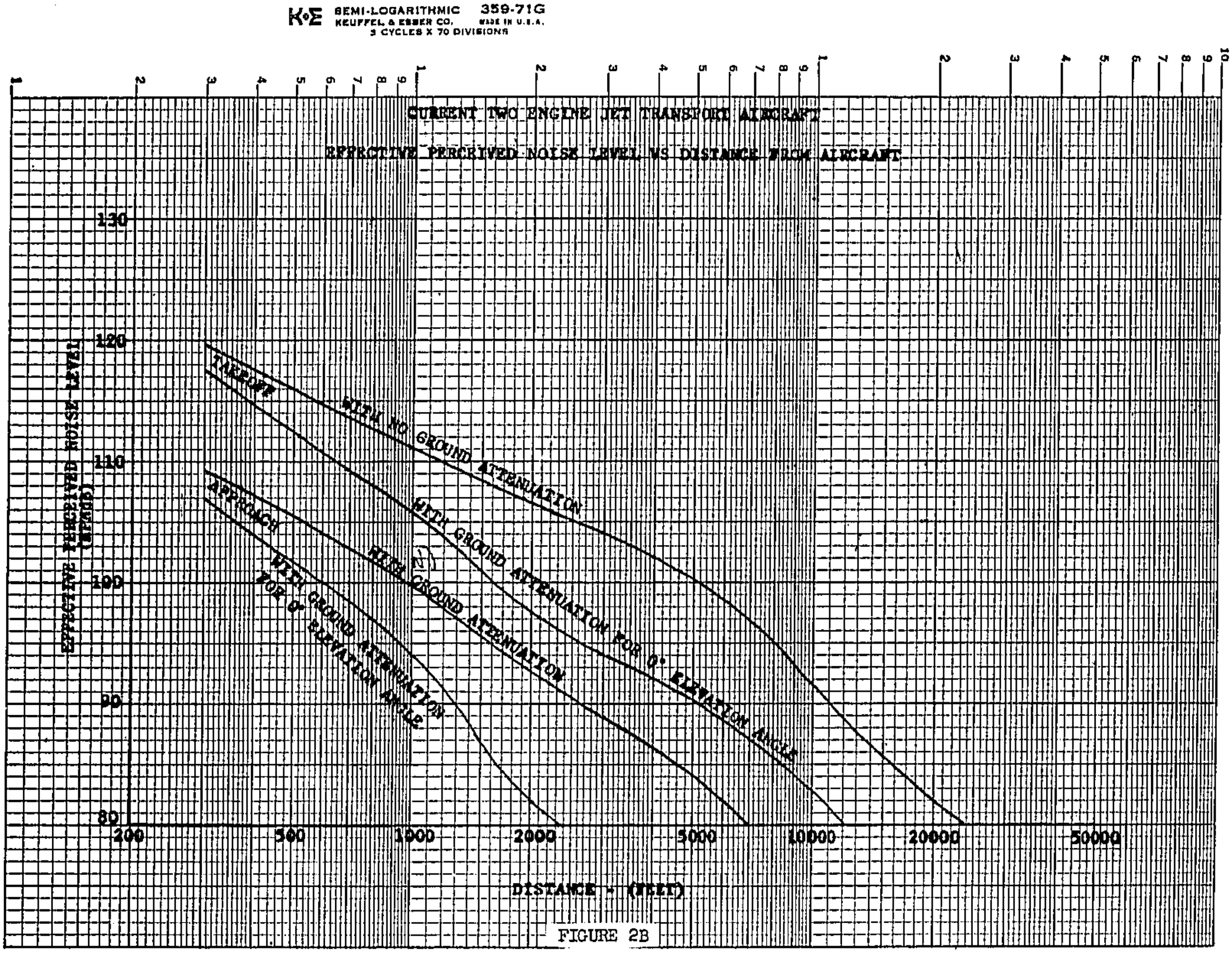

CURRENT FOUR ENGINE JET TRANSPORT AIRCRAFT
EFFECTIVE PERCEIVED NOISE LEVEL VS DISTANCE FROM AIRCRAFT
EFFECTIVE PERCEIVED NOISE LEVEL
(EPNdB)
120
110
100
90
80
TAKEOFF
APPROACH
WITH NO GROUND ATTENUATION
WITH GROUND ATTENUATION FOR 0° ELEVATION ANGLE
WITH NO GROUND ATTENUATION
WITH GROUND ATTENUATION FOR 0° ELEVATION ANGLE
200
400
1000
2000
5000
10000
20000
50000
DISTANCE - (FEET)

FIGURE 1B


K+E SEMI-LOGARITHMIC 359-71G
KEUFFEL & ESSER CO. MADE IN U.S.A.
3 CYCLES X 70 DIVISIONS
CURRENT TWO ENGINE JET TRANSPORT AIRCRAFT
EFFECTIVE PERCEIVED NOISE LEVEL VS DISTANCE FROM AIRCRAFT
EFFECTIVE PERCEIVED NOISE LEVEL (EPNdB)
130
120
110
100
90
80
TAKEOFF
WITH NO GROUND ATTENUATION
WITH GROUND ATTENUATION FOR 0° ELEVATION ANGLE
APPROACH
WITH GROUND ATTENUATION
WITH GROUND ATTENUATION FOR 0° ELEVATION ANGLE
200
500
1000
2000
5000
10000
20000
50000
DISTANCE - (FEET)
FIGURE 2B

DIFFERENCES BETWEEN

PERCEIVED NOISE LEVEL AND EFFECTIVE PERCEIVED NOISE LEVEL

AS A FUNCTION OF ALTITUDE

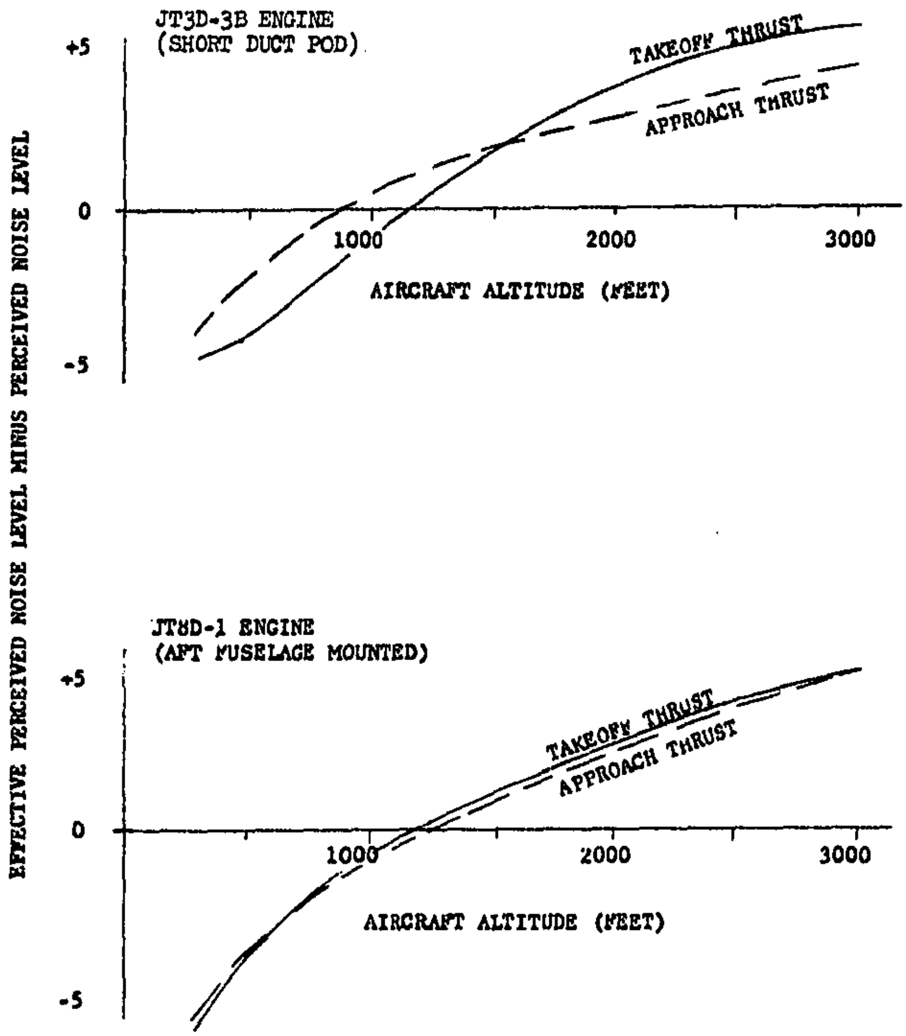


FIGURE 3B

APPENDIX C

AIRCRAFT PERFORMANCE

This Appendix presents the general takeoff and landing profiles used in conjunction with noise vs. distance data to obtain noise level contours for operations of the various aircraft.

TAKEOFF

The takeoff and climb performance capabilities of an aircraft are dependent upon many factors such as gross weight, runway elevation, drag, lift, total engine thrust and weather conditions. Fortunately, for the purpose of noise level evaluations, most of these factors can be treated in a fairly simple manner.

Figure 1C provides a set of five takeoff profiles denoted A, B, C, D and E representing the range of takeoff profiles for all conventional commercial jet transport aircraft at all operating gross weights. The interval between profiles was selected on the basis of roughly equal differences in EPNL below the flight path. For example, at 20,000 feet from brake release and directly below the flight path, the differences in noise level resulting from any two adjacent profiles for a takeoff thrust setting of the JT3D engine would be approximately 2.8 EPNdB.

In practice there will be some variations from these profiles for any given airplane. Takeoff thrust is rarely used above an altitude of 2,000 feet. There is usually some acceleration, a flap retraction and a reduction in engine power to maximum continuous thrust. However, these practices are not standardized and in most cases will not produce significant changes in noise levels. For example, reduction in noise resulting from reduced thrust normally results in a reduced climb angle. The lower altitude would tend to offset the reduction in noise generated. For the purpose of this evaluation the profiles are all for maximum takeoff thrust. Reductions in thrust which result in greatly reduced climb gradients are not considered in this analysis.

The proper profile to be used for any aircraft type will depend upon the type of engines and the gross weight of the aircraft. Figures 2C, 3C, and 4C have been included to permit the determination of the proper profile for any conventional two, three or four engine jet transport aircraft at any operating gross weight. Figure 2C relates the proper profile to the gross weight of four engine jet transport aircraft. Figure 3C provides a simplification of the information in Figure 2C by dividing the four engine aircraft into two classes. This simplification may be used with a loss in accuracy of about ± 1 EPNdB.

Four engine jet transport aircraft powered by JT3C-7 engines have not been included in Figure 2C. The JT3C-7 engine is used only on intermediate range aircraft which operate at much lower gross takeoff weights than those shown. Aircraft with these engines are being phased out. For takeoff operations of the decreasing number still in use, appropriate takeoff profiles may be approximated by adding 80,000 to their takeoff gross weight and using the lower line in Figure 3C.

Figures 2C through 4C select the proper profile for a temperature condition of 84°F and no wind. Any headwind or lower temperature would improve the climbout capability and any tailwind or higher temperature would have the opposite effect.

APPROACH

Conventional angles of descent for instrument approaches vary from about 2-1/2 to 3 degrees. Visual approaches may be at slightly higher angles. For the purposes of this evaluation technique an angle of 3^{0} has been used. Figure 5C relates altitude to distance from touchdown for this condition. (Note that the touchdown point is not on the end of the runway but is generally about 1000 feet from the landing threshold.)

There will be variations in noise levels during approach for a given aircraft type due to different engine thrust requirements as a function of aircraft gross weight. Average approach thrusts were used in establishing the approach thrust noise level curves in Figures 1B and 2B.

CURRENT JET TRANSPORT AIRCRAFT

TAKEOFF PROFILES - ALL ENGINES OPERATING

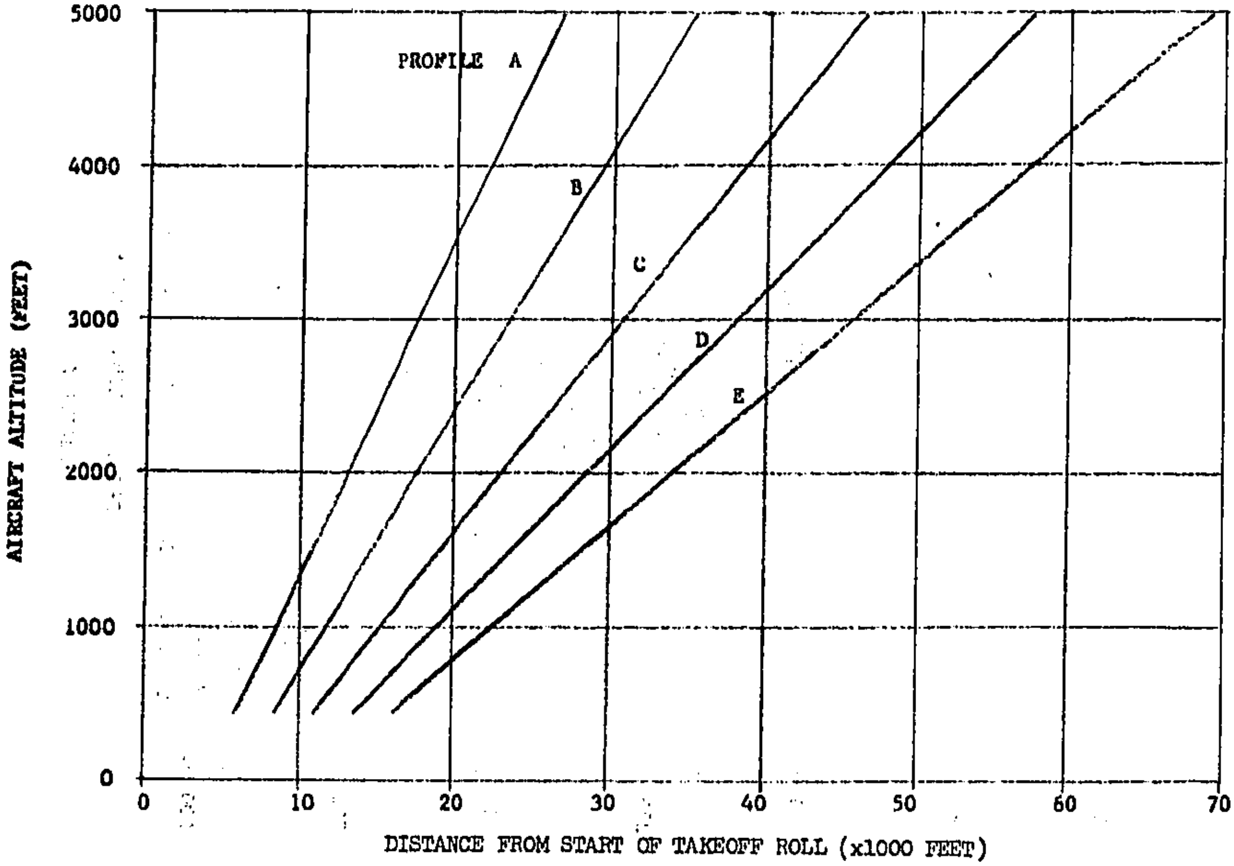


FIGURE 1C

CURRENT FOUR ENGINE JET TRANSPORT AIRCRAFT

APPROPRIATE TAKEOFF PROFILE

AS A FUNCTION OF TAKEOFF GROSS WEIGHT

84° SEA LEVEL NO WIND

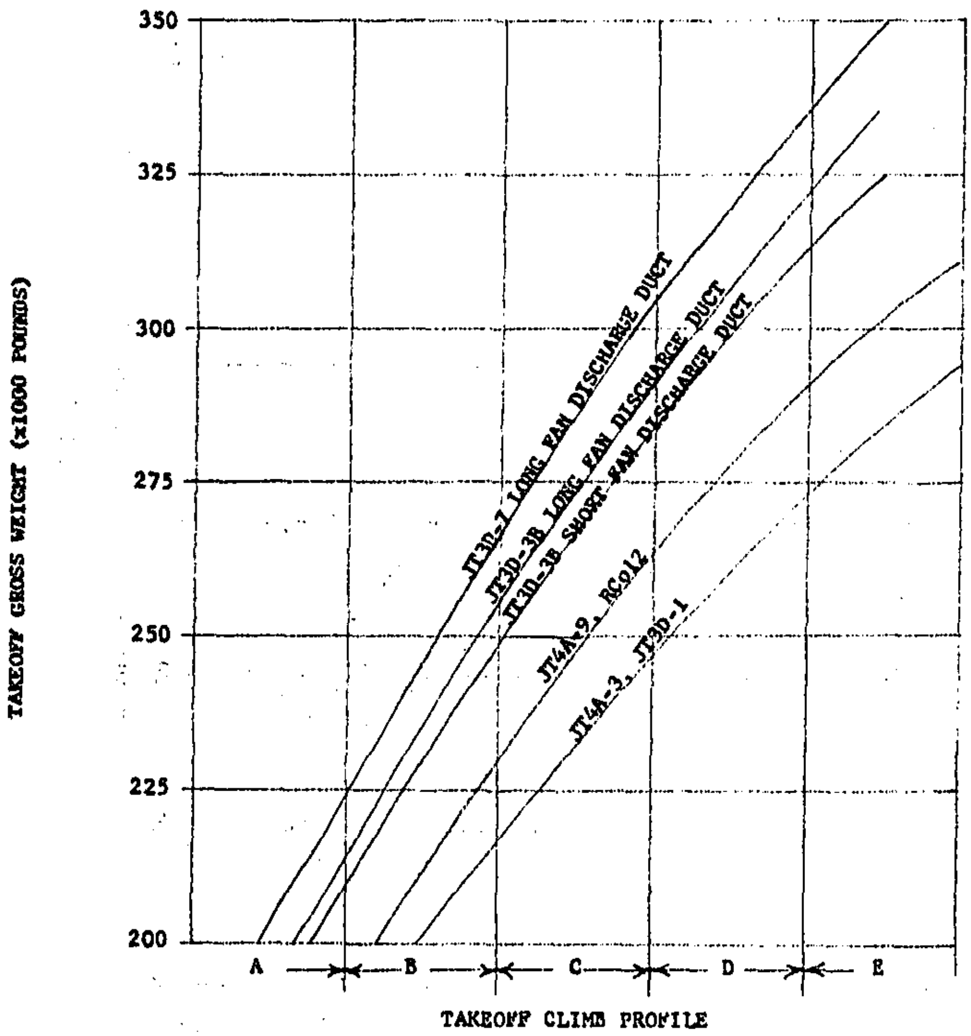


FIGURE 2C

CURRENT FOUR ENGINE JET TRANSPORT AIRCRAFT

APPROPRIATE TAKEOFF PROFILE AS A

FUNCTION OF TAKEOFF GROSS WEIGHT

84°F SEA LEVEL NO WIND

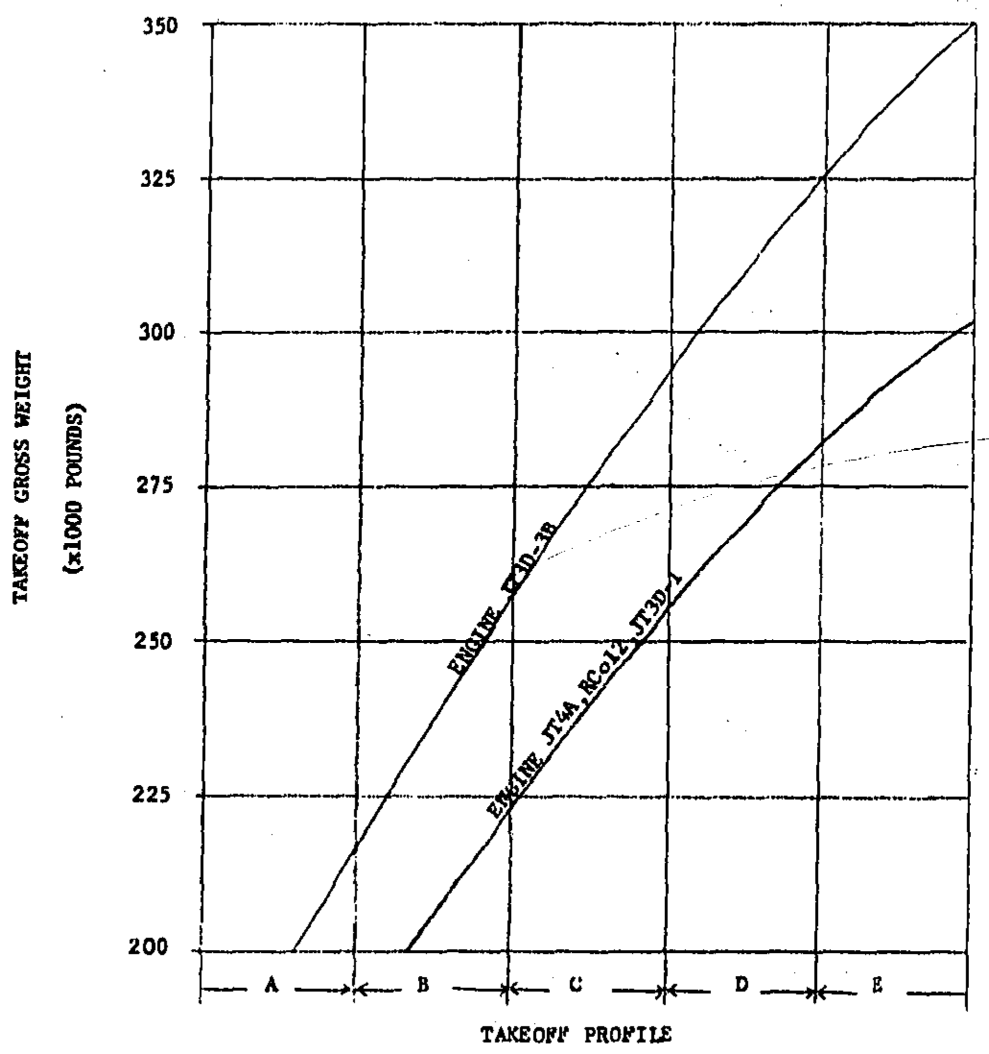


FIGURE 3C

CURRENT TWO AND THREE ENGINE JET TRANSPORT AIRCRAFT

APPROPRIATE TAKEOFF PROFILE AS A FUNCTION

OF TAKEOFF GROSS WEIGHT

84°F SEA LEVEL NO WIND

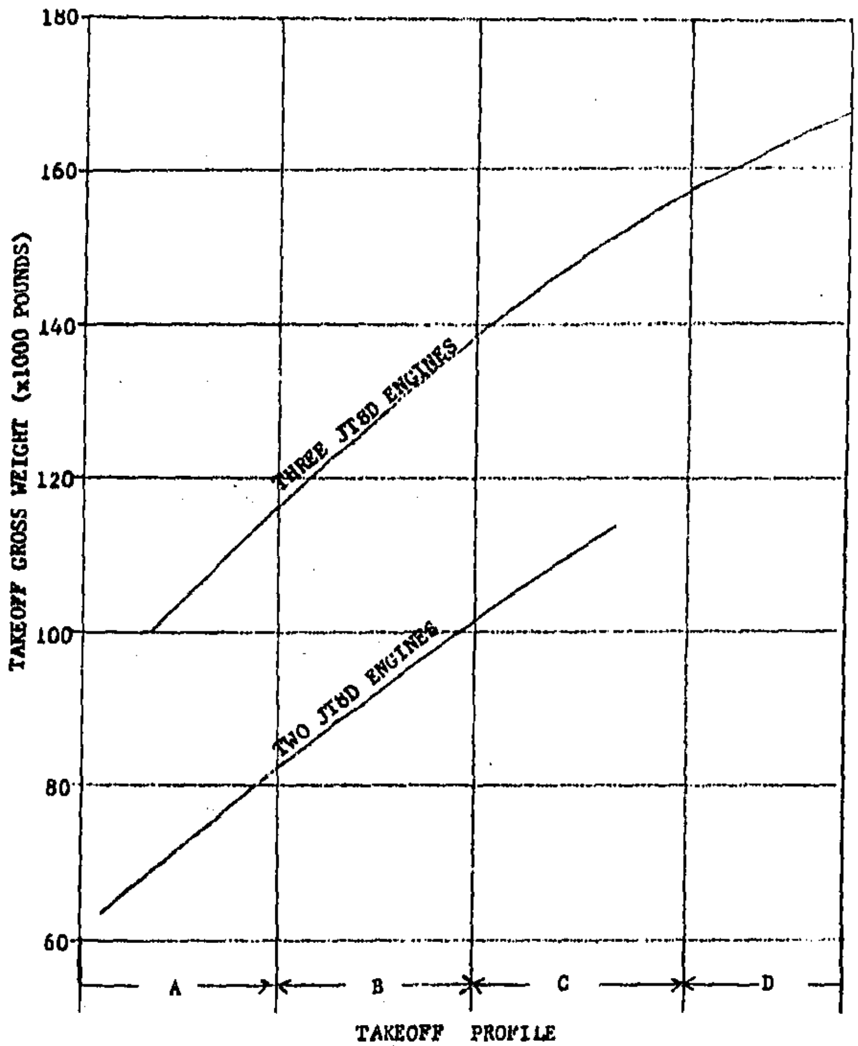


FIGURE 4C

CURRENT JET TRANSPORT AIRCRAFT

APPROACH PROFILE WITH A THREE DEGREE GLIDE SLOPE

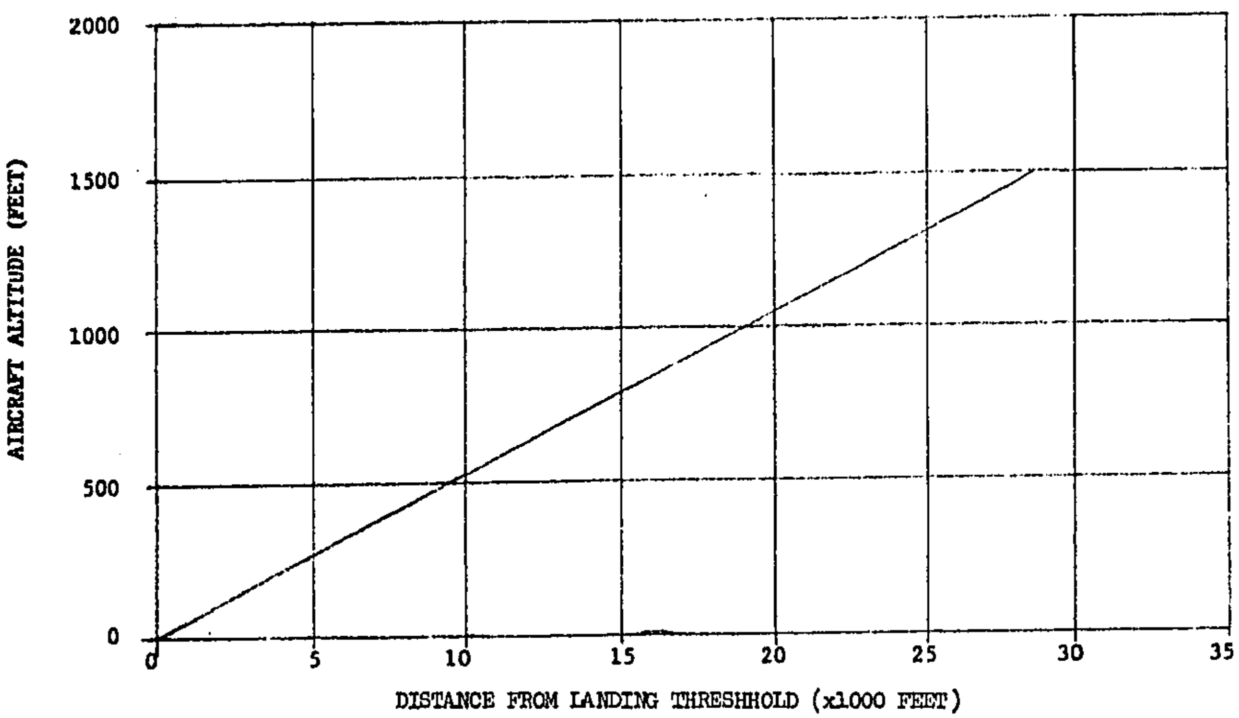


FIGURE 5C

APPENDIX D

EFFECTIVE PERCEIVED NOISE LEVEL CONTOURS AND TABLES

This appendix provides EPNL data for specific flight profiles and number of engines for current jet transports.

Detailed data are not available at this time for the next generation of large jet transport aircraft powered by the new high bypass ratio turbofan engines.

The newer engines will be quieter than current engines at both takeoff and approach thrusts. However, aircraft using these engines will be limited in number for the next few years and should not have a strong influence on NEF levels. It is recommended, therefore, that noise level contours for the current aircraft having the same number of engines be used for these new type aircraft.

No contours for supersonic transports have been included. The limited data available at the present time do not permit the type of analysis presented for current aircraft. However, when appropriate data become available they may be incorporated into the NEF's and treated in the same manner as current aircraft.

These contours are less accurate to the side when the aircraft is at low altitude where ground attenuation is an important factor.

Each contour and grid value set is identified by its flight profile letter (see Figure 1C) and the number of engines. For example, Figure 1D represents a contour set for flight profile A for two engine aircraft A2).

TAKEOFF EPNL CONTOUR SET A2

CURRENT TWO ENGINE AIRCRAFT

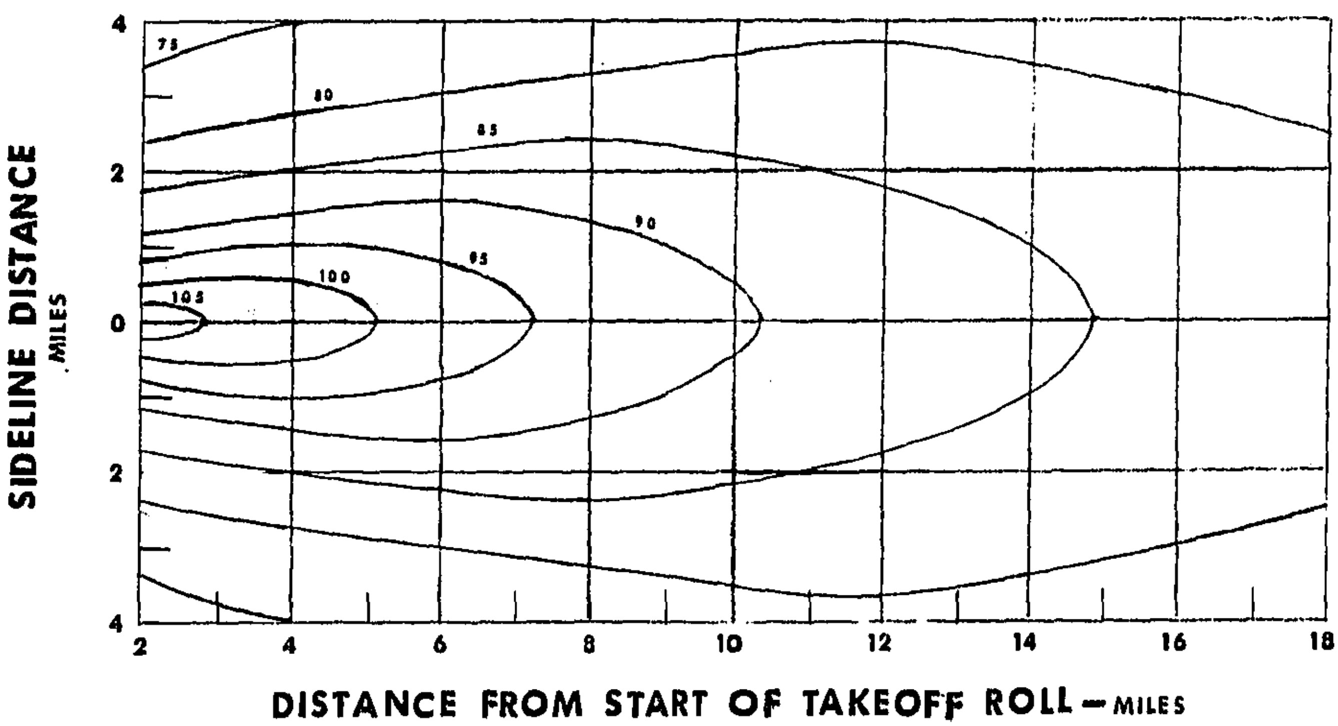


FIGURE 1D

TAKEOFF EPNL CONTOUR SET B2

CURRENT TWO ENGINE AIRCRAFT

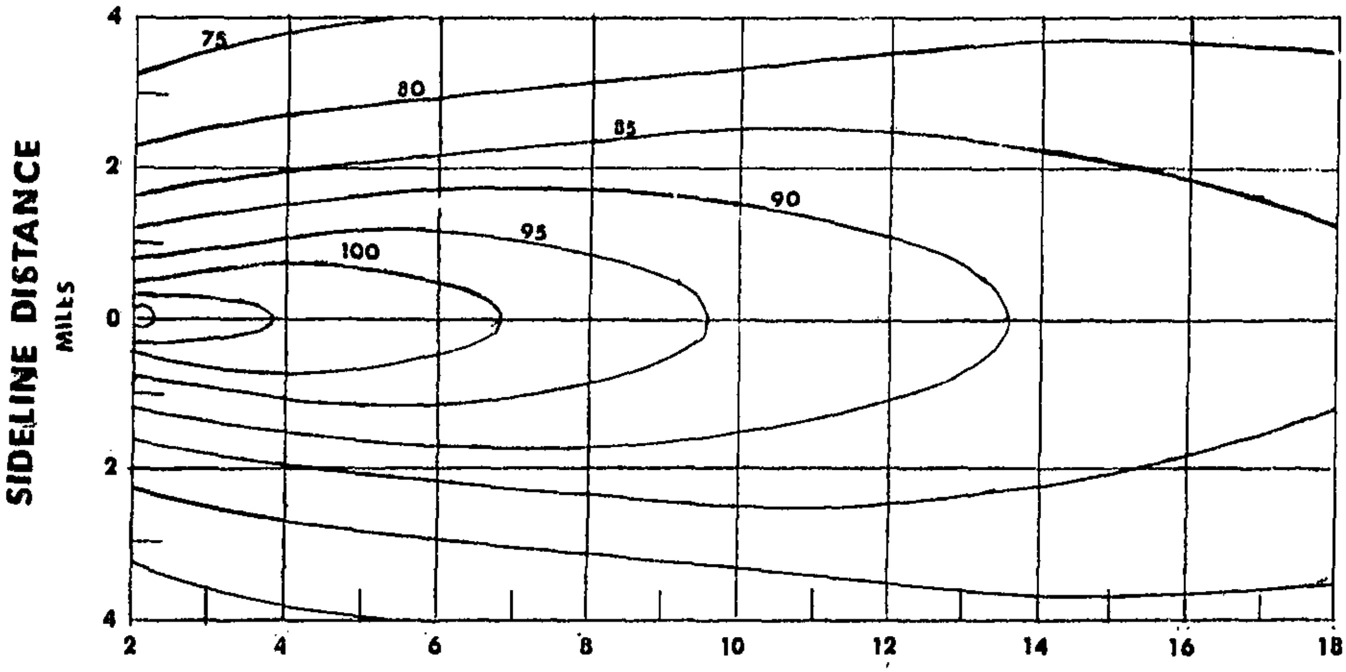


FIGURE 2D

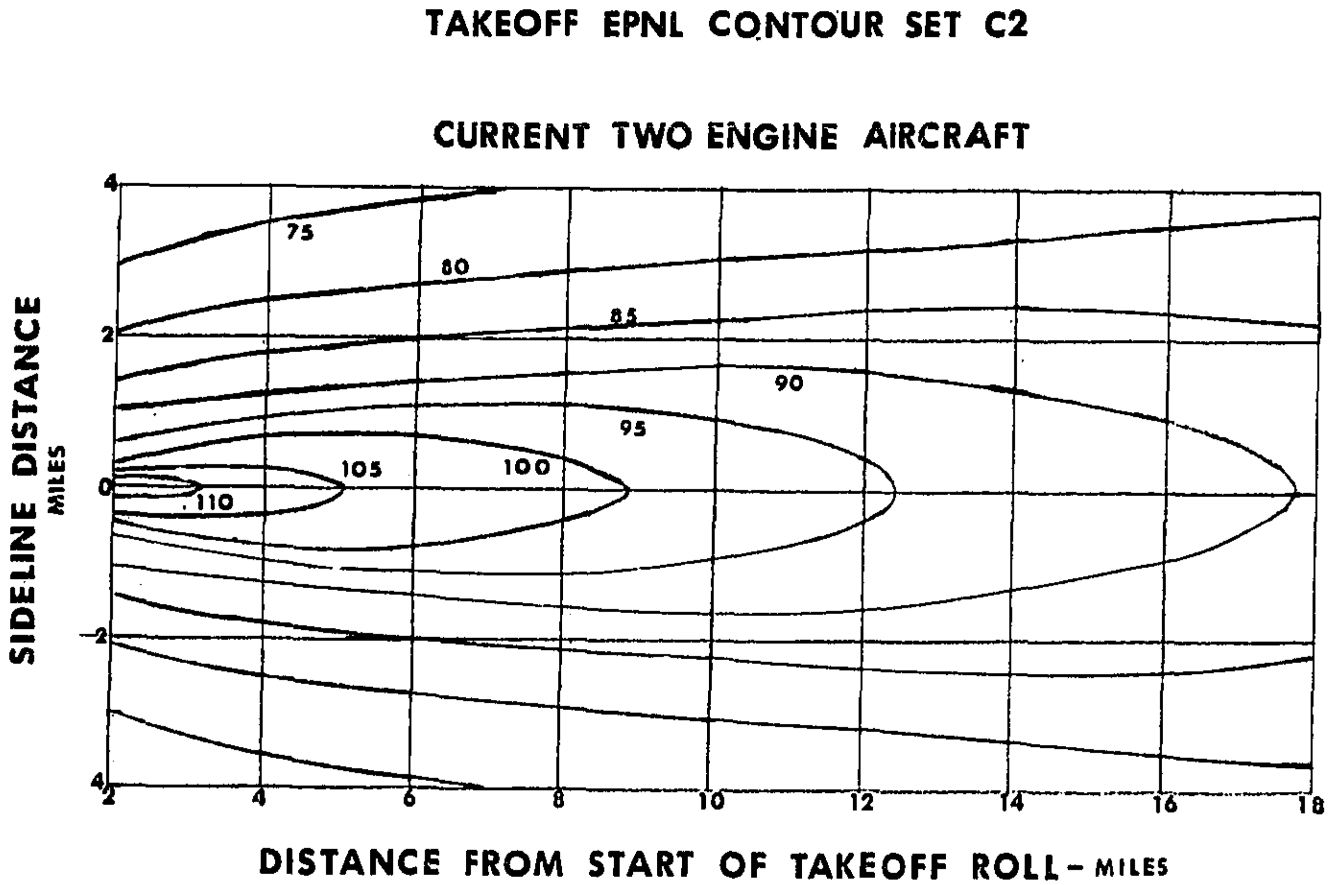

TAKEOFF EPNL CONTOUR SET C2
CURRENT TWO ENGINE AIRCRAFT
SIDELINE DISTANCE MILES
DISTANCE FROM START OF TAKEOFF ROLL - MILES
75
80
85
90
95
100
105
110
4
2
0
-2
4
2
4
6
8
10
12
14
16
18

FIGURE 3D

APPROACH EPNL CONTOUR SET 2

CURRENT TWO ENGINE AIRCRAFT

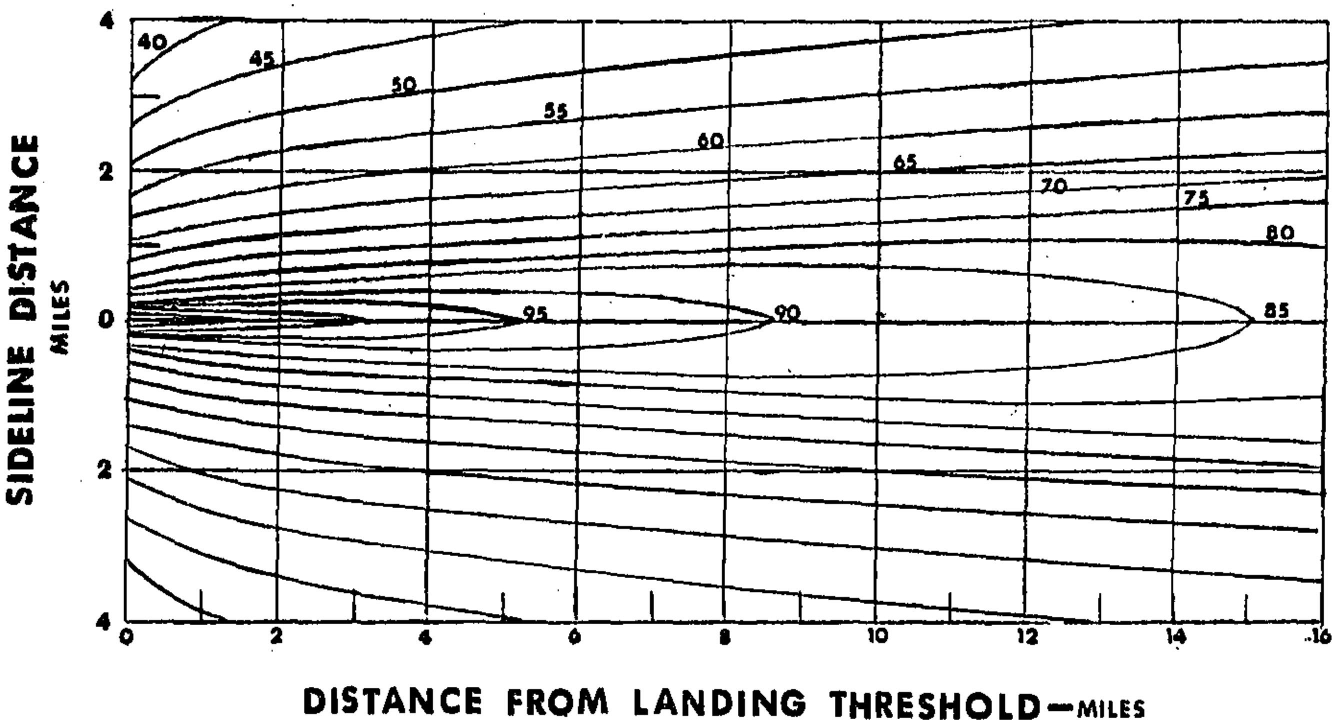


FIGURE 4D

TAKEOFF EPNL CONTOUR SET A3

CURRENT THREE ENGINE AIRCRAFT

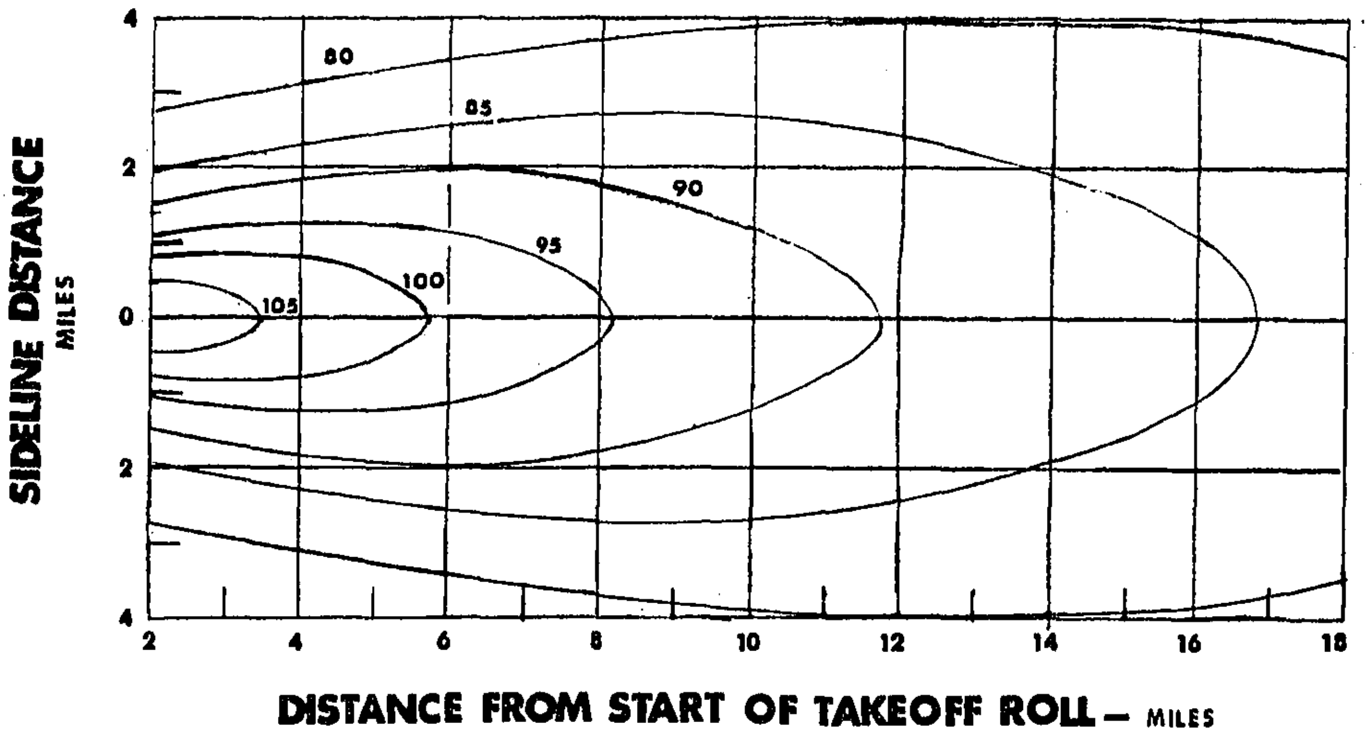


FIGURE 5D

TAKEOFF EPNL CONTOUR SET B3

CURRENT THREE ENGINE AIRCRAFT

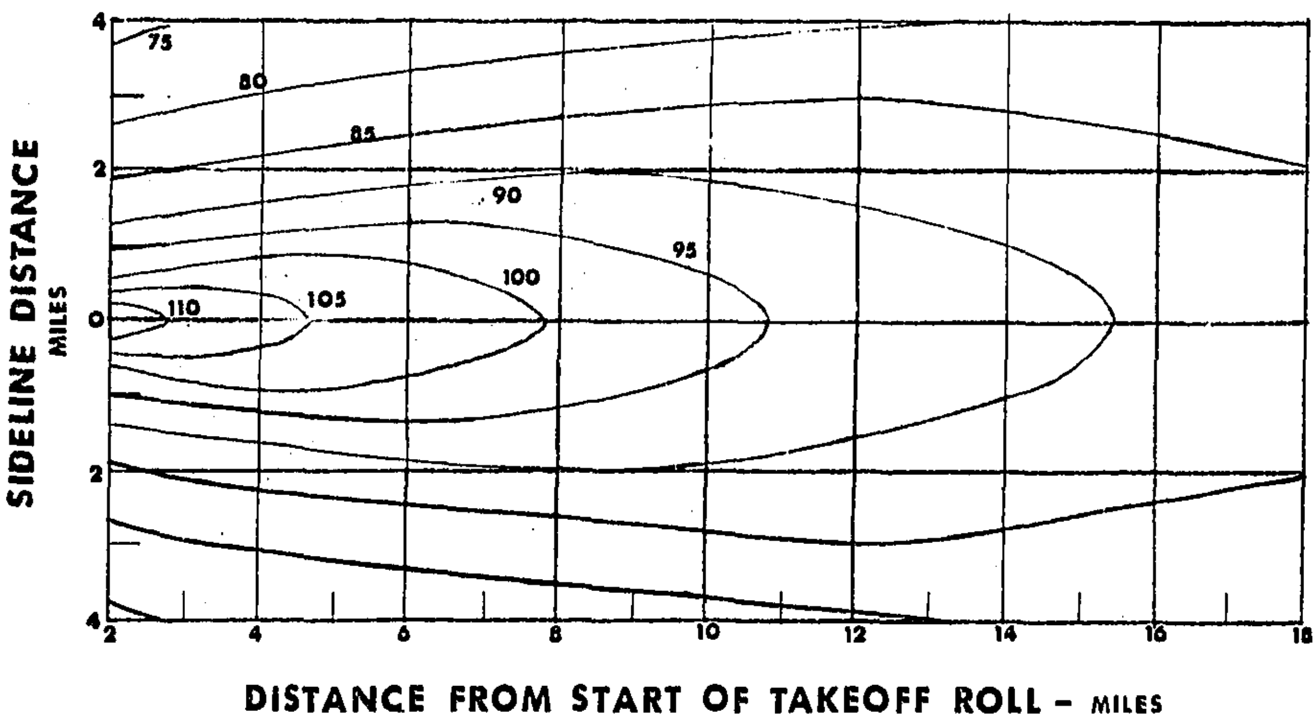


FIGURE 6D

TAKEOFF EPNL CONTOUR SET C3

CURRENT THREE ENGINE AIRCRAFT

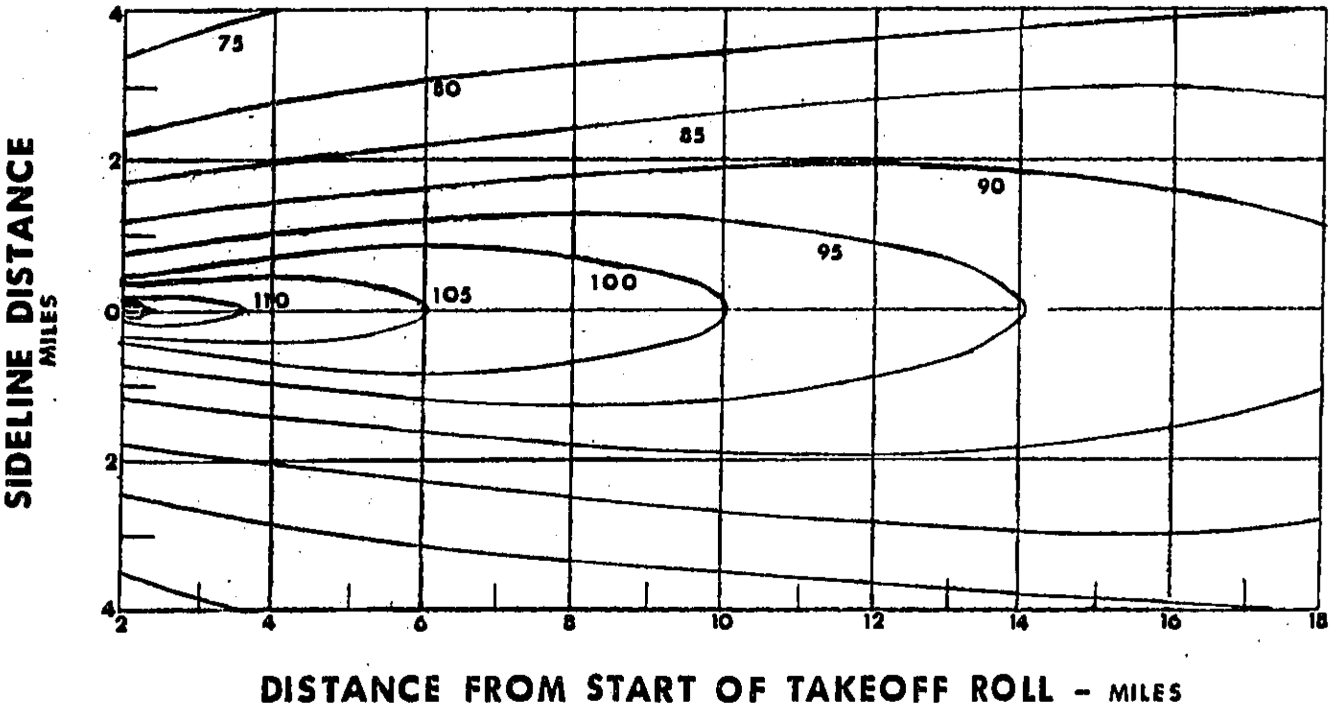


FIGURE 7D

TAKEOFF EPNL CONTOUR SET D3

CURRENT THREE ENGINE AIRCRAFT

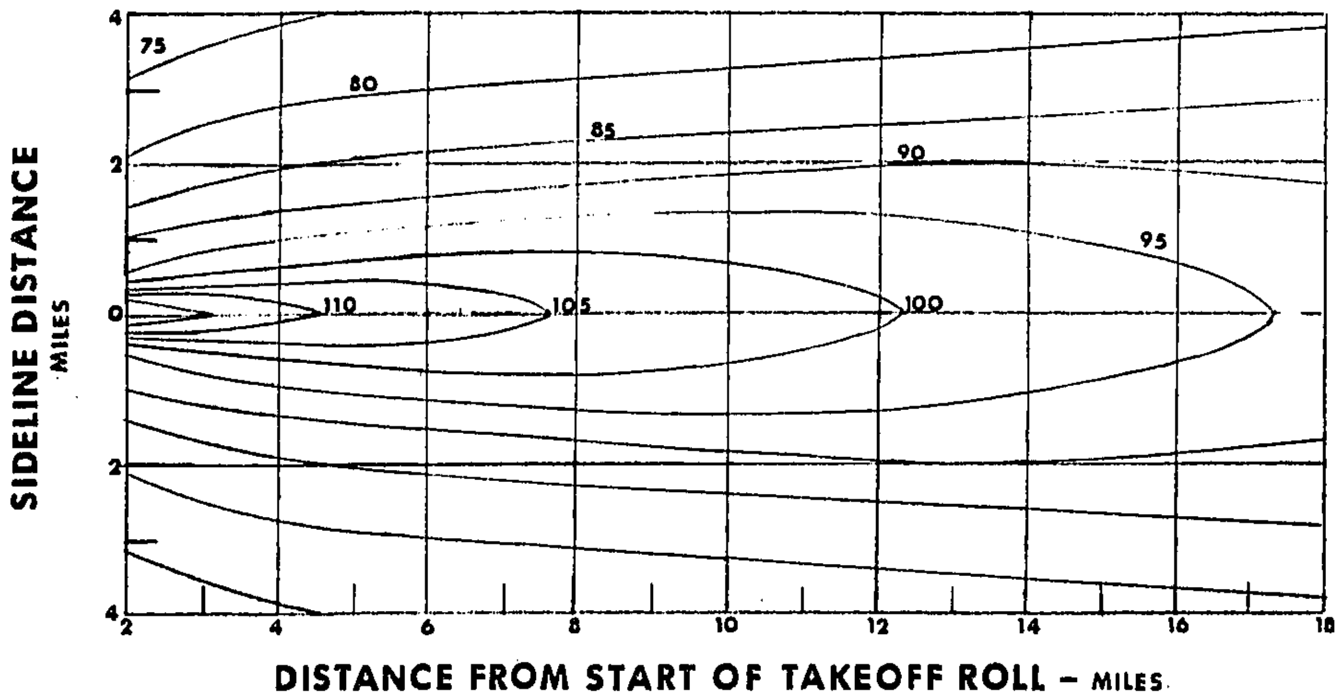


FIGURE 8D

APPROACH EPNL CONTOUR SET 3

CURRENT THREE ENGINE AIRCRAFT

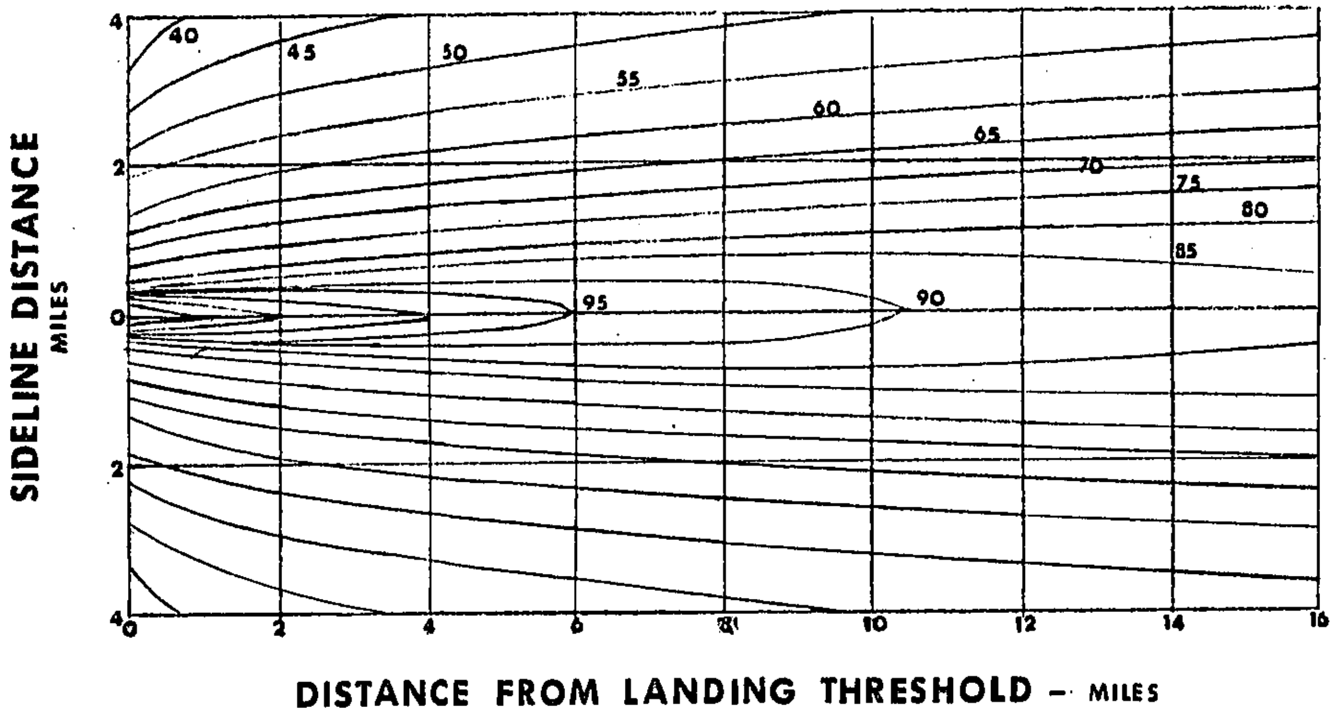


FIGURE 9D

TAKEOFF EPNL CONTOUR SET A4

CURRENT FOUR ENGINE AIRCRAFT

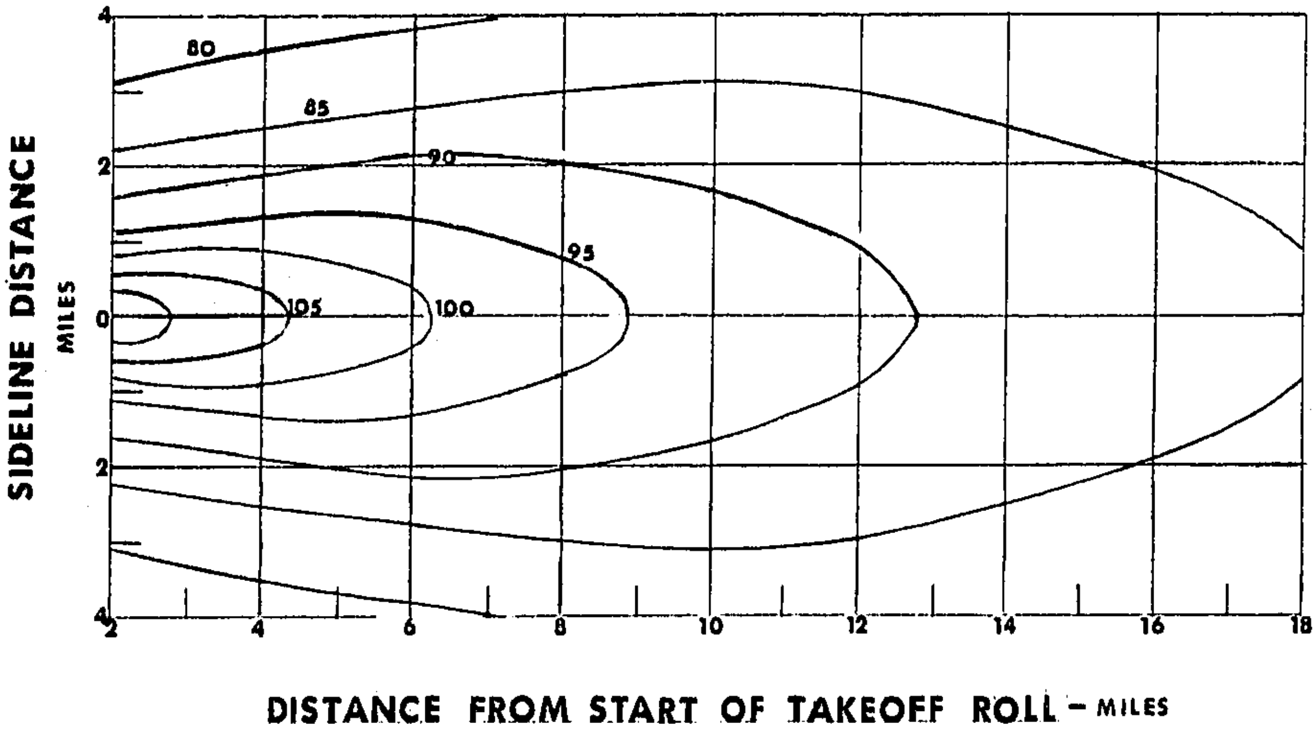


FIGURE 10D

TAKEOFF EPNL CONTOUR SET B4

CURRENT FOUR ENGINE AIRCRAFT

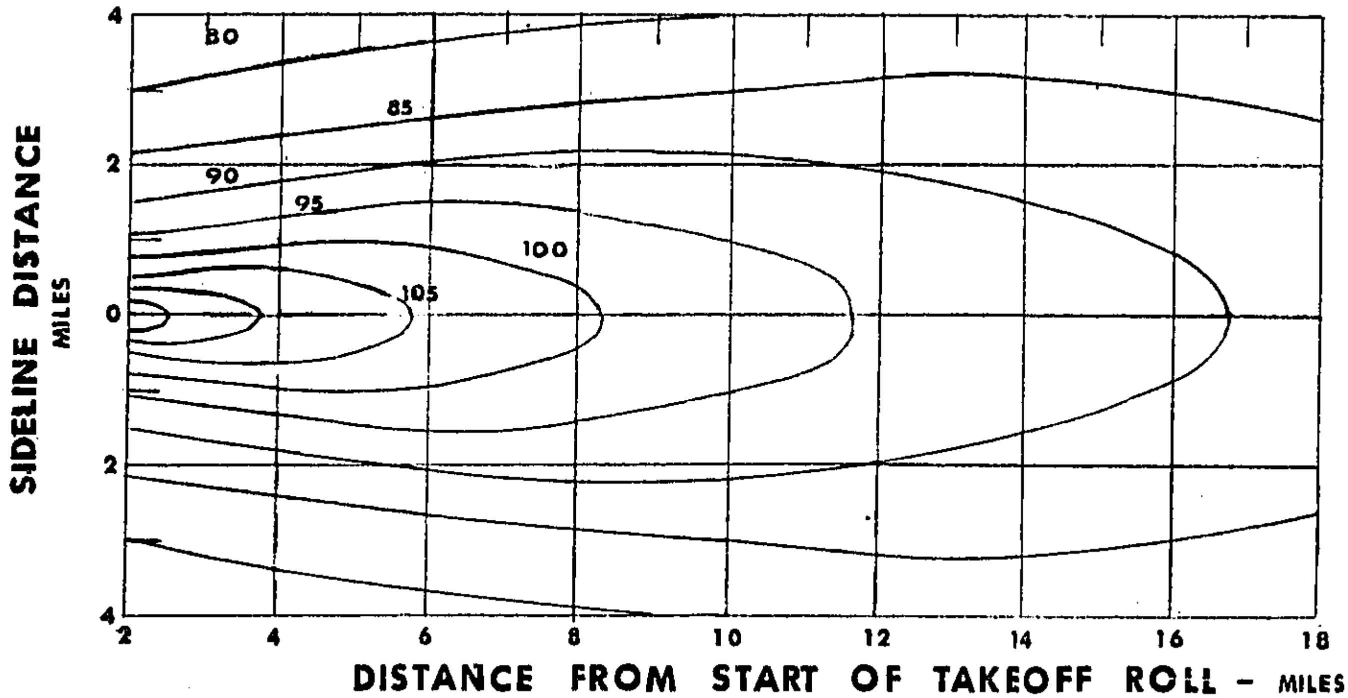


FIGURE 11D

TAKEOFF EPNL CONTOUR SET C4

CURRENT FOUR ENGINE AIRCRAFT

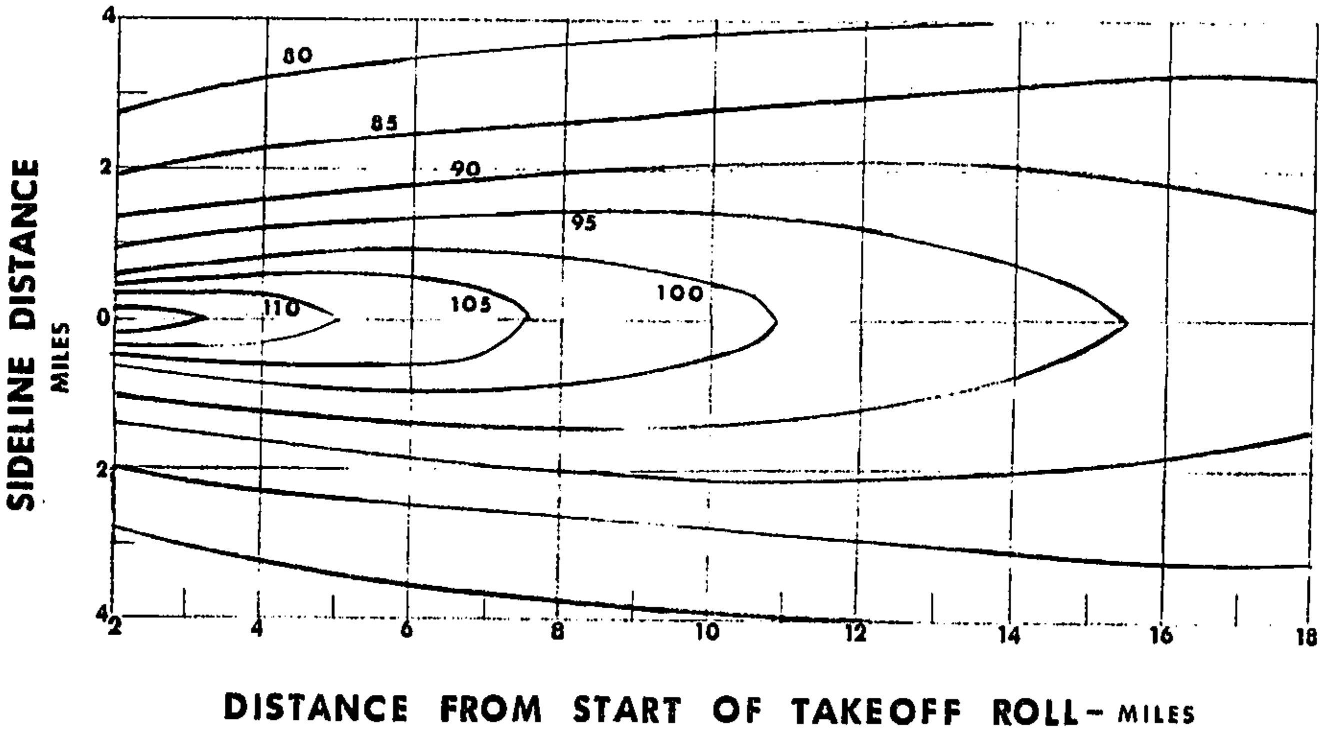


FIGURE 12D

TAKEOFF EPNL CONTOUR SET D4

CURRENT FOUR ENGINE AIRCRAFT

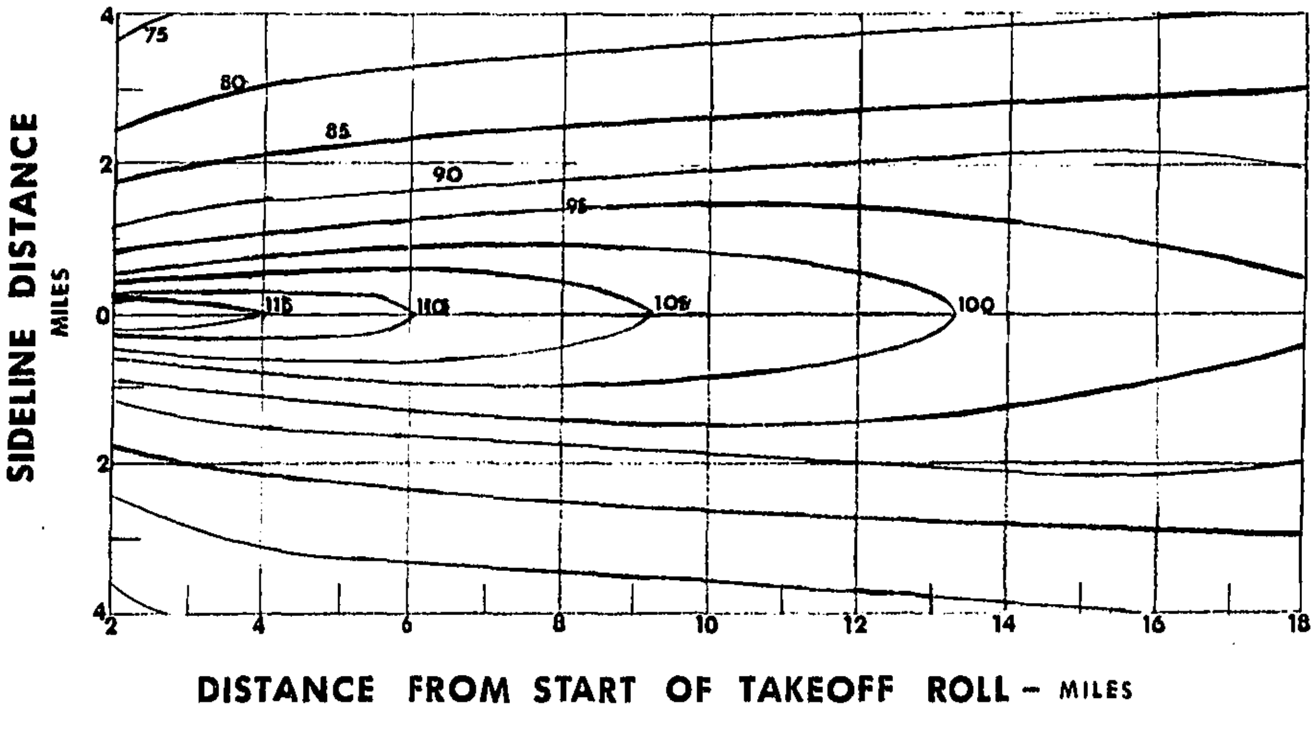


FIGURE 13D

TAKEOFF EPNL CONTOUR SET E4

CURRENT FOUR ENGINE AIRCRAFT

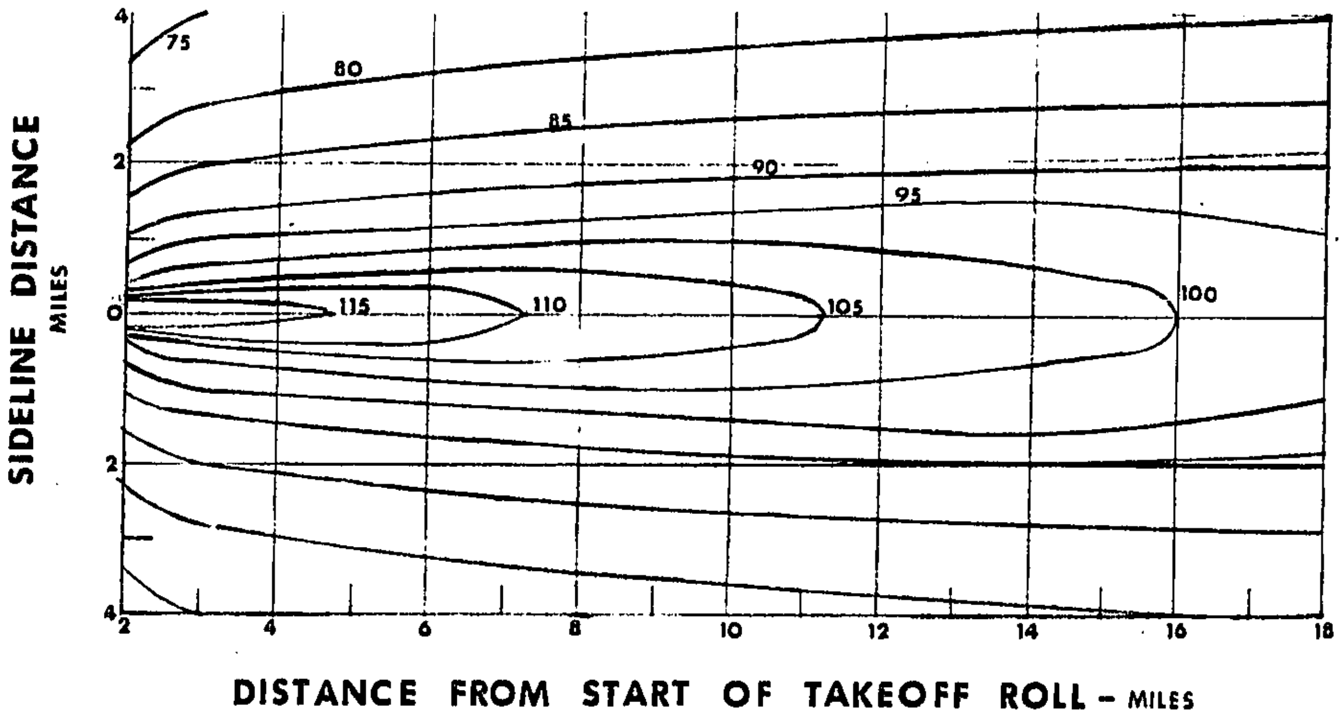


FIGURE 14D

APPROACH EPNL CONTOUR SET 4

CURRENT FOUR ENGINE AIRCRAFT

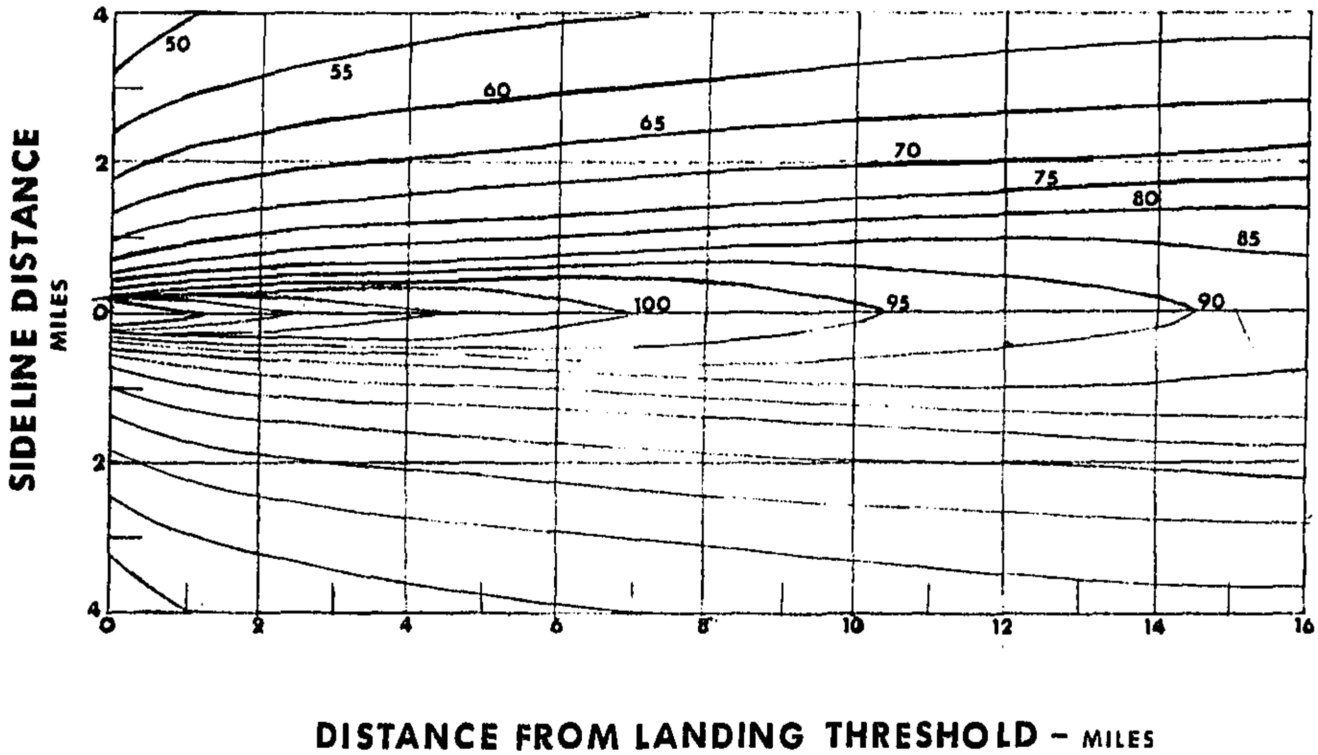


FIGURE 15D

TAKEOFF EPNL GRID VALUE SET A2

CURRENT TWO ENGINE AIRCRAFT

Dist. From Start of T/O Roll (Miles)	SIDELINE DISTANCE (MILES) 0	1/4	1/2	3/4	1	1 1/4	1 1/2	2 3/4	2	2 1/4	2 1/2	2 3/4	3	3 1/4	3 1/2	3 3/4	
2.00	108.8	105.9	102.2	97.2	93.8	90.4	87.6	85.3	83.3	81.5	79.9	78.5	77.2	76.0	74.9	73.9	73.1
2.25	107.1	105.5	103.2	98.0	94.3	90.8	88.0	85.7	83.7	81.9	80.3	78.9	77.6	76.4	75.3	74.3	73.3
2.50	105.9	105.1	102.9	98.9	94.8	91.2	88.4	86.1	84.0	82.2	80.6	79.2	77.9	76.7	75.6	74.6	73.5
2.75	105.3	104.4	102.5	99.7	95.2	91.6	88.8	86.4	84.3	82.5	80.9	79.5	78.2	77.0	75.9	74.8	73.9
3.00	104.6	103.8	102.1	100.4	95.8	92.0	89.1	86.7	84.6	82.8	81.2	79.8	78.4	77.2	76.1	75.1	74.1
3.25	103.9	103.2	101.7	100.2	96.4	92.4	89.4	86.9	84.9	83.1	81.5	80.0	78.7	77.5	76.3	75.3	74.3
3.50	103.2	102.7	101.3	99.9	97.4	92.8	89.7	87.2	85.1	83.3	81.7	80.2	78.9	77.7	76.6	75.5	74.5
3.75	102.7	102.2	101.0	99.4	97.0	93.3	90.0	87.5	85.4	83.5	81.9	80.4	79.1	77.9	76.8	75.7	74.7
4.00	102.1	101.6	100.6	99.0	96.7	93.7	90.3	87.7	85.6	83.7	82.1	80.6	79.3	78.1	76.9	75.9	74.9
4.25	101.5	101.2	100.3	98.5	96.4	94.4	90.7	88.0	85.8	83.9	82.3	80.8	79.5	78.3	77.1	76.1	75.1
4.50	101.0	100.7	100.0	98.0	96.1	94.2	91.2	88.3	86.1	84.1	82.5	81.0	79.7	78.4	77.3	76.2	75.2
4.75	100.6	100.3	99.3	97.6	95.7	93.9	91.3	88.6	86.3	84.4	82.7	81.2	79.8	78.6	77.4	76.4	75.4
5.00	100.2	100.0	98.7	97.1	95.4	93.6	92.0	89.0	86.5	84.6	82.8	81.3	80.0	78.7	77.6	76.5	75.5
5.25	99.7	99.3	98.2	96.7	95.0	93.4	91.8	89.3	86.8	84.8	83.0	81.5	80.1	78.9	77.7	76.7	75.7
5.50	99.0	98.6	97.6	96.2	94.7	93.1	91.6	90.2	87.1	85.0	83.2	81.7	80.3	79.0	77.9	76.8	75.8
5.75	98.3	98.0	97.1	95.8	94.3	92.8	91.4	90.0	87.4	85.2	83.4	81.8	80.4	79.2	78.0	76.9	75.9
6.00	97.7	97.4	96.5	95.4	94.0	92.6	91.2	89.8	87.7	85.5	83.6	82.0	80.6	79.3	78.1	77.1	76.1
6.25	97.1	96.8	96.0	94.9	93.6	92.3	90.9	89.6	88.4	85.8	83.8	82.2	80.7	79.5	78.3	77.2	76.2
6.50	96.5	96.3	95.6	94.5	93.3	92.0	90.7	89.5	88.3	86.0	84.1	82.4	80.9	79.6	78.4	77.3	76.3
6.75	96.0	95.7	95.1	94.1	93.0	91.7	90.5	89.3	88.1	86.1	84.3	82.6	81.1	79.7	78.5	77.4	76.4
7.00	95.4	95.2	94.6	93.7	92.6	91.4	90.2	89.1	87.9	86.9	84.6	82.8	81.2	79.9	78.7	77.6	76.5
7.25	94.9	94.7	94.2	93.3	92.3	91.2	90.0	88.9	87.8	86.7	84.8	83.0	81.4	80.0	78.8	77.7	76.7
7.50	94.5	94.3	93.7	92.9	92.0	90.9	89.8	88.7	87.6	86.6	85.6	83.2	81.6	80.2	78.9	77.8	76.8
7.75	94.0	93.8	93.3	92.6	91.6	90.6	89.6	88.5	87.4	86.4	85.5	83.4	81.8	80.4	79.1	77.9	76.9
8.00	93.5	93.4	92.9	92.2	91.3	90.3	89.3	88.3	87.3	86.3	85.3	83.5	82.0	80.5	79.2	78.1	77.0
8.25	93.1	92.9	92.5	91.8	91.0	90.1	89.1	88.1	87.1	86.1	85.2	84.3	82.2	80.7	79.4	78.2	77.1
8.50	92.7	92.5	92.1	91.5	90.7	89.8	88.9	87.9	86.9	86.0	85.1	84.2	82.4	80.9	79.5	78.3	77.2
8.75	92.3	92.1	91.7	91.1	90.4	89.5	88.6	87.7	86.8	85.9	85.0	84.1	82.4	81.1	79.7	78.5	77.4
9.00	91.9	91.7	91.4	90.8	90.1	89.3	88.4	87.5	86.6	85.7	84.8	84.0	83.2	81.3	79.9	78.6	77.5
9.25	91.5	91.4	91.0	90.5	89.8	89.0	88.2	87.3	86.4	85.6	84.7	83.9	83.1	81.4	80.1	78.8	77.6
9.50	91.1	91.0	90.7	90.2	89.5	88.8	87.9	87.1	86.2	85.4	84.6	83.8	83.0	32.2	80.2	78.9	77.7
9.75	90.7	90.6	90.3	89.8	89.2	88.5	87.7	86.9	86.1	85.2	84.4	83.6	82.9	82.1	80.4	79.1	77.9
10.00	90.4	90.3	90.0	89.5	88.9	88.2	87.5	86.7	85.9	85.1	84.3	83.5	82.8	82.0	80.4	79.3	78.0
10.25	90.0	89.9	89.7	89.2	88.7	88.0	87.3	86.5	85.7	84.9	84.2	83.4	82.7	81.9	81.2	79.4	79.2
10.50	89.7	89.6	89.3	88.9	88.4	87.8	87.1	86.3	85.6	84.8	84.0	83.3	82.5	81.9	81.1	79.5	78.4
10.75	89.4	89.3	89.0	88.6	88.1	87.5	86.8	86.1	85.4	84.6	83.9	83.2	82.4	81.7	81.1	79.5	79.5
11.00	89.1	89.0	88.7	88.4	87.9	87.3	86.6	85.9	85.2	84.5	83.8	83.0	82.3	81.6	81.0	80.3	79.5
11.25	88.7	88.7	88.4	88.1	87.6	87.0	86.4	85.7	85.0	84.3	83.6	82.9	82.2	81.5	80.9	80.2	78.7
11.50	88.4	88.4	88.2	87.8	87.3	86.8	86.2	85.5	84.9	84.2	83.5	82.8	82.1	81.4	80.8	80.2	79.5
11.75	88.1	88.1	87.9	87.5	87.1	86.6	86.0	85.3	84.7	84.0	83.3	82.7	82.0	81.3	80.7	80.1	79.5
12.00	87.9	87.8	87.6	87.3	86.8	86.3	85.8	85.2	84.5	83.9	83.2	82.5	81.9	81.2	80.6	80.0	79.4
12.25	87.6	87.5	87.3	87.0	85.6	86.1	85.6	85.0	84.3	83.7	83.1	82.4	81.8	81.1	80.5	79.9	79.3
12.50	87.3	87.2	87.0	86.8	85.4	85.9	85.4	84.8	84.2	83.6	82.9	82.3	81.7	81.0	80.4	79.8	79.2
12.75	87.0	87.0	86.8	86.5	86.1	85.7	85.2	84.6	84.0	83.4	82.8	82.2	81.5	80.9	80.3	79.7	79.2
13.00	86.8	86.7	86.5	86.3	85.9	85.5	85.0	84.4	83.8	83.2	82.6	82.0	81.4	80.8	80.2	79.6	79.1
13.25	86.5	86.4	86.3	86.0	85.7	85.2	84.8	84.2	83.7	83.1	82.5	81.9	81.3	80.7	80.1	79.6	79.0
13.50	86.2	86.2	86.0	85.8	85.4	85.0	84.6	84.1	83.5	82.9	82.4	81.8	81.2	80.6	80.0	79.5	78.9
13.75	86.0	85.9	85.8	85.5	85.2	84.8	84.4	83.9	83.3	82.8	82.2	81.6	81.1	80.5	79.9	79.4	78.9
14.00	85.7	85.7	85.6	85.3	85.0	84.6	84.2	83.7	83.2	82.6	82.1	81.5	81.0	80.4	79.8	79.3	78.8
14.25	85.5	85.5	85.3	85.1	84.8	84.4	84.0	83.5	83.0	82.5	81.9	81.4	80.8	80.3	79.7	79.2	78.7
14.50	85.3	85.2	85.1	84.9	84.6	84.2	83.8	83.3	82.9	82.3	81.8	81.3	80.7	80.2	79.6	79.1	78.6
14.75	85.0	85.0	84.9	84.6	84.4	84.0	83.6	83.2	82.7	82.2	81.7	81.1	80.6	80.1	79.5	79.0	79.5
15.00	84.8	84.8	84.6	84.4	84.2	83.8	83.4	83.0	82.5	82.0	81.5	81.0	80.5	80.0	79.4	78.9	78.4
15.25	84.6	84.5	84.4	84.2	84.0	83.6	83.2	82.8	82.4	81.9	81.4	80.9	80.4	79.9	79.3	78.8	78.3
15.50	84.4	84.3	84.2	84.0	83.8	83.4	83.1	82.7	82.2	81.7	81.3	80.8	80.3	79.8	79.3	78.7	78.3
15.75	84.1	84.1	84.0	83.8	83.6	83.2	82.9	82.5	82.1	81.6	81.1	80.6	80.1	79.6	79.2	78.7	78.2
16.00	83.9	83.9	83.8	83.6	83.4	83.1	82.7	82.3	81.9	81.5	81.0	80.5	80.0	79.5	79.1	78.6	78.1
16.25	83.7	83.7	83.6	83.4	83.2	82.9	82.5	82.2	81.8	81.3	80.9	80.4	79.9	79.4	79.0	78.5	78.0
16.50	83.5	83.5	83.4	83.2	83.0	82.7	82.4	82.0	81.6	81.2	80.7	80.3	79.8	79.3	78.9	78.4	77.9
16.75	83.3	83.3	83.2	83.0	82.8	82.5	82.2	81.8	81.4	81.0	80.6	80.1	79.7	79.2	78.8	78.3	77.8
17.00	83.1	83.1	83.0	82.8	82.6	82.3	82.0	81.7	81.3	80.9	80.5	80.0	79.6	79.1	78.7	78.2	77.7
17.25	82.9	82.9	82.8	82.6	82.4	82.2	81.9	81.5	81.1	80.7	80.3	79.9	79.5	79.0	78.6	78.1	77.7
17.50	82.7	82.7	82.6	82.4	82.2	82.0	81.7	81.4	81.0	80.6	80.2	79.8	79.3	78.9	78.5	78.0	77.6
17.75	82.5	82.5	82.4	82.3	82.1	81.8	81.5	81.2	80.9	80.5	80.1	79.7	79.2	78.8	78.4	77.9	77.5
18.00	82.3	82.3	82.2	82.1	81.9	81.7	81.4	81.1	80.7	80.3	79.9	79.5	79.1	78.7	78.3	77.8	77.4

TAKEOFF EPNL GRID VALUE SET B2

CURRENT TWO ENGINE AIRCRAFT

Dist. From Start of T/O Roll (Miles)	SIDELINE DISTANCE (MILES) 0	1/4	1/2	3/4	1	1 1/4	1 1/2	2 3/4	2	2 1/4	2 1/2	2 3/4	3	3 1/4	3 1/2	3 3/4	
2.00	112.1	108.1	99.6	95.5	92.5	89.1	86.4	84.1	82.2	80.4	78.9	77.5	76.2	75.1	74.0	73.0	72.1
2.25	110.7	107.3	100.4	96.2	93.0	89.7	86.9	84.6	82.6	80.9	79.3	77.9	76.6	75.5	74.4	73.4	72.5
2.50	109.8	106.4	101.3	96.8	93.5	90.1	87.3	85.0	83.0	81.2	79.7	78.3	77.0	75.8	74.7	73.7	72.9
2.75	108.6	105.9	102.4	97.3	93.9	90.5	87.7	85.4	83.3	81.6	80.0	78.6	77.3	76.1	75.0	74.0	73.0
3.00	107.2	105.6	103.2	97.9	94.3	90.8	88.0	85.7	83.6	81.9	80.3	78.9	77.6	76.4	75.3	74.2	73.3
3.25	106.0	105.2	103.0	98.6	94.6	91.1	88.3	85.9	83.9	82.1	80.5	79.1	77.8	76.6	75.5	74.5	73.5
3.50	105.6	104.8	102.7	99.3	95.0	91.4	88.6	86.2	84.2	82.4	80.8	79.3	78.0	76.8	75.7	74.7	73.7
3.75	105.2	104.3	102.4	100.5	95.3	91.7	88.8	86.4	84.4	82.6	81.0	79.6	78.2	77.0	75.9	74.9	73.9
4.00	104.6	103.8	102.1	100.4	95.8	92.0	89.1	86.7	84.6	82.8	81.2	79.8	78.4	77.2	76.1	75.1	74.1
4.25	104.1	103.4	101.8	100.2	96.2	92.3	89.3	86.9	84.8	83.0	81.4	79.9	78.6	77.4	76.3	75.3	74.3
4.50	103.5	103.0	101.5	100.0	95.6	92.6	89.5	87.1	85.0	83.2	81.6	80.1	78.8	77.6	76.5	75.4	74.4
4.75	103.1	102.6	101.2	99.8	97.3	92.9	89.8	87.3	85.2	83.4	81.7	80.3	79.0	77.7	76.6	75.6	74.6
5.00	102.6	102.1	100.9	99.4	97.0	93.3	90.0	87.5	85.4	83.5	81.9	80.4	79.1	77.9	76.8	75.7	74.7
5.25	102.2	101.7	100.7	99.1	96.8	93.6	90.3	87.7	85.5	83.7	82.1	80.6	79.3	78.0	76.9	75.9	74.9
5.50	101.8	101.4	100.4	98.7	95.5	94.5	90.6	87.9	85.7	83.9	82.2	80.7	79.4	78.2	77.0	76.0	75.0
5.75	101.4	101.0	100.2	98.3	95.3	94.3	90.9	88.1	85.9	84.0	82.4	80.9	79.5	78.3	77.2	76.1	75.1
6.00	101.0	100.7	99.9	98.0	96.0	94.1	91.2	88.3	86.1	84.2	82.5	81.0	79.7	78.4	77.3	76.2	75.3
6.25	100.6	100.4	99.4	97.6	95.8	93.9	91.4	88.6	86.3	84.3	82.6	81.1	79.8	78.6	77.4	76.4	75.4
6.50	100.3	100.1	99.0	97.3	95.5	93.7	92.1	88.9	86.5	84.5	82.8	81.3	79.9	78.7	77.5	76.5	75.5
6.75	100.1	99.7	98.5	96.9	95.2	93.5	91.9	89.1	86.7	84.6	82.9	81.4	80.0	78.8	77.6	76.6	75.6
7.00	99.6	99.2	98.1	96.6	95.0	93.3	91.8	89.4	86.9	84.8	83.1	81.5	80.2	78.9	77.8	76.7	75.7
7.25	99.0	98.7	97.7	96.3	94.7	93.1	91.6	90.2	87.1	85.0	83.2	81.7	80.3	79.0	77.9	76.8	75.8
7.50	98.5	98.2	97.2	95.9	94.4	92.9	91.4	90.1	87.4	85.2	83.4	81.8	80.4	79.1	78.0	76.9	75.9
7.75	98.0	97.7	96.8	95.6	94.2	92.7	91.3	89.9	87.6	85.4	83.5	81.9	80.5	79.2	78.1	77.0	76.0
8.00	97.6	97.3	96.4	95.3	93.9	92.5	91.1	89.8	87.6	85.6	83.7	82.0	80.6	79.3	78.2	77.1	76.1
8.25	97.1	96.8	96.0	94.9	93.6	92.3	90.9	89.6	88.4	85.8	83.8	82.2	80.7	79.5	78.3	77.2	76.2
8.50	96.7	96.4	95.7	94.6	93.4	92.1	90.8	89.5	88.3	86.0	84.0	82.3	80.9	79.6	78.4	77.3	76.3
8.75	96.2	96.0	95.3	94.3	93.1	91.9	90.6	89.4	88.2	86.1	84.2	82.5	81.0	79.7	78.5	77.4	76.4
9.00	95.8	95.6	94.9	94.0	92.9	91.6	90.4	89.2	88.1	87.0	84.4	82.6	81.1	79.8	78.6	77.5	76.5
9.25	95.4	95.2	94.6	93.7	92.6	91.4	90.2	89.1	87.9	86.9	84.6	82.8	81.2	79.9	78.7	77.6	76.5
9.50	95.0	94.8	94.3	93.4	92.4	91.2	90.1	88.9	87.8	86.7	84.7	83.0	81.4	80.0	78.8	77.7	76.6
9.75	94.7	94.5	93.9	93.1	92.1	91.0	89.9	88.8	87.7	86.6	84.8	83.1	81.5	80.1	78.9	77.8	76.7
10.00	94.3	94.1	93.6	92.8	91.9	90.8	89.7	88.6	87.6	86.5	85.6	83.3	81.7	80.2	79.0	77.9	76.9
10.25	93.9	93.8	93.3	92.5	91.6	90.6	89.5	88.5	87.4	86.4	85.5	83.5	81.8	80.4	79.1	77.9	76.9
10.50	93.6	93.4	93.0	92.2	91.4	90.4	89.4	88.3	87.3	86.3	85.4	83.5	82.0	80.5	79.2	78.0	77.0
10.75	93.3	93.1	92.6	92.0	91.1	90.2	89.2	88.2	87.2	86.2	85.3	84.4	82.1	80.6	79.3	78.1	77.1
11.00	92.9	92.8	92.3	91.7	90.9	90.0	89.0	88.0	87.0	86.1	85.2	84.3	82.3	80.8	79.4	78.2	77.2
11.25	92.6	92.5	92.1	91.4	90.6	89.8	88.8	87.9	86.9	86.0	85.1	84.2	82.4	80.9	79.6	78.3	77.3
11.50	92.3	92.2	91.8	91.2	90.4	89.6	88.6	87.7	86.8	85.9	85.0	84.1	82.4	81.1	79.7	78.5	77.3
11.75	92.0	91.9	91.5	90.9	90.2	89.4	88.5	87.6	86.6	85.8	84.9	84.0	83.2	81.7	79.8	78.6	77.4
12.00	91.7	91.6	91.2	90.7	90.0	89.2	88.3	87.4	86.5	85.6	84.8	83.9	83.1	81.3	80.0	78.7	77.5
12.25	91.4	91.3	90.9	90.4	89.7	89.0	88.1	87.3	86.4	85.5	84.7	83.9	83.1	81.4	80.1	78.8	77.6
12.50	91.1	91.0	90.7	90.2	89.5	88.8	87.9	87.1	86.3	85.4	84.6	83.8	83.0	82.2	80.2	78.9	77.7
12.75	90.8	90.7	90.4	89.9	89.3	88.6	87.8	87.0	86.1	85.3	84.5	83.7	82.9	82.1	80.3	79.0	77.9
13.00	90.6	90.5	90.2	89.7	89.1	88.4	87.6	86.8	86.0	85.2	84.4	83.6	82.8	82.1	80.4	79.2	78.0
13.25	90.3	90.2	89.9	89.4	88.9	88.2	87.4	86.7	85.9	85.1	84.3	83.5	82.7	82.0	80.4	79.3	78.1
13.50	90.0	89.9	89.7	89.2	88.7	88.0	87.3	86.5	85.7	84.9	84.2	83.4	82.7	81.9	81.2	79.4	78.2
13.75	89.8	89.7	89.4	89.0	88.4	87.8	87.1	86.4	85.6	84.8	84.1	83.3	82.6	81.9	81.2	79.5	78.3
14.00	89.5	89.4	89.2	88.8	88.2	87.6	86.9	86.2	85.5	84.7	83.9	83.2	82.5	81.8	81.1	79.5	78.4
14.25	89.3	89.2	88.9	88.5	88.0	87.4	86.8	86.1	85.3	84.6	83.8	83.1	82.4	81.7	81.0	80.4	78.6
14.50	89.0	88.9	88.7	88.3	87.8	87.2	86.6	85.9	85.2	84.5	83.7	83.0	82.3	81.6	81.0	80.3	79.7
14.75	88.8	88.7	88.5	88.1	87.6	87.1	86.4	85.8	85.1	84.3	83.6	82.9	82.2	81.6	80.9	80.3	79.7
15.00	88.6	88.5	88.3	87.9	87.4	86.9	86.3	85.6	84.9	84.2	83.5	82.8	82.1	81.5	80.8	80.2	78.7
15.25	88.3	88.3	88.0	87.7	87.2	86.7	86.1	85.5	84.8	84.1	83.4	82.7	82.1	81.4	80.8	80.1	79.5
15.50	88.1	88.0	87.8	87.5	87.1	86.5	85.9	85.3	84.7	84.0	83.3	82.6	82.0	81.3	80.7	80.1	79.5
15.75	87.9	87.8	87.6	87.3	85.9	86.4	85.8	85.2	84.5	83.9	83.2	82.5	81.9	81.2	80.6	80.0	79.4
16.00	87.7	87.6	87.4	87.1	85.7	86.2	85.6	85.0	84.4	83.8	83.1	82.4	81.8	81.2	80.5	79.9	79.3
16.25	87.4	87.4	87.2	86.9	85.5	86.0	85.5	84.9	84.3	83.6	83.0	82.4	81.7	81.1	80.5	79.9	79.3
16.50	87.2	87.2	87.0	86.7	85.3	85.8	85.3	84.7	84.1	83.5	82.9	82.3	81.6	81.0	80.4	79.8	79.2
16.75	87.0	87.0	86.8	86.5	85.1	85.7	85.2	84.6	84.0	83.4	82.8	82.2	81.5	80.9	80.3	79.7	79.2
17.00	86.8	86.8	86.6	86.3	85.0	85.5	85.0	84.5	83.9	83.3	82.7	82.1	81.5	80.8	80.3	79.7	79.1
17.25	86.6	86.6	86.4	86.1	85.8	85.3	84.9	84.3	83.8	83.2	82.6	82.0	81.4	80.8	80.2	79.6	79.0
17.50	86.4	86.4	86.2	86.0	85.6	85.2	84.7	84.2	83.6	83.1	82.5	81.9	81.3	80.7	80.1	79.5	79.0
17.75	86.2	86.2	86.0	85.8	85.4	85.0	84.6	84.0	83.5	82.9	82.4	81.8	81.2	80.6	80.0	79.5	78.9
18.00	86.0	86.0	85.8	85.6	85.3	84.9	84.4	83.9	83.4	82.8	82.2	81.7	81.1	80.5	80.0	79.4	78.9

TAKEOFF EPNL GRID VALUE SET C2

CURRENT TWO ENGINE AIRCRAFT

Dist. From Start of T/O Roll (Miles)	SIDELINE DISTANCE (MILES)																
	0	1/4	1/2	3/4	1	1 1/4	1 1/2	2 3/4	2	2 1/4	2 1/2	2 3/4	3	3 1/4	3 1/2	3 3/4	4
2.00	117.5	105.2	97.6	93.8	91.0	87.7	85.1	82.8	80.9	79.2	77.7	76.4	75.2	74.0	73.0	72.0	71.1
2.25	114.9	106.1	98.5	94.6	91.7	88.4	85.7	83.4	81.5	79.8	78.3	76.9	75.6	74.5	73.4	72.5	71.5
2.50	113.0	107.2	99.2	95.2	92.2	88.9	86.2	83.9	81.9	80.2	78.7	77.3	76.0	74.9	73.8	72.8	71.8
2.75	111.6	107.9	99.8	95.8	92.7	89.3	86.6	84.3	82.3	80.6	79.0	77.6	76.4	75.2	74.1	73.1	72.2
3.00	110.6	107.2	100.5	96.2	93.1	89.7	86.9	84.6	82.7	80.9	79.3	77.9	76.7	75.5	74.4	73.4	72.5
3.25	109.9	106.6	101.2	96.7	93.4	90.0	87.3	84.9	82.9	81.2	79.6	78.2	76.9	75.8	74.7	73.7	72.7
3.50	109.0	106.0	102.0	97.1	93.7	90.3	87.6	85.2	83.2	81.5	79.9	78.5	77.2	76.0	74.9	73.9	72.9
3.75	108.1	105.8	103.4	97.6	94.0	90.6	87.8	85.5	83.5	81.7	80.1	78.7	77.4	76.2	75.1	74.1	73.1
4.00	107.0	105.5	103.2	98.0	94.3	90.9	88.1	85.7	83.7	81.9	80.3	78.9	77.6	76.4	75.3	74.3	73.3
4.25	106.1	105.2	103.0	98.5	94.6	91.1	88.3	85.9	83.9	82.1	80.5	79.1	77.8	76.6	75.5	74.5	73.5
4.50	105.7	104.9	102.8	99.1	94.9	91.3	88.5	86.1	84.1	82.3	80.7	79.3	78.0	76.8	75.7	74.6	73.7
4.75	105.4	104.6	102.6	99.6	95.1	91.5	88.7	86.3	84.3	82.5	80.9	79.4	78.1	76.9	75.8	74.8	73.8
5.00	105.1	104.2	102.4	100.5	95.4	91.7	88.9	86.5	84.4	82.7	81.0	79.6	78.3	77.1	76.0	74.9	74.0
5.25	104.6	103.8	102.1	100.4	95.8	92.0	89.1	86.7	84.6	82.8	81.2	79.8	78.4	77.2	76.1	75.1	74.1
5.50	104.2	103.5	101.9	100.2	96.1	92.2	89.2	86.8	84.8	83.0	81.4	79.9	78.6	77.4	76.3	75.2	74.2
5.75	103.8	103.1	101.7	100.1	96.5	92.4	89.4	87.0	84.9	83.1	81.5	80.0	78.7	77.5	76.4	75.3	74.4
6.00	103.4	102.8	101.4	100.0	97.4	92.7	89.6	87.1	85.1	83.2	81.6	80.2	78.8	77.6	76.5	75.5	74.5
6.25	103.1	102.5	101.2	99.7	97.3	92.9	89.8	87.3	85.2	83.4	81.8	80.3	79.0	77.8	76.6	75.6	74.6
6.50	102.7	102.2	101.0	99.5	97.1	93.2	90.0	87.5	85.3	83.5	81.9	80.4	79.1	77.9	76.7	75.7	74.7
6.75	102.4	101.9	100.8	99.2	95.9	93.5	90.2	87.6	85.5	83.6	82.0	80.5	79.2	78.0	76.9	75.8	74.8
7.00	102.0	101.6	100.6	98.9	95.7	93.7	90.4	87.8	85.6	83.8	82.1	80.7	79.3	78.1	77.0	75.9	74.9
7.25	101.7	101.3	100.4	98.6	95.5	94.5	90.6	87.9	85.7	83.9	82.2	80.8	79.4	78.2	77.1	76.0	75.0
7.50	101.4	101.0	100.2	98.4	95.3	94.3	90.9	88.1	85.9	84.0	82.3	80.9	79.5	78.3	77.2	76.1	75.1
7.75	101.1	100.8	100.0	98.1	96.1	94.2	91.1	88.3	86.0	84.1	82.5	81.0	79.6	78.4	77.3	76.2	75.2
8.00	100.8	100.5	99.7	97.8	95.9	94.1	91.3	88.5	86.2	84.2	82.6	81.1	79.7	78.5	77.4	76.3	75.3
8.25	100.6	100.3	99.3	97.6	95.7	93.9	91.3	88.6	86.3	84.4	82.7	81.2	79.8	78.6	77.4	76.4	75.4
8.50	100.3	100.1	99.0	97.3	95.5	93.7	92.1	88.9	86.5	84.5	82.8	81.3	79.9	78.7	77.5	76.5	75.5
8.75	100.1	99.8	98.6	97.0	95.3	93.6	92.0	89.1	86.6	84.6	82.9	81.4	80.0	78.8	77.6	76.6	75.6
9.00	99.8	99.4	98.3	96.8	95.1	93.4	91.9	89.3	86.8	84.7	83.0	81.5	80.1	78.9	77.7	76.6	75.7
9.25	99.4	99.0	97.9	96.5	94.9	93.3	91.7	89.4	86.9	84.9	83.1	81.6	80.2	78.9	77.8	76.7	75.7
9.50	99.0	98.6	97.6	96.2	94.7	93.1	91.6	90.2	87.1	85.0	83.2	81.7	80.3	79.0	77.9	76.8	75.8
9.75	98.6	98.3	97.3	96.0	94.5	93.0	91.5	90.1	87.3	85.1	83.3	81.8	80.4	79.1	78.0	76.9	75.9
10.00	98.2	97.9	97.0	95.7	94.3	92.8	91.3	90.0	87.5	85.3	83.4	81.9	80.5	79.2	78.0	77.0	76.0
10.25	97.9	97.5	96.7	95.5	94.1	92.6	91.2	89.9	87.6	85.4	83.6	82.0	80.6	79.3	78.1	77.0	76.0
10.50	97.5	97.2	96.4	95.2	93.9	92.5	91.1	89.8	87.6	85.6	83.7	82.1	80.6	79.4	78.2	77.1	76.1
10.75	97.1	96.9	96.1	95.0	93.7	92.3	91.0	89.7	88.4	85.8	83.8	82.2	80.7	79.4	78.3	77.2	76.2
11.00	96.8	96.5	95.8	94.7	93.5	92.1	90.8	89.5	88.3	85.9	84.0	82.3	80.8	79.5	78.3	77.3	76.2
11.25	96.5	96.2	95.5	94.5	93.3	92.0	90.7	89.4	88.2	86.1	84.1	82.4	80.9	79.6	78.4	77.3	76.3
11.50	96.1	95.9	95.2	94.2	93.1	91.8	90.6	89.3	88.2	86.1	84.2	82.5	81.0	79.7	78.5	77.4	76.4
11.75	95.8	95.6	95.0	94.0	92.9	91.6	90.4	89.2	88.1	87.0	84.4	82.6	81.1	79.8	78.6	77.5	76.5
12.00	95.5	95.3	94.7	93.8	92.7	91.5	90.3	89.1	88.0	86.9	84.5	82.7	81.2	79.9	78.6	77.5	76.5
12.25	95.2	95.0	94.4	93.5	92.5	91.3	90.1	89.0	87.9	86.8	84.7	82.9	81.3	79.9	78.7	77.6	76.6
12.50	94.9	94.7	94.2	93.3	92.3	91.2	90.0	88.9	87.8	86.7	84.8	83.0	81.4	80.0	78.8	77.7	76.7
12.75	94.6	94.4	93.9	93.1	92.1	91.0	89.9	88.8	87.7	86.6	84.8	83.1	81.5	80.1	78.9	77.8	76.7
13.00	94.4	94.2	93.6	92.9	91.9	90.8	89.7	88.6	87.6	86.6	85.6	83.3	81.6	80.2	79.0	77.8	76.8
13.25	94.1	93.9	93.4	92.6	91.7	90.7	89.6	88.5	87.5	86.5	85.5	83.4	81.8	80.3	79.0	77.9	76.9
13.50	93.8	93.6	93.2	92.4	91.5	90.5	89.5	88.4	87.4	86.4	85.4	83.5	81.9	80.4	79.1	78.0	76.9
13.75	93.5	93.4	92.9	92.2	91.3	90.4	89.3	88.3	87.3	86.3	85.4	83.5	82.0	80.5	79.2	78.1	77.0
14.00	93.3	93.1	92.7	92.0	91.1	90.2	89.2	88.2	87.2	86.2	85.3	84.4	82.1	80.6	79.3	78.1	77.1
14.25	93.0	92.9	92.4	91.8	91.0	90.0	89.1	88.1	87.1	86.1	85.2	84.3	82.2	80.7	79.4	78.2	77.1
14.50	92.8	92.6	92.2	91.6	90.8	89.9	88.9	87.9	87.0	86.0	85.1	84.3	82.3	80.8	79.5	78.3	77.2
14.75	92.5	92.4	92.0	91.4	90.6	89.7	88.8	87.8	86.9	86.0	85.1	84.2	82.4	81.0	79.6	78.4	77.3
15.00	92.3	92.2	91.8	91.2	90.4	89.6	88.7	87.7	86.8	85.9	85.0	84.1	82.4	81.1	79.7	78.4	77.3
15.25	92.1	91.9	91.6	91.0	90.2	89.4	88.5	87.6	86.7	85.8	84.9	84.1	83.2	81.2	79.8	78.5	77.4
15.50	91.8	91.7	91.3	90.8	90.1	89.3	88.4	87.5	86.6	85.7	84.8	84.0	83.2	81.3	79.9	78.6	77.5
15.75	91.6	91.5	91.1	90.6	89.9	89.1	88.2	87.4	86.5	85.6	84.7	83.9	83.1	81.4	80.0	78.7	77.5
16.00	91.4	91.3	90.9	90.4	89.7	88.9	88.1	87.2	86.4	85.5	84.7	83.8	83.1	81.4	80.1	78.8	77.6
16.25	91.2	91.0	90.7	90.2	89.6	88.8	88.0	87.1	86.3	85.4	84.6	83.8	83.0	82.2	80.2	78.9	77.7
16.50	90.9	90.8	90.5	90.0	89.4	88.6	87.8	87.0	86.2	85.3	84.5	83.7	82.9	82.2	80.3	79.0	77.8
16.75	90.7	90.6	90.3	89.8	89.2	88.5	87.7	86.9	86.1	85.2	84.4	83.6	82.9	82.1	80.4	79.1	77.9
17.00	90.5	90.4	90.1	89.7	89.0	88.3	87.6	86.8	86.0	85.2	84.4	83.6	82.8	82.1	80.4	79.2	78.0
17.25	90.3	90.2	89.9	89.5	88.9	88.2	87.5	86.7	85.9	85.1	84.3	83.5	82.7	82.0	80.4	79.3	78.1
17.50	90.1	90.0	89.7	89.3	88.7	88.1	87.3	86.6	85.8	85.0	84.2	83.4	82.7	82.0	81.3	79.4	78.2
17.75	89.9	89.8	89.5	89.1	88.6	87.9	87.2	86.4	85.7	84.9	84.1	83.4	82.6	81.9	81.2	79.5	78.3
18.00	89.7	89.6	89.4	88.9	88.4	87.8	87.1	86.3	85.6	84.8	84.0	83.3	82.6	81.8	81.2	79.5	78.3

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TABLE 4D

APPROACH EPNL GRID VALUE SET 2

CURRENT TWO ENGINE AIRCRAFT

Distance From Landing Threshold (Miles)	SIDELINE DISTANCE (MILES)															
	0	1/4	1/2	3/4	1	1 1/4	1 1/2	1 3/4	2	2 1/4	2 1/2	2 3/4	3	3 1/4	3 1/2	3 3/4	
2.00	118.5	88.7	77.6	71.4	65.7	62.1	58.1	54.6	51.5	48.6	46.1	43.8	41.7	39.4	37.7	36.1	34.9
2.25	118.0	90.3	79.3	73.1	68.4	63.7	59.8	56.3	53.1	50.3	47.8	45.5	43.3	41.4	39.6	38.0	36.5
2.50	113.6	91.2	80.3	74.1	69.4	64.8	60.8	57.3	54.2	51.4	48.8	46.5	44.4	42.4	40.7	39.1	37.7
2.75	110.7	91.9	81.0	74.9	70.2	65.6	61.6	58.1	55.0	52.2	49.7	47.3	45.2	43.3	41.5	39.9	38.5
3.00	108.5	92.4	81.7	75.5	70.8	66.2	62.3	58.8	55.7	52.9	50.4	48.0	45.9	44.0	42.2	40.6	39.2
3.25	106.8	92.9	82.2	76.1	71.4	66.8	62.9	59.4	56.3	53.5	50.9	48.6	46.5	44.6	42.8	41.2	39.7
3.50	105.5	93.3	82.6	76.6	71.9	67.3	63.4	59.9	56.8	54.0	51.5	49.2	47.0	45.1	43.3	41.7	40.3
3.75	104.4	93.7	83.1	77.0	72.3	67.7	63.8	60.4	57.3	54.5	52.0	49.6	47.5	45.6	43.8	42.2	40.7
4.00	103.4	94.2	83.4	77.4	72.7	68.1	64.2	60.8	57.7	54.9	52.4	50.1	48.0	46.0	44.3	42.7	41.2
4.25	102.5	94.7	83.8	77.7	73.1	68.5	64.6	61.2	58.1	55.3	52.8	50.5	48.4	46.4	44.7	43.1	41.6
4.50	101.6	95.7	84.1	78.1	73.4	68.8	65.0	61.5	58.5	55.7	53.2	50.9	48.8	46.8	45.1	43.4	42.0
4.75	100.7	95.4	84.5	78.4	73.7	69.2	65.3	61.9	58.8	56.0	53.5	51.2	49.1	47.2	45.4	43.8	42.3
5.00	100.0	95.1	84.8	78.7	74.0	69.5	65.6	62.2	59.1	56.4	53.9	51.6	49.5	47.5	45.8	44.1	42.7
5.25	99.5	94.8	85.1	79.0	74.3	69.8	65.9	62.5	59.4	56.7	54.2	51.9	49.8	47.8	46.1	44.5	43.0
5.50	99.3	94.4	85.5	79.3	74.5	70.0	66.2	62.8	59.7	57.0	54.5	52.2	50.1	48.1	46.4	44.8	43.3
5.75	99.0	94.1	85.8	79.5	74.8	70.3	66.4	63.0	60.0	57.3	54.8	52.5	50.4	48.4	46.7	45.1	43.6
6.00	98.5	93.8	86.2	79.8	75.0	70.5	66.7	63.3	60.3	57.5	55.0	52.7	50.6	48.7	47.0	45.3	43.9
6.25	97.7	93.4	86.7	80.1	75.3	70.8	66.9	63.5	60.5	57.8	55.3	53.0	50.9	49.0	47.2	45.6	44.1
6.50	97.0	93.1	87.2	80.4	75.5	71.0	67.1	63.8	60.8	58.0	55.5	53.3	51.2	49.2	47.5	45.9	44.4
6.75	96.4	92.8	87.6	80.6	75.7	71.2	67.4	64.0	61.0	58.3	55.8	53.5	51.4	49.5	47.7	46.1	44.6
7.00	95.7	92.5	88.6	80.9	75.9	71.4	67.6	64.2	61.2	58.5	56.0	53.7	51.6	49.7	48.0	46.3	44.8
7.25	95.1	92.2	88.5	81.2	76.1	71.6	67.8	64.4	61.4	58.7	56.2	54.0	51.9	50.0	48.2	46.6	45.1
7.50	94.6	92.0	88.4	81.5	76.3	71.8	68.0	64.6	61.6	58.9	56.4	54.2	52.1	50.2	48.4	46.8	45.3
7.75	94.1	91.7	88.3	81.8	76.6	72.0	68.2	64.8	61.8	59.1	56.7	54.4	52.3	50.4	48.6	47.0	45.5
8.00	93.6	91.5	88.2	82.1	76.8	72.2	68.4	65.0	62.0	59.3	56.9	54.6	52.5	50.6	48.8	47.2	45.7
8.25	93.1	91.2	88.1	82.5	77.0	72.4	68.6	65.2	62.2	59.5	57.1	54.8	52.7	50.8	49.0	47.4	46.0
8.50	92.7	91.0	87.9	82.9	77.2	72.6	68.8	65.4	62.4	59.7	57.2	55.0	52.9	51.0	49.2	47.6	46.2
8.75	92.3	90.7	87.8	83.3	77.4	72.8	68.9	65.6	62.6	59.9	57.4	55.2	53.1	51.2	49.4	47.8	46.3
9.00	92.0	90.5	87.7	83.7	77.6	73.0	69.1	65.8	62.8	60.1	57.6	55.4	53.3	51.4	49.6	48.0	46.5
9.25	91.7	90.2	87.6	84.0	77.9	73.2	69.3	65.9	63.0	60.3	57.8	55.5	53.5	51.6	49.8	48.2	46.7
9.50	91.4	90.0	87.4	84.1	78.1	73.4	69.5	66.1	63.1	60.4	58.0	55.7	53.7	51.7	50.0	48.4	46.9
9.75	91.1	89.8	87.3	84.9	78.4	73.5	69.6	66.3	63.3	60.6	58.1	55.9	53.8	51.9	50.2	48.6	47.1
10.00	90.8	89.6	87.2	84.8	78.6	73.7	69.8	66.5	63.5	60.8	58.3	56.1	54.0	52.1	50.3	48.7	47.2
10.25	90.5	89.3	87.0	84.8	78.9	73.9	70.0	66.6	63.6	60.9	58.5	56.2	54.2	52.3	50.5	48.9	47.4
10.50	90.2	89.1	86.9	84.7	79.2	74.1	70.2	66.8	63.8	61.1	58.6	56.4	54.3	52.4	50.7	49.1	47.6
10.75	89.9	88.9	86.8	84.6	79.5	74.3	70.3	66.9	63.9	61.2	58.8	56.6	54.5	52.6	50.8	49.2	47.7
11.00	89.7	88.7	86.7	84.5	79.8	74.5	70.5	67.1	64.1	61.4	59.0	56.7	54.6	52.7	51.0	49.4	47.9
11.25	89.4	88.5	86.5	84.5	80.2	74.8	70.7	67.3	64.3	61.6	59.1	56.9	54.8	52.9	51.1	49.5	48.1
11.50	89.2	88.3	86.4	84.4	80.5	75.0	70.9	67.4	64.4	61.7	59.3	57.0	55.0	53.1	51.3	49.7	48.2
11.75	88.9	88.1	86.3	84.3	80.7	75.2	71.0	67.6	64.6	61.9	59.4	57.2	55.1	53.2	51.5	49.8	48.4
12.00	88.7	87.9	86.2	84.2	80.8	75.5	71.2	67.7	64.7	62.0	59.6	57.3	55.2	53.4	51.6	50.0	48.5
12.25	88.5	87.7	86.0	84.1	81.6	75.7	71.4	67.9	64.9	62.2	59.7	57.5	55.4	53.5	51.7	50.1	48.6
12.50	88.3	87.5	85.9	84.0	81.5	76.0	71.6	68.1	65.0	62.3	59.8	57.6	55.5	53.6	51.9	50.3	48.8
12.75	88.1	87.4	85.8	83.9	81.4	76.2	71.8	68.2	65.2	62.5	60.0	57.7	55.7	53.8	52.0	50.4	48.9
13.00	87.8	87.2	85.6	83.8	81.3	76.5	72.0	68.4	65.3	62.6	60.1	57.9	55.8	53.9	52.2	50.6	49.1
13.25	87.6	87.0	85.5	83.6	81.3	76.8	72.2	68.6	65.5	62.7	60.3	58.0	56.0	54.1	52.3	50.7	49.2
13.50	87.4	86.8	85.4	83.5	81.2	77.1	72.4	68.7	65.6	62.9	60.4	58.2	56.1	54.2	52.4	50.8	49.3
13.75	87.3	86.7	85.3	83.4	81.1	77.4	72.6	68.9	65.8	63.0	60.5	58.3	56.2	54.3	52.6	51.0	49.5
14.00	87.1	86.5	85.2	83.3	81.0	77.7	72.8	69.1	65.9	63.2	60.7	58.4	56.4	54.5	52.7	51.1	49.6
14.25	86.9	86.3	85.0	83.1	80.9	77.9	73.0	69.2	66.1	63.3	60.8	58.6	56.5	54.6	52.8	51.2	49.7
14.50	86.7	86.2	84.9	83.0	80.8	77.9	73.3	69.4	66.2	63.4	61.0	58.7	56.6	54.7	53.0	51.4	49.9
14.75	86.5	86.0	84.8	82.9	80.7	78.7	73.5	69.6	66.4	63.6	61.1	58.8	56.8	54.9	53.1	51.5	50.0
15.00	86.4	85.9	84.7	82.8	80.7	78.7	73.8	69.8	66.5	63.7	61.2	59.0	56.9	55.0	53.2	51.6	50.1
15.25	86.2	85.7	84.6	82.7	80.6	78.6	74.0	70.0	66.7	63.9	61.4	59.1	57.0	55.1	53.3	51.7	50.2
15.50	86.0	85.6	84.4	82.5	80.5	78.5	74.3	70.2	66.9	64.0	61.5	59.2	57.1	55.2	53.5	51.9	50.4
15.75	85.8	85.4	84.3	82.4	80.4	78.5	74.6	70.4	67.0	64.2	61.6	59.3	57.3	55.4	53.6	52.0	50.5
16.00	85.7	85.3	84.2	82.3	80.3	78.4	74.9	70.6	67.2	64.3	61.8	59.5	57.4	55.5	53.7	52.1	50.6
16.25	85.5	85.1	84.1	82.2	80.2	78.3	75.1	70.8	67.3	64.5	61.9	59.6	57.5	55.6	53.8	52.2	50.7
16.50	85.4	85.0	83.9	82.0	80.1	78.3	75.3	71.0	67.5	64.6	62.0	59.7	57.6	55.7	54.0	52.3	50.8
16.75	85.2	84.8	83.7	81.9	80.0	78.2	75.5	71.2	67.7	64.7	62.2	59.9	57.8	55.8	54.1	52.5	51.0
17.00	85.1	84.7	83.6	81.8	79.9	78.1	75.6	71.5	67.9	64.9	62.3	60.0	57.9	56.0	54.2	52.6	51.1
17.25	84.9	84.6	83.4	81.7	79.8	78.1	76.4	71.7	68.0	65.0	62.4	60.1	58.0	56.1	54.3	52.7	51.2
17.50	84.8	84.4	83.3	81.6	79.8	78.0	76.3	71.9	68.2	65.2	62.6	60.2	58.1	56.2	54.4	52.8	51.3
17.75	84.6	84.3	83.1	81.4	79.7	77.9	76.3	72.2	68.4	65.4	62.7	60.4	58.3	56.3	54.5	52.9	51.4
18.00	84.5	84.2	83.0	81.3	79.6	77.8	76.2	72.4	68.6	65.5	62.9	60.5	58.4	56.4	54.7	53.0	51.5

TABLE 5D

TAKEOFF EPNL GRID VALUE SET A3

CURRENT THREE ENGINE AIRCRAFT

Dist. From Start of T/O Roll (Miles)	SIDELINE DISTANCE (MILES)																
	0	1/4	1/2	3/4	1	1 1/4	1 1/2	2 3/4	2	2 1/4	2 1/2	2 3/4	3	3 1/4	3 1/2	3 3/4	4
2.00	110.6	107.7	104.0	99.0	95.6	92.2	89.4	87.1	85.1	83.3	81.7	80.3	79.0	77.8	76.7	75.7	74.8
2.25	108.9	107.3	105.0	99.8	95.1	92.6	89.8	87.5	85.5	83.7	82.1	80.7	79.4	78.2	77.1	76.1	75.1
2.50	107.7	106.9	104.7	100.7	95.6	93.0	90.2	87.9	85.8	84.0	82.4	81.0	79.7	78.5	77.4	76.4	75.4
2.75	107.1	106.2	104.3	101.5	97.0	93.4	90.6	88.2	86.1	84.3	82.7	81.3	80.0	78.8	77.7	76.6	75.7
3.00	106.4	105.6	103.9	102.2	97.6	93.8	90.9	88.5	86.4	84.6	83.0	81.6	80.2	79.0	77.9	76.9	75.9
3.25	105.7	105.0	103.5	102.0	98.2	94.2	91.2	88.7	86.7	84.9	83.3	81.8	80.5	79.3	78.1	77.1	76.1
3.50	105.0	104.5	103.1	101.7	99.2	94.6	91.5	89.0	86.9	85.1	83.5	82.0	80.7	79.5	78.4	77.3	76.3
3.75	104.5	104.0	102.8	101.2	98.8	95.1	91.8	89.3	87.2	85.3	83.7	82.2	80.9	79.7	78.6	77.5	76.5
4.00	103.9	103.4	102.4	100.8	98.5	95.5	92.1	89.5	87.4	85.5	83.9	82.4	81.1	79.9	78.7	77.7	76.7
4.25	103.3	103.0	102.1	100.3	98.2	96.2	92.5	89.8	87.6	85.7	84.1	82.6	81.3	80.1	78.9	77.9	76.9
4.50	102.8	102.5	101.8	99.8	97.9	96.0	93.0	90.1	87.9	85.9	84.3	82.8	81.5	80.2	79.1	78.0	77.0
4.75	102.4	102.1	101.1	99.4	97.5	95.7	93.1	90.4	88.1	86.2	84.5	83.0	81.6	80.4	79.2	78.2	77.2
5.00	102.0	101.8	100.5	98.9	97.2	95.4	93.8	90.8	88.3	86.4	84.6	83.1	81.8	80.5	79.4	78.3	77.3
5.25	101.5	101.1	100.0	98.5	95.8	95.2	93.6	91.1	88.6	86.6	84.8	83.3	81.9	80.7	79.5	78.5	77.5
5.50	100.8	100.4	99.4	98.0	96.5	94.9	93.4	92.0	88.9	86.8	85.0	83.5	82.1	80.8	79.7	78.6	77.6
5.75	100.1	99.8	98.9	97.6	96.1	94.6	93.2	91.8	89.2	87.0	85.2	83.6	82.2	81.0	79.8	78.7	77.7
6.00	99.5	99.2	98.3	97.2	95.8	94.4	93.0	91.6	89.5	87.3	85.4	83.8	82.4	81.1	79.9	78.9	77.9
6.25	98.9	98.6	97.8	96.7	95.4	94.1	92.7	91.4	90.2	87.6	85.6	84.0	82.5	81.3	80.1	79.0	78.0
6.50	98.3	98.1	97.4	96.3	95.1	93.8	92.5	91.3	90.1	87.8	85.9	84.2	82.7	81.4	80.2	79.1	78.1
6.75	97.8	97.5	96.9	95.9	94.8	93.5	92.3	91.1	89.9	87.9	86.1	84.4	82.9	81.5	80.3	79.2	78.2
7.00	97.2	97.0	96.4	95.5	94.4	93.2	92.0	90.9	89.7	88.7	86.4	84.6	83.0	81.7	80.5	79.4	78.3
7.25	96.7	96.5	96.0	95.1	94.1	93.0	91.8	90.7	89.6	88.5	86.6	84.8	83.2	81.8	80.6	79.5	78.5
7.50	96.3	96.1	95.5	94.7	93.8	92.7	91.6	90.5	89.4	88.4	87.4	85.0	83.4	82.0	80.7	79.6	78.6
7.75	95.8	95.6	95.1	94.4	93.4	92.4	91.4	90.3	89.2	88.2	87.3	85.2	83.6	82.2	80.9	79.7	78.7
8.00	95.3	95.2	94.7	94.0	93.1	92.1	91.1	90.1	89.1	88.1	87.1	85.3	83.8	82.3	81.0	79.9	78.8
8.25	94.9	94.7	94.3	93.6	92.8	91.9	90.9	89.9	88.9	87.9	87.0	86.1	84.0	82.5	81.2	80.0	78.9
8.50	94.5	94.3	93.9	93.3	92.5	91.6	90.7	89.7	88.7	87.8	86.9	86.0	84.2	82.7	81.3	80.1	79.0
8.75	94.1	93.9	93.5	92.9	92.2	91.3	90.4	89.5	88.6	87.7	86.8	85.9	84.2	82.9	81.5	80.3	79.2
9.00	93.7	93.5	93.2	92.6	91.9	91.1	90.2	89.3	88.4	87.5	86.6	85.8	85.0	83.1	81.7	80.4	79.3
9.25	93.3	93.2	92.8	92.3	91.6	90.8	90.0	89.1	88.2	87.4	86.5	85.7	84.9	83.2	81.9	80.6	79.4
9.50	92.9	92.8	92.5	92.0	91.3	90.6	89.7	88.9	88.0	87.2	86.4	85.6	84.8	84.0	82.0	80.7	79.5
9.75	92.5	92.4	92.1	91.6	91.0	90.3	89.5	88.7	87.9	87.0	86.2	85.4	84.7	83.9	82.2	80.9	79.7
10.00	92.2	92.1	91.8	91.3	90.7	90.0	89.3	88.5	87.7	86.9	86.1	85.3	84.6	83.8	82.2	81.1	79.8
10.25	91.8	91.7	91.5	91.0	90.5	89.8	89.1	88.3	87.5	86.7	86.0	85.2	84.5	83.7	83.0	81.2	80.0
10.50	91.5	91.4	91.1	90.7	90.2	89.6	88.9	88.1	87.4	86.6	85.8	85.1	84.3	83.6	82.9	81.3	80.2
10.75	91.2	91.1	90.8	90.4	89.9	89.3	88.6	87.9	87.2	86.4	85.7	85.0	84.2	83.5	82.9	81.3	80.3
11.00	90.9	90.8	90.5	90.2	89.7	89.1	88.4	87.7	87.0	86.3	85.6	84.8	84.1	83.4	82.8	82.1	80.4
11.25	90.5	90.5	90.2	89.9	89.4	88.8	88.2	87.5	86.8	86.1	85.4	84.7	84.0	83.3	82.7	82.0	80.5
11.50	90.2	90.2	90.0	89.6	89.1	88.6	88.0	87.3	86.7	86.0	85.3	84.6	83.9	83.2	82.6	82.0	81.3
11.75	89.9	89.9	89.7	89.3	88.9	88.4	87.8	87.1	86.5	85.8	85.1	84.5	83.8	83.1	82.5	81.9	81.3
12.00	89.7	89.6	89.4	89.1	88.6	88.1	87.6	87.0	86.3	85.7	85.0	84.3	83.7	83.0	82.4	81.8	81.2
12.25	89.4	89.3	89.1	88.8	88.4	87.9	87.4	86.8	86.1	85.5	84.9	84.2	83.6	82.9	82.3	81.7	81.1
12.50	89.1	89.0	88.8	88.6	88.2	87.7	87.2	86.6	86.0	85.4	84.7	84.1	83.5	82.8	82.2	81.6	81.0
12.75	88.8	88.8	88.6	88.3	87.9	87.5	87.0	86.4	85.8	85.2	84.6	84.0	83.3	82.7	82.1	81.5	81.0
13.00	88.6	88.5	88.3	88.1	87.7	87.3	86.8	86.2	85.6	85.0	84.4	83.8	83.2	82.6	82.0	81.4	80.9
13.25	88.3	88.2	88.1	87.8	87.5	87.0	86.6	86.0	85.5	84.9	84.3	83.7	83.1	82.5	81.9	81.4	80.8
13.50	88.0	88.0	87.8	87.6	87.2	86.8	86.4	85.9	85.3	84.7	84.2	83.6	83.0	82.4	81.8	81.3	80.7
13.75	87.8	87.7	87.6	87.3	87.0	86.6	86.2	85.7	85.1	84.6	84.0	83.4	82.9	82.3	81.7	81.2	80.6
14.00	87.5	87.5	87.4	87.1	85.8	86.4	86.0	85.5	85.0	84.4	83.9	83.3	82.8	82.2	81.6	81.1	80.5
14.25	87.3	87.3	87.1	86.9	85.6	86.2	85.8	85.3	84.8	84.3	83.7	83.2	82.6	82.1	81.5	81.0	80.5
14.50	87.1	87.0	86.9	86.7	85.4	86.0	85.6	85.1	84.7	84.1	83.6	83.1	82.5	82.0	81.4	80.9	80.4
14.75	86.8	86.8	86.7	86.4	86.2	85.8	85.4	85.0	84.5	84.0	83.5	82.9	82.4	81.9	81.3	80.8	80.3
15.00	86.6	86.6	86.4	86.2	86.0	85.6	85.2	84.8	84.3	83.8	83.3	82.8	82.3	81.8	81.2	80.7	80.2
15.25	86.4	86.3	86.2	86.0	85.8	85.4	85.0	84.6	84.2	83.7	83.2	82.7	82.2	81.7	81.1	80.6	80.1
15.50	86.2	86.1	86.0	85.8	85.6	85.2	84.9	84.5	84.0	83.5	83.1	82.6	82.1	81.6	81.1	80.5	80.1
15.75	85.9	85.9	85.8	85.6	85.4	85.0	84.7	84.3	83.9	83.4	82.9	82.4	81.9	81.4	81.0	80.5	80.0
16.00	85.7	85.7	85.6	85.4	85.2	84.9	84.5	84.1	83.7	83.3	82.8	82.3	81.8	81.3	80.9	80.4	79.9
16.25	85.5	85.5	85.4	85.2	85.0	84.7	84.3	84.0	83.6	83.1	82.7	82.2	81.7	81.2	80.8	80.3	79.8
16.50	85.3	85.3	85.2	85.0	84.8	84.5	84.2	83.8	83.4	83.0	82.5	82.1	81.6	81.1	80.7	80.2	79.7
16.75	85.1	85.1	85.0	84.8	84.6	84.3	84.0	83.6	83.2	82.8	82.4	81.9	81.5	81.0	80.6	80.1	79.5
17.00	84.9	84.9	84.8	84.6	84.4	84.1	83.8	83.5	83.1	82.7	82.3	81.8	81.4	80.9	80.5	80.0	79.5
17.25	84.7	84.7	84.6	84.4	84.2	84.0	83.7	83.3	82.9	82.5	82.1	81.7	81.3	80.8	80.4	79.9	79.5
17.50	84.5	84.5	84.4	84.2	84.0	83.8	83.5	83.2	82.8	82.4	82.0	81.6	81.1	80.7	80.3	79.8	79.4
17.75	84.3	84.3	84.2	84.1	83.9	83.6	83.3	83.0	82.7	82.3	81.9	81.5	81.0	80.6	80.2	79.7	79.3
18.00	84.1	84.1	84.0	83.9	83.7	83.5	83.2	82.9	82.5	82.1	81.7	81.3	80.9	80.5	80.1	79.6	79.2

TAKEOFF EPNL GRID VALUE SET B3

CURRENT THREE ENGINE AIRCRAFT

Dist. From Start of T/O Roll (Miles)	SIDELINE DISTANCE (MILES) 0	1/4	1/2	3/4	1	1 1/4	1 1/2	2 3/4	2	2 1/4	2 1/2	2 3/4	3	3 1/4	3 1/2	3 3/4	4
2.00	113.9	109.9	101.4	97.3	94.3	90.9	88.2	85.9	84.0	82.2	80.7	79.3	78.0	76.9	75.8	74.8	73.9
2.25	112.5	109.1	102.2	98.0	94.8	91.5	88.7	86.4	84.4	82.7	81.1	79.7	78.4	77.3	76.2	75.2	74.3
2.50	111.6	108.2	103.1	98.6	95.3	91.9	89.1	86.8	84.8	83.0	81.5	80.1	78.8	77.6	76.5	75.5	74.6
2.75	110.4	107.7	104.2	99.1	95.7	92.3	89.5	87.2	85.1	83.4	81.8	80.4	79.1	77.9	76.8	75.9	74.8
3.00	109.0	107.4	105.0	99.7	96.1	92.6	89.8	87.5	85.4	83.7	82.1	80.7	79.4	78.2	77.1	76.0	75.1
3.25	107.8	107.0	104.8	100.4	95.4	92.9	90.1	87.7	85.7	83.9	82.3	80.9	79.6	78.4	77.3	76.3	75.3
3.50	107.4	106.6	104.5	101.1	95.8	93.2	90.4	88.0	86.0	84.2	82.6	81.1	79.8	78.6	77.5	76.5	75.5
3.75	107.0	106.1	104.2	102.3	97.1	93.5	90.6	88.2	86.2	84.4	82.8	81.4	80.0	78.8	77.7	76.7	75.7
4.00	106.4	105.6	103.9	102.2	97.6	93.8	90.9	88.5	86.4	84.6	83.0	81.6	80.2	79.0	77.9	76.9	75.9
4.25	105.9	105.2	103.6	102.0	98.0	94.1	91.1	88.7	86.6	84.8	83.2	81.7	80.4	79.2	78.1	77.1	76.1
4.50	105.3	104.8	103.3	101.8	98.4	94.4	91.3	88.9	86.8	85.0	83.4	81.9	80.6	79.4	78.3	77.2	76.2
4.75	104.9	104.4	103.0	101.6	99.1	94.7	91.6	89.1	87.0	85.2	83.5	82.1	80.8	79.5	78.4	77.4	76.4
5.00	104.4	103.9	102.7	101.2	98.8	95.1	91.8	89.3	87.2	85.3	83.7	82.2	80.9	79.7	78.6	77.5	76.5
5.25	104.0	103.5	102.5	100.9	98.6	95.4	92.1	89.5	87.3	85.5	83.9	82.4	81.1	79.8	78.7	77.7	76.7
5.50	103.6	103.2	102.2	100.5	98.3	96.3	92.4	89.7	87.5	85.7	84.0	82.5	81.2	80.0	78.8	77.8	76.8
5.75	103.2	102.8	102.0	100.1	98.1	96.1	92.7	89.9	87.7	85.8	84.2	82.7	81.3	80.1	79.0	77.9	76.9
6.00	102.8	102.5	101.7	99.8	97.8	95.9	93.0	90.1	87.9	86.0	84.3	82.8	81.5	80.2	79.1	78.0	77.1
6.25	102.4	102.2	101.2	99.4	97.6	95.7	93.2	90.4	88.1	86.1	84.4	82.9	81.6	80.4	79.2	78.2	77.2
6.50	102.1	101.9	100.8	99.1	97.3	95.5	93.9	90.7	88.3	86.3	84.6	83.1	81.7	80.5	79.3	78.3	77.3
6.75	101.9	101.5	100.3	98.7	97.0	95.3	93.7	90.9	88.5	86.4	84.7	83.2	81.8	80.6	79.4	78.4	77.4
7.00	101.4	101.0	99.9	98.4	96.8	95.1	93.6	91.2	88.7	86.6	84.9	83.3	82.0	80.7	79.6	78.5	77.5
7.25	100.8	100.5	99.5	98.1	96.5	94.9	93.4	92.0	88.9	86.8	85.0	83.5	82.1	80.8	79.7	78.6	77.6
7.50	100.3	100.0	99.0	97.7	95.2	94.7	93.2	91.9	89.2	87.0	85.2	83.6	82.2	80.9	79.8	78.7	77.7
7.75	99.8	99.5	98.6	97.4	95.0	94.5	93.1	91.7	89.4	87.2	85.3	83.7	82.3	81.0	79.9	78.8	77.9
8.00	99.4	99.1	98.2	97.1	95.7	94.3	92.9	91.6	89.4	87.4	85.5	83.8	82.4	81.1	80.0	78.9	77.9
8.25	98.9	98.6	97.8	96.7	95.4	94.1	92.7	91.4	90.2	87.6	85.6	84.0	82.5	81.3	80.1	79.0	78.0
8.50	98.5	98.2	97.5	96.4	95.2	93.9	92.6	91.3	90.1	87.8	85.8	84.1	82.7	81.4	80.2	79.1	78.1
8.75	98.0	97.8	97.1	96.1	94.9	93.7	92.4	91.2	90.0	87.9	86.0	84.3	82.8	81.5	80.3	79.2	78.2
9.00	97.6	97.4	96.7	95.8	94.7	93.4	92.2	91.0	89.9	88.8	86.2	84.4	82.9	81.6	80.4	79.3	78.3
9.25	97.2	97.0	96.4	95.5	94.4	93.2	92.0	90.9	89.7	88.7	86.4	84.6	83.0	81.7	80.5	79.4	78.3
9.50	96.8	96.6	96.1	95.2	94.2	93.0	91.9	90.7	89.6	88.5	86.5	84.8	83.2	81.8	80.6	79.5	78.4
9.75	96.5	96.3	95.7	94.9	93.9	92.8	91.7	90.6	89.5	88.4	86.6	84.9	83.3	81.9	80.7	79.6	78.5
10.00	96.1	95.9	95.4	94.6	93.7	92.6	91.5	90.4	89.4	88.3	87.4	85.1	83.5	82.0	80.8	79.6	78.6
10.25	95.7	95.6	95.1	94.3	93.4	92.4	91.3	90.3	89.2	88.2	87.3	85.3	83.6	82.2	80.9	79.7	78.7
10.50	95.4	95.2	94.8	94.0	93.2	92.2	91.2	90.1	89.1	88.1	87.2	85.3	83.8	82.3	81.0	79.8	78.8
10.75	95.1	94.9	94.4	93.8	92.9	92.0	91.0	90.0	89.0	88.0	87.1	86.2	83.9	82.4	81.1	79.9	78.9
11.00	94.7	94.6	94.1	93.5	92.7	91.8	90.8	89.8	88.8	87.9	87.0	86.1	84.1	82.6	81.2	80.0	79.0
11.25	94.4	94.3	93.9	93.2	92.4	91.6	90.6	89.7	88.7	87.8	86.9	86.0	84.2	82.7	81.4	80.1	79.1
11.50	94.1	94.0	93.6	93.0	92.2	91.4	90.4	89.5	88.6	87.7	86.8	85.9	84.2	82.9	81.5	80.3	79.1
11.75	93.8	93.7	93.3	92.7	92.0	91.2	90.3	89.4	88.4	87.6	86.7	85.8	85.0	83.0	81.6	80.4	79.2
12.00	93.5	93.4	93.0	92.5	91.8	91.0	90.1	89.2	88.3	87.4	86.6	85.7	84.9	83.1	81.8	80.5	79.3
12.25	93.2	93.1	92.7	92.2	91.5	90.8	89.9	89.1	88.2	87.3	86.5	85.7	84.9	83.2	81.9	80.6	79.4
12.50	92.9	92.8	92.5	92.0	91.3	90.6	89.7	88.9	88.1	87.2	86.4	85.6	84.8	84.0	82.0	80.7	79.5
12.75	92.6	92.5	92.2	91.7	91.1	90.4	89.6	88.8	87.9	87.1	86.3	85.5	84.7	83.9	82.1	80.8	79.7
13.00	92.4	92.3	92.0	91.5	90.9	90.2	89.4	88.6	87.8	87.0	86.2	85.4	84.6	83.9	82.2	81.0	79.8
13.25	92.1	92.0	91.7	91.2	90.7	90.0	89.2	88.5	87.7	86.9	86.1	85.3	84.5	83.8	82.2	81.1	79.9
13.50	91.8	91.7	91.5	91.0	90.5	89.8	89.1	88.3	87.5	86.7	86.0	85.2	84.5	83.7	83.0	81.2	80.0
13.75	91.6	91.5	91.2	90.8	90.2	89.6	88.9	88.2	87.4	86.6	85.9	85.1	84.4	83.7	83.0	81.3	80.1
14.00	91.3	91.2	91.0	90.6	90.0	89.4	88.7	88.0	87.3	86.5	85.7	85.0	84.3	83.6	82.9	81.3	80.2
14.25	91.1	91.0	90.7	90.3	89.8	89.2	88.6	87.9	87.1	86.4	85.6	84.9	84.2	83.5	82.9	82.2	80.4
14.50	90.8	90.7	90.5	90.1	89.6	89.0	88.4	87.7	87.0	86.3	85.5	84.8	84.1	83.4	82.8	82.1	80.5
14.75	90.6	90.5	90.3	89.9	89.4	88.9	88.2	87.6	86.9	86.1	85.4	84.7	84.0	83.4	82.7	82.1	80.5
15.00	90.4	90.3	90.1	89.7	89.2	88.7	88.1	87.4	86.7	86.0	85.3	84.6	83.9	83.3	82.6	82.0	80.5
15.25	90.1	90.1	89.8	89.5	89.0	88.5	87.9	87.3	86.6	85.9	85.2	84.5	83.9	83.2	82.6	81.9	81.3
15.50	89.9	89.8	89.6	89.3	88.9	88.3	87.7	87.1	86.5	85.8	85.1	84.4	83.8	83.1	82.5	81.9	81.3
15.75	89.7	89.6	89.4	89.1	88.7	88.2	87.6	87.0	86.3	85.7	85.0	84.3	83.7	83.0	82.4	81.8	81.2
16.00	89.5	89.4	89.2	88.9	88.5	88.0	87.4	86.8	86.2	85.6	84.9	84.2	83.6	83.0	82.3	81.7	81.1
16.25	89.2	89.2	89.0	88.7	88.3	87.8	87.3	86.7	86.1	85.4	84.8	84.2	83.5	82.9	82.3	81.7	81.1
16.50	89.0	89.0	88.8	88.5	88.1	87.6	87.1	86.5	85.9	85.3	84.7	84.1	83.4	82.8	82.2	81.6	81.0
16.75	88.8	88.8	88.6	88.3	87.9	87.5	87.0	86.4	85.8	85.2	84.6	84.0	83.3	82.7	82.1	81.5	81.0
17.00	88.6	88.6	88.4	88.1	87.8	87.3	86.8	86.3	85.7	85.1	84.5	83.9	83.3	82.6	82.1	81.5	80.9
17.25	88.4	88.4	88.2	87.9	87.6	87.1	86.7	86.1	85.6	85.0	84.4	83.8	83.2	82.6	82.0	81.4	80.8
17.50	88.2	88.2	88.0	87.8	87.4	87.0	86.5	86.0	85.4	84.9	84.3	83.7	83.1	82.5	81.9	81.3	80.8
17.75	88.0	88.0	87.8	87.6	87.2	86.8	86.4	85.8	85.3	84.7	84.2	83.6	83.0	82.4	81.8	81.3	80.7
18.00	87.8	87.8	87.6	87.4	87.1	86.7	86.2	85.7	85.2	84.6	84.0	83.5	82.9	82.3	81.8	81.2	80.7

TAKEOFF EPNL GRID VALUE SET C3

CURRENT THREE ENGINE AIRCRAFT

SIDELINE DISTANCE (MILES)

Dist. From Start of T/O Roll (Miles)	0	1/4	1/2	3/4	1	1 1/4	1 1/2	2 3/4	2	2 1/4	2 1/2	2 3/4	3	3 1/4	3 1/2	3 3/4	4
2.00	119.3	107.0	99.4	95.6	92.8	89.5	86.9	84.6	82.7	81.0	79.5	78.2	77.0	75.8	74.9	73.8	72.9
2.25	116.7	107.9	100.3	96.4	93.5	90.2	87.5	85.2	83.3	81.6	80.1	78.7	77.4	76.3	75.2	74.3	73.3
2.50	114.8	109.0	101.0	97.0	94.0	90.7	88.0	85.7	83.7	82.0	80.5	79.1	77.8	76.7	75.6	74.6	73.7
2.75	113.4	109.7	101.6	97.6	94.5	91.1	88.4	86.1	84.1	82.4	80.8	79.4	78.2	77.0	75.9	74.9	74.0
3.00	112.4	109.0	102.3	98.0	94.9	91.5	88.7	86.4	84.5	82.7	81.1	79.7	78.5	77.3	76.2	75.2	74.3
3.25	111.7	108.4	103.0	98.5	95.2	91.8	89.1	86.7	84.7	83.0	81.4	80.0	78.7	77.6	76.5	75.5	74.5
3.50	110.8	107.8	103.8	98.9	95.5	92.1	89.4	87.0	85.0	83.3	81.7	80.3	79.0	77.8	76.7	75.7	74.7
3.75	109.9	107.6	105.2	99.4	95.8	92.4	89.6	87.3	85.3	83.5	81.9	80.5	79.2	78.0	76.9	75.9	74.9
4.00	108.8	107.3	105.0	99.8	96.1	92.7	89.9	87.5	85.5	83.7	82.1	80.7	79.4	78.2	77.1	76.1	75.1
4.25	107.9	107.0	104.8	100.3	96.4	92.9	90.1	87.7	85.7	83.9	82.3	80.9	79.6	78.4	77.3	76.3	75.3
4.50	107.5	106.7	104.6	100.9	96.7	93.1	90.3	87.9	85.9	84.1	82.5	81.1	79.8	78.6	77.5	76.4	75.4
4.75	107.2	106.4	104.4	101.4	96.9	93.3	90.5	88.1	86.1	84.3	82.7	81.2	79.9	78.7	77.6	76.6	75.6
5.00	106.9	106.0	104.2	102.3	97.2	93.5	90.7	88.3	86.2	84.5	82.8	81.4	80.1	78.9	77.8	76.7	75.8
5.25	106.4	105.6	103.9	102.2	97.6	93.8	90.9	88.5	86.4	84.6	83.0	81.6	80.2	79.0	77.9	76.9	75.9
5.50	106.0	105.3	103.7	102.0	97.9	94.0	91.0	88.6	86.6	84.8	83.2	81.7	80.4	79.2	78.1	77.0	76.0
5.75	105.6	104.9	103.5	101.9	98.3	94.2	91.2	88.8	86.7	84.9	83.3	81.8	80.5	79.3	78.2	77.1	76.2
6.00	105.2	104.6	103.2	101.8	99.2	94.5	91.4	88.9	86.9	85.0	83.4	82.0	80.6	79.4	78.3	77.3	76.3
6.25	104.9	104.3	103.0	101.5	99.1	94.7	91.6	89.1	87.0	85.2	83.6	82.1	80.8	79.6	78.4	77.4	76.4
6.50	104.5	104.0	102.8	101.3	98.9	95.0	91.8	89.3	87.1	85.3	83.7	82.2	80.9	79.7	78.5	77.5	76.5
6.75	104.2	103.7	102.6	101.0	98.7	95.3	92.0	89.4	87.3	85.4	83.8	82.3	81.0	79.8	78.7	77.6	76.6
7.00	103.8	103.4	102.4	100.7	98.5	95.5	92.2	89.6	87.4	85.6	83.9	82.5	81.1	79.9	78.8	77.7	76.7
7.25	103.5	103.1	102.2	100.4	98.3	96.3	92.4	89.7	87.5	85.7	84.0	82.6	81.2	80.0	78.9	77.8	76.8
7.50	103.2	102.8	102.0	100.2	98.1	96.1	92.7	89.9	87.7	85.8	84.1	82.7	81.3	80.1	79.0	77.9	76.9
7.75	102.9	102.6	101.8	99.9	97.9	96.0	92.9	90.1	87.8	85.9	84.3	82.8	81.4	80.2	79.1	78.0	77.0
8.00	102.6	102.3	101.5	99.6	97.7	95.9	93.1	90.3	88.0	86.0	84.4	82.9	81.5	80.3	79.2	78.1	77.1
8.25	102.4	102.1	101.1	99.4	97.5	95.7	93.1	90.4	88.1	86.2	84.5	83.0	81.6	80.4	79.2	78.2	77.2
8.50	102.1	101.9	100.8	99.1	97.3	95.5	93.9	90.7	88.3	86.3	84.6	83.1	81.7	80.5	79.3	78.3	77.3
8.75	101.9	101.6	100.4	98.8	97.1	95.4	93.8	90.9	88.4	86.4	84.7	83.2	81.8	80.6	79.4	78.4	77.4
9.00	101.6	101.2	100.1	98.6	96.9	95.2	93.7	91.1	88.6	86.5	84.8	83.3	81.9	80.7	79.5	78.4	77.5
9.25	101.2	100.8	99.7	98.3	96.7	95.1	93.5	91.2	88.7	86.7	84.9	83.4	82.0	80.7	79.6	78.5	77.5
9.50	100.8	100.4	99.4	98.0	96.5	94.9	93.4	92.0	88.9	86.8	85.0	83.5	82.1	80.8	79.7	78.6	77.6
9.75	100.4	100.1	99.1	97.8	96.3	94.8	93.3	91.9	89.1	86.9	85.1	83.6	82.2	80.9	79.8	78.7	77.7
10.00	100.0	99.7	98.8	97.5	96.1	94.6	93.1	91.8	89.3	87.1	85.2	83.7	82.3	81.0	79.8	78.8	77.8
10.25	99.7	99.3	98.5	97.3	95.9	94.4	93.0	91.7	89.4	87.2	85.4	83.8	82.4	81.1	79.9	78.8	77.9
10.50	99.3	99.0	98.2	97.0	95.7	94.3	92.9	91.6	89.4	87.4	85.5	83.9	82.4	81.2	80.0	78.9	77.9
10.75	98.9	98.7	97.9	96.8	95.5	94.1	92.8	91.5	90.2	87.6	85.6	84.0	82.5	81.2	80.1	79.0	78.0
11.00	98.6	98.3	97.6	96.5	95.3	93.9	92.6	91.3	90.1	87.7	85.8	84.1	82.6	81.3	80.1	79.1	78.0
11.25	98.3	98.0	97.3	96.3	95.1	93.8	92.5	91.2	90.0	87.9	85.9	84.2	82.7	81.4	80.2	79.1	78.1
11.50	97.9	97.7	97.0	96.0	94.9	93.6	92.4	91.1	90.0	87.9	86.0	84.3	82.8	81.5	80.3	79.2	78.2
11.75	97.6	97.4	96.8	95.8	94.7	93.4	92.2	91.0	89.9	88.8	86.2	84.4	82.9	81.6	80.4	79.3	78.3
12.00	97.3	97.1	96.5	95.6	94.5	93.3	92.1	90.9	89.8	88.7	86.3	84.5	83.0	81.7	80.4	79.3	78.3
12.25	97.0	96.8	96.2	95.3	94.3	93.1	91.9	90.8	89.7	88.6	86.5	84.7	83.1	81.7	80.5	79.4	78.4
12.50	96.7	96.5	96.0	95.1	94.1	93.0	91.8	90.7	89.6	88.5	86.6	84.8	83.2	81.8	80.6	79.5	78.5
12.75	96.4	96.2	95.7	94.9	93.9	92.8	91.7	90.6	89.5	88.4	86.6	84.9	83.3	81.9	80.7	79.6	78.5
13.00	96.2	96.0	95.4	94.7	93.7	92.6	91.5	90.4	89.4	88.4	87.4	85.1	83.4	82.0	80.8	79.6	78.6
13.25	95.9	95.7	95.2	94.4	93.5	92.5	91.4	90.3	89.3	88.3	87.3	85.2	83.6	82.1	80.8	79.7	78.7
13.50	95.6	95.4	95.0	94.2	93.3	92.3	91.3	90.2	89.2	88.2	87.2	85.3	83.7	82.2	80.9	79.8	78.7
13.75	95.3	95.2	94.7	94.0	93.1	92.2	91.1	90.1	89.1	88.1	87.2	85.3	83.8	82.3	81.0	79.9	78.8
14.00	95.1	94.9	94.5	93.8	92.9	92.0	91.0	90.0	89.0	88.0	87.1	86.2	83.9	82.4	81.1	79.9	78.9
14.25	94.8	94.7	94.2	93.6	92.8	91.8	90.9	89.9	88.9	87.9	87.0	86.1	84.0	82.5	81.2	80.0	78.9
14.50	94.6	94.4	94.0	93.4	92.6	91.7	90.7	89.7	88.8	87.9	86.9	86.1	84.1	82.6	81.3	80.1	79.0
14.75	94.3	94.2	93.8	93.2	92.4	91.5	90.6	89.6	88.7	87.8	86.9	86.0	84.2	82.8	81.4	80.2	79.1
15.00	94.1	94.0	93.6	93.0	92.2	91.4	90.5	89.5	88.6	87.7	86.8	85.9	84.2	82.9	81.5	80.2	79.1
15.25	93.9	93.7	93.4	92.8	92.0	91.2	90.3	89.4	88.5	87.6	86.7	85.9	85.0	83.0	81.6	80.3	79.2
15.50	93.6	93.5	93.1	92.6	91.9	91.1	90.2	89.3	88.4	87.5	86.6	85.8	85.0	83.1	81.7	80.4	79.3
15.75	93.4	93.3	92.9	92.4	91.7	90.9	90.0	89.2	88.3	87.4	86.5	85.7	84.9	83.2	81.8	80.5	79.4
16.00	93.2	93.1	92.7	92.2	91.5	90.7	89.9	89.0	88.2	87.3	86.5	85.6	84.9	83.2	81.9	80.6	79.4
16.25	93.0	92.8	92.5	92.0	91.4	90.6	89.8	88.9	88.1	87.2	86.4	85.6	84.8	84.0	82.0	80.7	79.5
16.50	92.7	92.6	92.3	91.8	91.2	90.4	89.6	88.8	88.0	87.1	86.3	85.5	84.7	84.0	82.1	80.8	79.6
16.75	92.5	92.4	92.1	91.6	91.0	90.3	89.5	88.7	87.9	87.0	86.2	85.4	84.7	83.9	82.2	80.9	79.7
17.00	92.3	92.2	91.9	91.5	90.8	90.1	89.4	88.6	87.8	87.0	86.2	85.4	84.6	83.9	82.2	81.0	79.8
17.25	92.1	92.0	91.7	91.3	90.7	90.0	89.3	88.5	87.7	86.9	86.1	85.3	84.5	83.8	82.2	81.1	79.9
17.50	91.9	91.8	91.5	91.1	90.5	89.9	89.1	88.4	87.6	86.8	86.0	85.2	84.5	83.8	83.1	81.2	80.0
17.75	91.7	91.6	91.3	90.9	90.4	89.7	89.0	88.2	87.5	86.7	85.9	85.2	84.4	83.7	83.0	81.3	80.1
18.00	91.5	91.4	91.2	90.7	90.2	89.6	88.9	88.1	87.4	86.6	85.8	85.1	84.4	83.6	83.0	81.3	80.1

TAKEOFF EPNL GRID VALUE SET D3

CURRENT THREE ENGINE AIRCRAFT

SIDELINE DISTANCE (MILES)

Dist. From Start of T/O Roll (Miles)	0	1/4	1/2	3/4	1	1 1/4	1 1/2	2 3/4	2	2 1/4	2 1/2	2 3/4	3	3 1/4	3 1/2	3 3/4	4
2.00	127.8	104.9	97.2	93.6	91.0	87.8	85.3	83.2	81.3	79.7	78.3	77.0	75.9	74.7	73.7	72.7	71.9
2.25	122.2	106.2	98.5	94.8	92.1	88.9	86.2	84.1	82.2	80.5	79.0	77.7	76.5	75.4	74.3	73.4	72.5
2.50	119.1	107.0	99.5	95.6	92.8	89.5	86.9	84.7	82.7	81.1	79.6	78.2	77.0	75.8	74.8	73.8	72.9
2.75	117.0	107.8	100.2	96.3	93.4	90.1	87.4	85.1	83.2	81.5	80.0	78.6	77.4	76.2	75.2	74.2	73.3
3.00	115.4	108.6	100.8	96.8	93.9	90.5	87.8	85.5	83.6	81.9	80.3	79.0	77.7	76.6	75.5	74.5	73.6
3.25	114.1	109.9	101.3	97.3	94.3	90.9	88.2	85.9	83.9	82.2	80.7	79.3	78.0	76.8	75.8	74.8	73.9
3.50	113.0	109.5	101.8	97.7	94.6	91.2	88.5	86.2	84.2	82.5	80.9	79.5	78.3	77.1	76.0	75.0	74.1
3.75	112.4	108.9	102.3	98.1	94.9	91.5	88.8	86.5	84.5	82.7	81.2	79.8	78.5	77.3	76.2	75.2	74.3
4.00	111.8	108.4	102.9	98.5	95.2	91.8	89.0	86.7	84.7	83.0	81.4	80.0	78.7	77.5	76.5	75.4	74.5
4.25	111.1	107.9	103.6	98.8	95.5	92.1	89.3	87.0	85.0	83.2	81.6	80.2	78.9	77.7	76.6	75.6	74.7
4.50	110.3	107.7	104.3	99.2	95.7	92.3	89.5	87.2	85.2	83.4	81.8	80.4	79.1	77.9	76.8	75.8	74.9
4.75	109.5	107.5	105.1	99.5	95.9	92.5	89.7	87.4	85.4	83.6	82.0	80.6	79.3	78.1	77.0	76.0	75.0
5.00	108.6	107.3	105.0	99.9	96.2	92.7	89.9	87.6	85.5	83.8	82.2	80.7	79.4	78.2	77.1	76.1	75.2
5.25	107.9	107.0	104.8	100.3	96.4	92.9	90.1	87.7	85.7	83.9	82.3	80.9	79.6	78.4	77.3	76.3	75.3
5.50	107.6	106.8	104.7	100.8	96.6	93.1	90.3	87.9	85.9	84.1	82.5	81.0	79.7	78.5	77.4	76.4	75.4
5.75	107.3	106.5	104.5	101.3	96.8	93.3	90.4	88.1	86.0	84.2	82.6	81.2	79.9	78.7	77.6	76.5	75.5
6.00	107.1	106.2	104.3	102.4	97.1	93.4	90.6	88.2	86.2	84.4	82.8	81.3	80.0	78.8	77.7	76.7	75.7
6.25	106.8	105.9	104.1	102.3	97.3	93.6	90.7	88.3	86.3	84.5	82.9	81.4	80.1	78.9	77.8	76.8	75.8
6.50	106.4	105.6	103.9	102.2	97.6	93.8	90.9	88.5	86.4	84.6	83.0	81.6	80.3	79.0	77.9	76.9	75.9
6.75	106.0	105.3	103.7	102.1	97.9	94.0	91.0	88.6	86.6	84.7	83.1	81.7	80.4	79.2	78.0	77.0	76.0
7.00	105.7	105.0	103.5	102.0	98.2	94.1	91.2	88.7	86.7	84.9	83.3	81.8	80.5	79.3	78.1	77.1	76.1
7.25	105.4	104.8	103.3	101.9	98.4	94.3	91.3	88.9	86.8	85.0	83.4	81.9	80.6	79.4	78.3	77.2	76.2
7.50	105.1	104.5	103.2	101.7	98.2	94.6	91.5	89.0	86.9	85.1	83.5	82.0	80.7	79.5	78.4	77.3	76.3
7.75	104.8	104.3	103.0	101.5	99.0	94.8	91.6	89.1	87.0	85.2	83.6	82.1	80.8	79.6	78.4	77.4	76.4
8.00	104.5	104.0	102.8	101.3	98.9	95.0	91.8	89.3	87.1	85.3	83.7	82.2	80.9	79.7	78.5	77.5	76.5
8.25	104.3	103.8	102.6	101.0	98.7	95.2	91.9	89.4	87.3	85.4	83.8	82.3	81.0	79.8	78.6	77.6	76.6
8.50	104.0	103.5	102.4	100.8	98.6	95.5	92.1	89.5	87.4	85.5	83.9	82.4	81.1	79.8	78.7	77.7	76.7
8.75	103.7	103.3	102.3	100.6	98.4	95.5	92.3	89.6	87.5	85.6	84.0	82.5	81.2	79.9	78.8	77.8	76.8
9.00	103.4	103.0	102.1	100.4	98.3	96.3	92.5	89.8	87.6	85.7	84.1	82.6	81.2	80.0	78.9	77.8	76.9
9.25	103.2	102.8	102.0	100.2	98.1	96.1	92.7	89.9	87.7	85.8	84.2	82.7	81.3	80.1	79.0	77.9	76.9
9.50	102.9	102.6	101.8	99.9	97.9	96.0	92.9	90.0	87.8	85.9	84.2	82.8	81.4	80.2	79.0	78.0	77.0
9.75	102.7	102.4	101.6	99.7	97.8	95.9	93.1	90.2	87.9	86.0	84.3	82.8	81.5	80.3	79.1	78.1	77.1
10.00	102.5	102.2	101.3	99.5	97.6	95.8	93.2	90.3	88.0	86.1	84.4	82.9	81.6	80.3	79.2	78.1	77.2
10.25	102.3	102.0	101.0	99.3	97.4	95.7	94.0	90.5	88.1	86.2	84.5	83.0	81.7	80.4	79.3	78.2	77.2
10.50	102.1	101.9	100.7	99.1	97.3	95.5	93.9	90.7	88.3	86.3	84.6	83.1	81.7	80.5	79.3	78.3	77.3
10.75	101.9	101.6	100.4	98.8	97.1	95.4	93.8	90.9	88.4	86.4	84.7	83.2	81.8	80.6	79.4	78.4	77.4
11.00	101.7	101.3	100.2	98.6	95.9	95.3	93.7	91.0	88.5	86.5	84.8	83.2	81.9	80.6	79.5	78.4	77.4
11.25	101.4	101.0	99.9	98.4	95.8	95.1	93.6	91.1	88.7	86.6	84.9	83.3	82.0	80.7	79.6	78.5	77.5
11.50	101.1	100.7	99.6	98.2	96.6	95.0	93.5	91.2	88.8	86.7	84.9	83.4	82.0	80.8	79.6	78.6	77.5
11.75	100.7	100.4	99.4	98.0	95.4	94.9	93.4	92.0	89.0	86.8	85.0	83.5	82.1	80.8	79.7	78.6	77.6
12.00	100.4	100.1	99.1	97.8	95.3	94.7	93.3	91.9	89.1	86.9	85.1	83.6	82.2	80.9	79.8	78.7	77.7
12.25	100.1	99.8	98.8	97.6	95.1	94.6	93.2	91.8	89.3	87.1	85.2	83.6	82.2	81.0	79.8	78.7	77.7
12.50	99.8	99.5	98.6	97.4	95.9	94.5	93.1	91.7	89.4	87.2	85.3	83.7	82.3	81.0	79.9	78.8	77.8
12.75	99.5	99.2	98.3	97.1	95.8	94.4	93.0	91.6	89.5	87.3	85.4	83.8	82.4	81.1	79.9	78.9	77.9
13.00	99.2	98.9	98.1	96.9	95.6	94.2	92.9	91.5	90.3	87.4	85.5	83.9	82.5	81.2	80.0	78.9	77.9
13.25	98.9	98.6	97.9	96.7	95.4	94.1	92.7	91.4	90.2	87.6	85.6	84.0	82.5	81.2	80.1	79.0	78.0
13.50	98.6	98.4	97.6	96.5	95.3	94.0	92.6	91.4	90.1	87.7	85.7	84.1	82.6	81.3	80.1	79.0	78.0
13.75	98.4	98.1	97.4	96.3	95.1	93.8	92.5	91.3	90.1	87.8	85.9	84.2	82.7	81.4	80.2	79.1	78.1
14.00	98.1	97.8	97.2	96.1	95.0	93.7	92.4	91.2	90.0	87.9	86.0	84.3	82.8	81.5	80.3	79.2	78.2
14.25	97.8	97.6	96.9	96.0	94.8	93.6	92.3	91.1	89.9	87.9	86.1	84.3	82.8	81.5	80.3	79.2	78.2
14.50	97.6	97.3	96.7	95.8	94.6	93.4	92.2	91.0	89.8	88.7	86.2	84.4	82.9	81.6	80.4	79.3	78.3
14.75	97.3	97.1	96.5	95.6	94.5	93.3	92.1	90.9	89.8	88.7	86.3	84.5	83.0	81.7	80.4	79.3	78.3
15.00	97.1	96.9	96.3	95.4	94.3	93.2	92.0	90.8	89.7	88.6	86.4	84.6	83.1	81.7	80.5	79.4	78.4
15.25	96.8	96.6	96.1	95.2	94.2	93.0	91.9	90.7	89.6	88.5	86.5	84.8	83.2	81.8	80.6	79.5	78.4
15.50	96.6	96.4	95.8	95.0	94.0	92.9	91.8	90.6	89.5	88.5	86.6	84.9	83.3	81.9	80.6	79.5	78.5
15.75	96.4	96.2	95.6	94.8	93.8	92.8	91.6	90.5	89.5	88.4	86.5	85.0	83.4	82.0	80.7	79.6	78.5
16.00	96.1	96.0	95.4	94.6	93.7	92.6	91.5	90.4	89.4	88.3	87.4	85.1	83.4	82.0	80.8	79.6	78.6
16.25	95.9	95.7	95.2	94.5	93.5	92.5	91.4	90.3	89.3	88.3	87.3	85.2	83.5	82.1	80.8	79.7	78.6
16.50	95.7	95.5	95.0	94.3	93.4	92.4	91.3	90.3	89.2	88.2	87.2	85.3	83.6	82.2	80.9	79.8	78.7
16.75	95.5	95.3	94.8	94.1	93.2	92.2	91.2	90.2	89.1	88.1	87.2	85.3	83.7	82.3	81.0	79.8	78.8
17.00	95.3	95.1	94.6	93.9	93.1	92.1	91.1	90.1	89.1	88.1	87.1	85.3	83.8	82.4	81.0	79.9	78.9
17.25	95.1	94.9	94.4	93.8	92.9	92.0	91.0	90.0	89.0	88.0	87.1	86.2	83.9	82.4	81.1	79.9	78.9
17.50	94.8	94.7	94.3	93.6	92.8	91.8	90.9	89.9	88.9	87.9	87.0	86.1	84.0	82.5	81.2	80.0	78.9
17.75	94.6	94.5	94.1	93.4	92.6	91.7	90.8	89.8	88.8	87.9	86.9	86.1	84.1	82.6	81.3	80.1	79.0
18.00	94.4	94.3	93.9	93.3	92.5	91.6	90.6	89.7	88.7	87.8	86.9	86.0	84.2	82.7	81.3	80.1	79.0

APPROACH EPNL GRID VALUE SET 3

CURRENT THREE ENGINE AIRCRAFT

Distance From Landing Threshold (Miles)	SIDELINE DISTANCE (MILES)																
	0	1/4	1/2	3/4	1	1 1/4	1 1/2	2 3/4	2	2 1/4	2 1/2	2 3/4	3	3 1/4	3 1/2	3 3/4	4
2.00	120.3	90.5	79.4	73.2	68.5	63.9	59.9	56.4	53.3	50.4	47.9	45.6	43.5	41.2	39.5	37.9	36.7
2.25	119.8	92.1	81.1	74.9	70.2	65.5	61.6	58.1	54.9	52.1	49.6	47.3	45.1	43.2	41.4	39.8	38.4
2.50	115.4	93.0	82.1	75.9	71.2	66.6	62.6	59.1	56.0	53.2	50.6	48.3	46.2	44.2	42.5	40.9	39.5
2.75	112.5	93.7	82.8	76.7	72.0	67.4	63.4	59.9	56.8	54.0	51.5	49.1	47.0	45.1	43.3	41.7	40.3
3.00	110.3	94.2	83.5	77.3	72.6	68.0	64.1	60.6	57.5	54.7	52.2	49.8	47.7	45.8	44.0	42.4	41.0
3.25	108.6	94.7	84.0	77.9	73.2	68.6	64.7	61.2	58.1	55.3	52.7	50.4	48.3	46.4	44.6	43.0	41.5
3.50	107.3	95.1	84.4	78.4	73.7	69.1	65.2	61.7	58.6	55.8	53.3	51.0	48.8	46.9	45.1	43.5	42.1
3.75	106.2	95.5	84.9	78.8	74.1	69.5	65.6	62.2	59.1	56.3	53.8	51.4	49.3	47.4	45.6	44.0	42.5
4.00	105.2	96.0	85.2	79.2	74.5	69.9	66.0	62.6	59.5	56.7	54.2	51.9	49.8	47.8	46.1	44.5	43.0
4.25	104.3	96.5	85.6	79.5	74.9	70.3	66.4	63.0	59.9	57.1	54.6	52.3	50.2	48.2	46.5	44.9	43.4
4.50	103.4	97.5	85.9	79.9	75.2	70.6	66.8	63.3	60.3	57.5	55.0	52.7	50.6	48.6	46.9	45.2	43.8
4.75	102.5	97.2	86.3	80.2	75.5	71.0	67.1	63.7	60.6	57.8	55.3	53.0	50.9	49.0	47.2	45.6	44.1
5.00	101.8	96.9	86.6	80.5	75.8	71.3	67.4	64.0	60.9	58.2	55.7	53.4	51.3	49.3	47.6	45.9	44.5
5.25	101.3	96.6	86.9	80.8	76.1	71.6	67.7	64.3	61.2	58.5	56.0	53.7	51.6	49.6	47.9	46.3	44.8
5.50	101.1	96.2	87.3	81.1	76.3	71.8	68.0	64.6	61.5	58.8	56.3	54.0	51.9	49.9	48.2	46.6	45.1
5.75	100.8	95.9	87.6	81.3	76.6	72.1	68.2	64.8	61.8	59.1	56.6	54.3	52.2	50.2	48.5	46.9	45.4
6.00	100.3	95.6	88.0	81.6	76.8	72.3	68.5	65.1	62.1	59.3	56.8	54.5	52.4	50.5	48.8	47.1	45.7
6.25	99.5	95.2	88.5	81.9	77.1	72.6	68.7	65.3	62.3	59.6	57.1	54.8	52.7	50.8	49.0	47.4	45.9
6.50	98.8	94.9	89.0	82.2	77.3	72.8	68.9	65.6	62.6	59.8	57.3	55.1	53.0	51.0	49.3	47.7	46.2
6.75	98.2	94.6	89.4	82.4	77.5	73.0	69.2	65.8	62.8	60.1	57.6	55.3	53.2	51.3	49.5	47.9	46.4
7.00	97.5	94.3	90.4	82.7	77.7	73.2	69.4	66.0	63.0	60.3	57.8	55.5	53.4	51.5	49.8	48.1	46.7
7.25	96.9	94.0	90.3	83.0	77.9	73.4	69.6	66.2	63.2	60.5	58.0	55.8	53.7	51.8	50.0	48.4	46.9
7.50	96.4	93.8	90.2	83.3	78.1	73.6	69.8	66.4	63.4	60.7	58.2	56.0	53.9	52.0	50.2	48.6	47.1
7.75	95.9	93.5	90.1	83.6	78.4	73.8	70.0	66.6	63.6	60.9	58.5	56.2	54.1	52.2	50.4	48.8	47.3
8.00	95.4	93.3	90.0	83.9	78.6	74.0	70.2	66.8	63.8	61.1	58.7	56.4	54.3	52.4	50.6	49.0	47.5
8.25	94.9	93.0	89.9	84.3	78.8	74.2	70.4	67.0	64.0	61.3	58.9	56.6	54.5	52.6	50.8	49.2	47.8
8.50	94.5	92.8	89.7	84.7	79.0	74.4	70.6	67.2	64.2	61.5	59.0	56.8	54.7	52.8	51.0	49.4	48.0
8.75	94.1	92.5	89.6	85.1	79.2	74.6	70.7	67.4	64.4	61.7	59.2	57.0	54.9	53.0	51.2	49.6	48.1
9.00	93.8	92.3	89.5	85.5	79.4	74.8	70.9	67.6	64.6	61.9	59.4	57.2	55.1	53.2	51.4	49.8	48.3
9.25	93.5	92.0	89.4	85.8	79.7	75.0	71.1	67.7	64.8	62.1	59.6	57.3	55.3	53.4	51.6	50.0	48.5
9.50	93.2	91.8	89.2	85.9	79.9	75.2	71.3	67.9	64.9	62.2	59.8	57.5	55.5	53.5	51.8	50.2	48.7
9.75	92.9	91.6	89.1	86.7	80.2	75.3	71.4	68.1	65.1	62.4	59.9	57.7	55.6	53.7	52.0	50.4	48.9
10.00	92.6	91.4	89.0	86.6	80.4	75.5	71.6	68.3	65.3	62.6	60.1	57.9	55.8	53.9	52.1	50.5	49.0
10.25	92.3	91.1	88.8	86.6	80.7	75.7	71.8	68.4	65.4	62.7	60.3	58.0	56.0	54.1	52.3	50.7	49.2
10.50	92.0	90.9	88.7	86.5	81.0	75.9	72.0	68.6	65.6	62.9	60.4	58.2	56.1	54.2	52.5	50.9	49.4
10.75	91.7	90.7	88.6	86.4	81.3	76.1	72.1	68.7	65.7	63.0	60.6	58.4	56.3	54.4	52.6	51.0	49.5
11.00	91.5	90.5	88.5	86.3	81.6	76.3	72.3	68.9	65.9	63.2	60.8	58.5	56.4	54.5	52.8	51.2	49.7
11.25	91.2	90.3	88.3	86.3	82.0	76.6	72.5	69.1	66.1	63.4	60.9	58.7	56.6	54.7	52.9	51.3	49.9
11.50	91.0	90.1	88.2	86.2	82.3	76.8	72.7	69.2	66.2	63.5	61.1	58.8	56.8	54.9	53.1	51.5	50.0
11.75	90.7	89.9	88.1	86.1	82.5	77.0	72.8	69.4	66.4	63.7	61.2	59.0	56.9	55.0	53.3	51.6	50.2
12.00	90.5	89.7	88.0	86.0	82.6	77.3	73.0	69.5	66.5	63.8	61.4	59.1	57.0	55.2	53.4	51.8	50.3
12.25	90.3	89.5	87.8	85.9	83.4	77.5	73.2	69.7	66.7	64.0	61.5	59.3	57.2	55.3	53.5	51.9	50.4
12.50	90.1	89.3	87.7	85.8	83.3	77.8	73.4	69.9	66.8	64.1	61.6	59.4	57.3	55.4	53.7	52.1	50.6
12.75	89.9	89.2	87.6	85.7	83.2	78.0	73.6	70.0	67.0	64.3	61.8	59.5	57.5	55.6	53.8	52.2	50.7
13.00	89.6	89.0	87.4	85.6	83.1	78.3	73.8	70.2	67.1	64.4	61.9	59.7	57.6	55.7	54.0	52.4	50.9
13.25	89.4	88.8	87.3	85.4	83.1	78.6	74.0	70.4	67.3	64.5	62.1	59.8	57.8	55.9	54.1	52.5	51.0
13.50	89.2	88.6	87.2	85.3	83.0	78.9	74.2	70.5	67.4	64.7	62.2	60.0	57.9	56.0	54.2	52.6	51.1
13.75	89.1	88.5	87.1	85.2	82.9	79.2	74.4	70.7	67.6	64.8	62.3	60.1	58.0	56.1	54.4	52.8	51.3
14.00	88.9	88.3	87.0	85.1	82.8	79.5	74.6	70.9	67.7	65.0	62.5	60.2	58.2	56.3	54.5	52.9	51.4
14.25	88.7	88.1	86.8	84.9	82.7	79.7	74.8	71.0	67.9	65.1	62.6	60.4	58.3	56.4	54.6	53.0	51.5
14.50	88.5	88.0	86.7	84.8	82.6	79.7	75.1	71.2	68.0	65.2	62.8	60.5	58.4	56.5	54.8	53.2	51.7
14.75	88.3	87.8	86.6	84.7	82.5	80.5	75.3	71.4	68.2	65.4	62.9	60.6	58.6	56.7	54.9	53.3	51.8
15.00	88.2	87.7	86.5	84.6	82.5	80.5	75.6	71.6	68.3	65.5	63.0	60.8	58.7	56.8	55.0	53.4	51.9
15.25	88.0	87.5	86.4	84.5	82.4	80.4	75.8	71.8	68.5	65.7	63.2	60.9	58.8	56.9	55.1	53.5	52.0
15.50	87.8	87.4	86.2	84.3	82.3	80.3	76.1	72.0	68.7	65.8	63.3	61.0	58.9	57.0	55.3	53.7	52.2
15.75	87.6	87.2	86.1	84.2	82.2	80.3	76.4	72.2	68.8	66.0	63.4	61.1	59.1	57.2	55.4	53.8	52.3
16.00	87.5	87.1	86.0	84.1	82.1	80.2	76.7	72.4	69.0	66.1	63.6	61.3	59.2	57.3	55.5	53.9	52.4
16.25	87.3	86.9	85.9	84.0	82.0	80.1	76.9	72.6	69.1	66.3	63.7	61.4	59.3	57.4	55.6	54.0	52.5
16.50	87.2	86.8	85.7	83.8	81.9	80.1	77.1	72.8	69.3	66.4	63.8	61.5	59.4	57.5	55.8	54.1	52.6
16.75	87.0	86.6	85.5	83.7	81.8	80.0	77.3	73.0	69.5	66.5	64.0	61.7	59.6	57.6	55.9	54.3	52.8
17.00	86.9	86.5	85.4	83.6	81.7	79.9	77.4	73.3	69.7	66.7	64.1	61.8	59.7	57.8	56.0	54.4	52.9
17.25	86.7	86.4	85.2	83.5	81.6	79.9	78.2	73.5	69.8	66.8	64.2	61.9	59.8	57.9	56.1	54.5	53.0
17.50	86.6	86.2	85.1	83.4	81.6	79.8	78.1	73.7	70.0	67.0	64.4	62.0	59.9	58.0	56.2	54.6	53.1
17.75	86.4	86.1	84.9	83.2	81.5	79.7	78.1	74.0	70.2	67.2	64.5	62.2	60.1	58.1	56.3	54.7	53.2
18.00	86.3	86.0	84.8	83.1	81.4	79.6	78.0	74.2	70.4	67.3	64.7	62.3	60.2	58.2	56.5	54.8	53.3

TAKEOFF EPNL GRID VALUE SET A4

CURRENT FOUR ENGINE AIRCRAFT

Dist. From Start of T/O Roll (Miles)	SIDELINE DISTANCE (MILES)															
	0	1/4	1/2	3/4	1	1 1/4	1 1/2	2 3/4	2	2 1/4	2 1/2	2 3/4	3	3 1/4	3 1/2	3 3/4	4
2.00	114.0	111.6	106.9	101.1	97.1	93.8	91.0	88.7	86.7	85.0	83.4	82.0	80.8	79.6	78.5	77.5	76.5
2.25	112.6	110.9	107.8	101.8	97.6	94.2	91.4	89.1	87.1	85.4	83.8	82.4	81.1	79.9	78.8	77.8	76.9
2.50	111.5	110.1	107.4	102.5	98.0	94.5	91.8	89.4	87.4	85.7	84.1	82.7	81.4	80.2	79.1	78.1	77.1
2.75	110.4	109.2	106.8	103.1	98.4	94.9	92.1	89.7	87.7	85.9	84.4	82.9	81.6	80.5	79.4	78.3	77.4
3.00	109.5	108.5	106.2	103.6	98.9	95.2	92.3	90.0	88.0	86.2	84.6	83.2	81.9	80.7	79.6	78.6	77.5
3.25	108.6	107.8	105.6	103.3	99.4	95.5	92.6	90.2	88.2	86.4	84.8	83.4	82.1	80.9	79.8	78.8	77.8
3.50	107.8	107.1	105.1	102.9	100.4	95.9	92.9	90.5	88.4	86.6	85.0	83.6	82.3	81.1	80.0	79.0	78.0
3.75	107.1	106.3	104.6	102.4	100.0	96.3	93.2	90.7	88.6	86.8	85.2	83.8	82.5	81.3	80.2	79.1	78.2
4.00	106.2	105.5	104.0	102.0	99.7	96.7	93.5	90.9	88.8	87.0	85.4	84.0	82.7	81.5	80.3	79.3	78.3
4.25	105.4	104.8	103.5	101.5	99.4	97.4	93.8	91.2	89.0	87.2	85.6	84.1	82.8	81.5	80.5	79.5	78.5
4.50	104.7	104.2	103.0	101.0	99.1	97.2	94.2	91.4	89.3	87.4	85.8	84.3	83.0	81.8	80.6	79.6	78.6
4.75	104.0	103.6	102.3	100.6	98.7	96.9	94.3	91.7	89.5	87.6	85.9	84.5	83.1	81.9	80.8	79.7	78.8
5.00	103.4	103.0	101.7	100.1	98.4	96.6	95.0	92.0	89.7	87.8	86.1	84.6	83.3	82.1	80.9	79.9	78.9
5.25	102.7	102.3	101.2	99.7	98.0	96.4	94.8	92.3	89.9	87.9	86.3	84.8	83.4	82.2	81.1	80.0	79.0
5.50	102.0	101.6	100.6	99.2	97.7	96.1	94.6	93.2	90.2	88.1	86.4	84.9	83.5	82.3	81.2	80.1	79.2
5.75	101.3	101.0	100.1	98.8	97.3	95.8	94.4	93.0	90.5	88.4	86.6	85.1	83.7	82.4	81.3	80.3	79.3
6.00	100.7	100.4	99.5	98.4	97.0	95.6	94.2	92.8	90.7	88.6	86.8	85.2	83.8	82.6	81.4	80.4	79.4
6.25	100.1	99.8	99.0	97.9	96.6	95.3	93.9	92.6	91.4	88.8	87.0	85.4	84.0	82.7	81.5	80.5	79.5
6.50	99.5	99.3	98.6	97.5	96.3	95.0	93.7	92.5	91.3	89.1	87.2	85.5	84.1	82.8	81.7	80.6	79.6
6.75	99.0	98.7	98.1	97.1	95.0	94.7	93.5	92.3	91.1	89.1	87.4	85.7	84.2	82.9	81.8	80.7	79.7
7.00	98.4	98.2	97.6	96.7	95.6	94.4	93.2	92.1	90.9	89.9	87.6	85.9	84.4	83.1	81.9	80.8	79.8
7.25	97.9	97.7	97.2	96.3	95.3	94.2	93.0	91.9	90.8	89.7	87.8	86.1	84.5	83.2	82.0	80.9	79.9
7.50	97.5	97.3	96.7	95.9	95.0	93.9	92.8	91.7	90.6	89.6	88.6	86.3	84.7	83.3	82.1	81.0	80.0
7.75	97.0	96.8	96.3	95.6	94.6	93.6	92.6	91.5	90.4	89.4	88.5	86.5	84.9	83.5	82.2	81.1	80.1
8.00	96.5	96.4	95.9	95.2	94.3	93.3	92.3	91.3	90.3	89.3	88.3	86.5	85.1	83.6	82.4	81.2	80.2
8.25	96.1	95.9	95.5	94.8	94.0	93.1	92.1	91.1	90.1	89.1	88.2	87.3	85.2	83.8	82.5	81.4	80.3
8.50	95.7	95.5	95.1	94.5	93.7	92.8	91.9	90.9	89.9	89.0	88.1	87.2	85.4	84.0	82.6	81.5	80.4
8.75	95.3	95.1	94.7	94.1	93.4	92.5	91.6	90.7	89.8	88.9	88.0	87.1	85.4	84.1	82.8	81.6	80.5
9.00	94.9	94.7	94.4	93.8	93.1	92.3	91.4	90.5	89.6	88.7	87.8	87.0	86.2	84.3	82.9	81.7	80.6
9.25	94.5	94.4	94.0	93.5	92.8	92.0	91.2	90.3	89.4	88.6	87.7	86.9	86.1	84.4	83.1	81.9	80.8
9.50	94.1	94.0	93.7	93.2	92.5	91.8	90.9	90.1	89.2	88.4	87.6	86.8	86.0	85.2	83.3	82.0	80.9
9.75	93.7	93.6	93.3	92.8	92.2	91.5	90.7	89.9	89.1	88.2	87.4	86.6	85.9	85.1	83.4	82.2	81.0
10.00	93.4	93.3	93.0	92.5	91.9	91.2	90.5	89.7	88.9	88.1	87.3	86.5	85.8	85.0	83.6	82.3	81.1
10.25	93.0	92.9	92.7	92.2	91.7	91.0	90.3	89.5	88.7	87.9	87.2	86.4	85.7	84.9	84.2	82.4	81.3
10.50	92.7	92.6	92.3	91.9	91.4	90.8	90.1	89.3	88.6	87.8	87.0	86.3	85.5	84.8	84.1	82.5	81.4
10.75	92.4	92.3	92.0	91.6	91.1	90.5	89.8	89.1	88.4	87.6	86.9	86.2	85.4	84.7	84.1	82.5	81.5
11.00	92.1	92.0	91.7	91.4	90.9	90.3	89.6	88.9	88.2	87.5	86.8	86.0	85.3	84.6	84.0	83.3	81.7
11.25	91.7	91.7	91.4	91.1	90.6	90.0	89.4	88.7	88.0	87.3	86.6	85.9	85.2	84.5	83.9	83.2	81.7
11.50	91.4	91.4	91.2	90.8	90.3	89.8	89.2	88.5	87.9	87.2	86.5	85.8	85.1	84.4	83.8	83.2	82.5
11.75	91.1	91.1	90.9	90.5	90.1	89.6	89.0	88.3	87.7	87.0	86.3	85.7	85.0	84.3	83.7	83.1	82.5
12.00	90.9	90.8	90.6	90.3	89.8	89.3	88.8	88.2	87.5	86.9	86.2	85.5	84.9	84.2	83.6	83.0	82.4
12.25	90.6	90.5	90.3	90.0	89.6	89.1	88.6	88.0	87.3	86.7	86.1	85.4	84.8	84.1	83.5	82.9	82.3
12.50	90.3	90.2	90.0	89.8	89.4	88.9	88.4	87.8	87.2	86.6	85.9	85.3	84.7	84.0	83.4	82.9	82.2
12.75	90.0	90.0	89.8	89.5	89.1	88.7	88.2	87.6	87.0	86.4	85.8	85.2	84.5	83.9	83.3	82.7	82.2
13.00	89.8	89.7	89.5	89.3	88.9	88.5	88.0	87.4	86.8	86.2	85.6	85.0	84.4	83.8	83.2	82.6	82.1
13.25	89.5	89.4	89.3	89.0	88.7	88.2	87.8	87.2	86.7	86.1	85.5	84.9	84.3	83.7	83.1	82.6	82.0
13.50	89.2	89.2	89.0	88.8	88.4	88.0	87.6	87.1	86.5	85.9	85.4	84.8	84.2	83.6	83.0	82.5	81.9
13.75	89.0	88.9	88.8	88.5	88.2	87.8	87.4	86.9	86.3	85.8	85.2	84.6	84.1	83.5	82.9	82.4	81.8
14.00	88.7	88.7	88.6	88.3	88.0	87.6	87.2	86.7	86.2	85.6	85.1	84.5	84.0	83.4	82.8	82.3	81.8
14.25	88.5	88.5	88.3	88.1	87.8	87.4	87.0	86.5	86.0	85.5	84.9	84.4	83.8	83.3	82.7	82.2	81.7
14.50	88.3	88.2	88.1	87.9	87.6	87.2	86.8	86.3	85.9	85.3	84.8	84.3	83.7	83.2	82.6	82.1	81.6
14.75	88.0	88.0	87.9	87.6	87.4	87.0	86.6	86.2	85.7	85.2	84.7	84.1	83.6	83.1	82.5	82.0	81.5
15.00	87.8	87.8	87.6	87.4	87.2	86.8	86.4	86.0	85.5	85.0	84.5	84.0	83.5	83.0	82.4	81.9	81.4
15.25	87.6	87.5	87.4	87.2	87.0	86.6	86.2	85.8	85.4	84.9	84.4	83.9	83.4	82.9	82.3	81.8	81.3
15.50	87.4	87.3	87.2	87.0	85.8	86.4	86.1	85.7	85.2	84.7	84.3	83.8	83.3	82.8	82.3	81.7	81.3
15.75	87.1	87.1	87.0	86.8	86.6	86.2	85.9	85.5	85.1	84.6	84.1	83.6	83.1	82.6	82.2	81.7	81.2
16.00	86.9	86.9	86.8	86.6	85.4	86.1	85.7	85.3	84.9	84.5	84.0	83.5	83.0	82.5	82.1	81.6	81.1
16.25	86.7	86.7	86.6	86.4	85.2	85.9	85.5	85.2	84.8	84.3	83.9	83.4	82.9	82.4	82.0	81.5	81.0
16.50	86.5	86.5	86.4	86.2	85.0	85.7	85.4	85.0	84.6	84.2	83.7	83.3	82.8	82.3	81.9	81.4	80.9
16.75	86.3	86.3	86.2	86.0	85.8	85.5	85.2	84.8	84.4	84.0	83.6	83.1	82.7	82.2	81.8	81.3	80.8
17.00	86.1	86.1	86.0	85.8	85.6	85.3	85.0	84.7	84.3	83.9	83.5	83.0	82.6	82.1	81.7	81.2	80.7
17.25	85.9	85.9	85.8	85.6	85.4	85.2	84.9	84.5	84.1	83.7	83.3	82.9	82.5	82.0	81.6	81.1	80.7
17.50	85.7	85.7	85.6	85.4	85.2	85.0	84.7	84.4	84.0	83.6	83.2	82.8	82.3	81.9	81.5	81.0	80.6
17.75	85.5	85.5	85.4	85.3	85.1	84.8	84.5	84.2	83.9	83.5	83.1	82.7	82.2	81.8	81.4	80.9	80.5
18.00	85.3	85.3	85.2	85.1	84.9	84.7	84.4	84.1	83.7	83.3	82.9	82.5	82.1	81.7	81.3	80.8	80.4

TABLE IID

TAKEOFF EPNL GRID VALUE SET B4

CURRENT FOUR ENGINE AIRCRAFT

Dist. From Start of T/O Roll (Miles)	SIDELINE DISTANCE (MILES)																
	0	1/4	1/2	3/4	1	1 1/4	1 1/2	1 3/4	2	2 1/4	2 1/2	2 3/4	3	3 1/4	3 1/2	3 3/4	4
2.00	118.6	113.3	104.6	99.7	95.0	92.6	89.9	87.7	85.7	84.0	82.5	81.1	79.8	78.7	77.6	76.7	75.7
2.25	116.5	112.8	105.3	100.3	95.4	93.1	90.4	88.1	86.1	84.4	82.9	81.5	80.2	79.1	78.0	77.0	76.1
2.50	115.0	112.1	106.1	100.8	95.9	93.5	90.8	88.5	86.5	84.8	83.2	81.8	80.5	79.4	78.3	77.3	76.4
2.75	113.8	111.5	107.1	101.2	97.2	93.8	91.1	88.8	86.8	85.1	83.5	82.1	80.8	79.6	78.6	77.6	76.6
3.00	112.7	110.9	107.8	101.7	97.5	94.1	91.4	89.1	87.1	85.3	83.8	82.4	81.1	79.9	78.8	77.8	76.9
3.25	111.8	110.3	107.5	102.2	97.9	94.4	91.7	89.3	87.3	85.6	84.0	82.6	81.3	80.1	79.0	78.0	77.1
3.50	111.0	109.7	107.1	102.8	98.2	94.7	91.9	89.6	87.6	85.8	84.2	82.8	81.5	80.3	79.2	78.2	77.3
3.75	110.2	109.1	106.7	103.9	98.5	94.9	92.1	89.8	87.8	86.0	84.4	83.0	81.7	80.5	79.4	78.4	77.4
4.00	109.5	108.5	106.3	103.6	98.9	95.2	92.3	90.0	88.0	86.2	84.6	83.2	81.9	80.7	79.6	78.6	77.6
4.25	108.8	108.0	105.8	103.4	99.3	95.4	92.6	90.2	88.2	86.4	84.8	83.4	82.0	80.9	79.7	78.7	77.9
4.50	108.2	107.5	105.3	103.1	99.6	95.7	92.8	90.4	88.3	86.5	84.9	83.5	82.2	81.0	79.9	78.9	77.9
4.75	107.6	106.9	104.9	102.8	100.3	96.0	93.0	90.5	88.5	86.7	85.1	83.7	82.4	81.2	80.0	79.0	78.0
5.00	107.0	106.3	104.5	102.4	101.0	96.3	93.2	90.7	88.7	86.8	85.2	83.8	82.5	81.3	80.2	79.1	78.2
5.25	106.3	105.7	104.1	102.1	99.8	96.7	93.4	90.9	88.8	87.0	85.4	83.9	82.6	81.4	80.3	79.3	78.3
5.50	105.7	105.1	103.7	101.7	99.5	97.5	93.7	91.1	89.0	87.1	85.5	84.1	82.8	81.5	80.4	79.4	78.4
5.75	105.1	104.6	103.3	101.3	99.3	97.3	93.9	91.3	89.1	87.3	85.7	84.2	82.9	81.7	80.6	79.5	78.5
6.00	104.6	104.1	102.9	101.0	99.0	97.1	94.2	91.5	89.3	87.4	85.8	84.3	83.0	81.8	80.7	79.6	78.7
6.25	104.1	103.7	102.4	100.6	98.8	96.9	94.4	91.7	89.4	87.5	85.9	84.4	83.1	81.9	80.8	79.7	78.8
6.50	103.6	103.2	102.0	100.3	98.5	96.7	95.1	91.9	89.6	87.7	86.0	84.6	83.2	82.0	80.9	79.8	78.9
6.75	103.1	102.7	101.5	99.9	98.2	96.5	94.9	92.2	89.8	87.8	86.2	84.7	83.3	82.1	81.0	79.9	79.0
7.00	102.6	102.2	101.1	99.6	98.0	96.3	94.8	92.4	90.0	88.0	86.3	84.8	83.4	82.2	81.1	80.0	79.1
7.25	102.0	101.7	100.7	99.3	97.7	96.1	94.6	93.2	90.2	88.1	86.4	84.9	83.5	82.3	81.2	80.1	79.1
7.50	101.5	101.2	100.2	98.9	97.4	95.9	94.6	93.1	90.4	88.3	86.5	85.0	83.6	82.4	81.3	80.2	79.2
7.75	101.0	100.7	99.8	98.6	97.2	95.7	94.3	92.9	90.6	88.5	86.7	85.1	83.7	82.5	81.4	80.3	79.3
8.00	100.6	100.3	99.4	98.3	96.9	95.5	94.1	92.8	90.6	88.6	86.8	85.2	83.8	82.6	81.5	80.4	79.4
8.25	100.1	99.8	99.0	97.9	96.6	95.3	93.9	92.6	91.4	88.8	87.0	85.4	84.0	82.7	81.5	80.5	79.5
8.50	99.7	99.4	98.7	97.6	96.4	95.1	93.8	92.5	91.3	89.0	87.1	85.5	84.1	82.8	81.6	80.6	79.6
8.75	99.2	99.0	98.3	97.3	96.1	94.9	93.6	92.4	91.2	89.1	87.3	85.6	84.2	82.9	81.7	80.6	79.7
9.00	98.8	98.6	97.9	97.0	95.9	94.6	93.4	92.2	91.1	90.0	87.4	85.7	84.3	83.0	81.8	80.7	79.7
9.25	98.4	98.2	97.6	96.7	95.6	94.4	93.2	92.1	90.9	89.9	87.6	85.9	84.4	83.1	81.9	80.8	79.8
9.50	98.0	97.8	97.3	96.4	95.4	94.2	93.1	91.9	90.8	89.7	87.7	86.0	84.5	83.2	82.0	80.9	79.9
9.75	97.7	97.5	96.9	96.1	95.1	94.0	92.9	91.8	90.7	89.6	87.8	86.2	84.6	83.3	82.1	81.0	80.0
10.00	97.3	97.1	96.6	95.8	94.9	93.8	92.7	91.6	90.6	89.5	88.6	86.3	84.8	83.4	82.2	81.1	80.0
10.25	96.9	96.8	96.3	95.5	94.6	93.6	92.5	91.5	90.4	89.4	88.5	86.5	84.9	83.5	82.3	81.1	80.1
10.50	96.6	96.4	96.0	95.2	94.4	93.4	92.4	91.3	90.3	89.3	88.4	86.5	85.0	83.6	82.4	81.2	80.2
10.75	96.3	96.1	95.6	95.0	94.1	93.2	92.2	91.2	90.2	89.2	88.3	87.4	85.2	83.7	82.5	81.3	80.3
11.00	95.9	95.8	95.3	94.7	93.9	93.0	92.0	91.0	90.0	89.1	88.2	87.3	85.3	83.9	82.6	81.4	80.4
11.25	95.6	95.5	95.1	94.4	93.6	92.8	91.8	90.9	89.9	89.0	88.1	87.2	85.4	84.0	82.7	81.5	80.4
11.50	95.3	95.2	94.8	94.2	93.4	92.6	91.6	90.7	89.8	88.9	88.0	87.1	85.4	84.1	82.8	81.6	80.5
11.75	95.0	94.9	94.5	93.9	93.2	92.4	91.5	90.6	89.6	88.9	87.9	87.0	86.2	84.2	82.9	81.7	80.6
12.00	94.7	94.6	94.2	93.7	93.0	92.2	91.3	90.4	89.5	88.6	87.8	86.9	86.1	84.3	83.0	81.8	80.7
12.25	94.4	94.3	93.9	93.4	92.7	92.0	91.1	90.3	89.4	88.5	87.7	86.9	86.1	84.4	83.1	81.9	80.9
12.50	94.1	94.0	93.7	93.2	92.5	91.8	90.9	90.1	89.3	88.4	87.6	86.8	86.0	85.2	83.3	82.0	80.9
12.75	93.8	93.7	93.4	92.9	92.3	91.6	90.8	90.0	89.1	88.3	87.5	86.7	85.9	85.1	83.4	82.1	81.0
13.00	93.6	93.5	93.2	92.7	92.1	91.4	90.6	89.8	89.0	88.2	87.4	86.6	85.8	85.1	83.4	82.2	81.1
13.25	93.3	93.2	92.9	92.4	91.9	91.2	90.4	89.7	88.9	88.1	87.3	86.5	85.7	85.0	83.4	82.3	81.2
13.50	93.0	92.9	92.7	92.2	91.7	91.0	90.3	89.5	88.7	87.9	87.2	86.4	85.7	84.9	84.2	82.4	81.3
13.75	92.8	92.7	92.4	92.0	91.4	90.8	90.1	89.4	88.6	87.8	87.1	86.3	85.6	84.9	84.2	82.5	81.4
14.00	92.5	92.4	92.2	91.8	91.2	90.6	89.9	89.2	88.5	87.7	86.9	86.2	85.5	84.8	84.1	82.5	81.5
14.25	92.3	92.2	91.9	91.5	91.0	90.4	89.8	89.1	88.3	87.6	86.8	86.1	85.4	84.7	84.0	83.4	81.6
14.50	92.0	91.9	91.7	91.3	90.8	90.2	89.6	88.9	88.2	87.5	86.7	86.0	85.3	84.6	84.0	83.3	81.7
14.75	91.8	91.7	91.5	91.1	90.6	90.1	89.4	88.8	88.1	87.3	86.6	85.9	85.2	84.6	83.9	83.3	81.7
15.00	91.6	91.5	91.3	90.9	90.4	89.9	89.3	88.6	87.9	87.2	86.5	85.8	85.1	84.5	83.9	83.2	81.7
15.25	91.3	91.3	91.0	90.7	90.2	89.7	89.1	88.5	87.8	87.1	86.4	85.7	85.1	84.4	83.8	83.1	82.5
15.50	91.1	91.0	90.8	90.5	90.1	89.5	88.9	88.3	87.7	87.0	86.3	85.6	85.0	84.3	83.7	83.1	82.5
15.75	90.9	90.8	90.6	90.3	89.9	89.4	88.8	88.2	87.5	86.9	86.2	85.5	84.9	84.2	83.6	83.0	82.4
16.00	90.7	90.6	90.4	90.1	89.7	89.2	88.6	88.0	87.4	86.8	86.1	85.4	84.8	84.2	83.5	82.9	82.3
16.25	90.4	90.4	90.2	89.9	89.5	89.0	88.5	87.9	87.3	86.6	86.0	85.4	84.7	84.1	83.5	82.9	82.3
16.50	90.2	90.2	90.0	89.7	89.3	88.8	88.3	87.7	87.1	86.5	85.9	85.3	84.6	84.0	83.4	82.8	82.2
16.75	90.0	90.0	89.8	89.5	89.1	88.7	88.2	87.6	87.0	86.4	85.8	85.2	84.5	83.9	83.3	82.7	82.2
17.00	89.8	89.8	89.6	89.3	89.0	88.5	88.0	87.5	86.9	86.3	85.7	85.1	84.5	83.8	83.3	82.7	82.1
17.25	89.6	89.6	89.4	89.1	88.8	88.3	87.9	87.3	86.8	86.2	85.6	85.0	84.4	83.8	83.2	82.6	82.0
17.50	89.4	89.4	89.2	89.0	88.6	88.2	87.7	87.2	86.6	86.1	85.5	84.9	84.3	83.7	83.1	82.5	82.0
17.75	89.2	89.2	89.0	88.8	88.4	88.0	87.6	87.0	86.5	85.9	85.4	84.8	84.2	83.6	83.0	82.5	81.9
18.00	89.0	89.0	88.8	88.6	88.3	87.9	87.4	86.9	86.4	85.8	85.2	84.7	84.1	83.5	83.0	82.4	81.9

TABLE 12D

TAKEOFF EPNL GRID VALUE SET C4

CURRENT FOUR ENGINE AIRCRAFT

Dist. From Start of T/O Roll (Miles)	SIDELINE DISTANCE (MILES)																
	0	1/4	1/2	3/4	1	1 1/4	1 1/2	2 3/4	2	2 1/4	2 1/2	2 3/4	3	3 1/4	3 1/2	3 3/4	4
2.00	125.5	110.4	102.7	98.2	94.5	91.3	88.7	86.5	84.6	82.9	81.4	80.1	78.8	77.7	76.7	75.7	74.8
2.25	122.1	111.3	103.6	98.9	95.2	91.9	89.2	87.0	85.1	83.4	81.9	80.5	79.3	78.2	77.1	76.1	75.2
2.50	119.8	112.4	104.2	99.4	95.7	92.4	89.7	87.4	85.5	83.8	82.3	80.9	79.7	78.5	77.5	76.5	75.6
2.75	117.9	113.2	104.8	99.9	96.1	92.8	90.1	87.8	85.9	84.1	82.6	81.2	80.0	78.8	77.8	76.8	75.9
3.00	116.4	112.7	105.4	100.3	96.5	93.1	90.4	88.1	86.2	84.4	82.9	81.5	80.2	79.1	78.0	77.0	76.1
3.25	115.2	112.2	106.0	100.7	96.8	93.4	90.7	88.4	86.4	84.7	83.2	81.8	80.5	79.3	78.2	77.2	76.3
3.50	114.2	111.8	106.8	101.1	97.1	93.7	91.0	88.7	86.7	84.9	83.4	82.0	80.7	79.5	78.5	77.5	76.5
3.75	113.3	111.3	108.0	101.4	97.3	94.0	91.2	88.9	86.9	85.2	83.6	82.2	80.9	79.7	78.7	77.6	76.7
4.00	112.6	110.8	107.8	101.8	97.6	94.2	91.4	89.1	87.1	85.4	83.8	82.4	81.1	79.9	78.8	77.8	76.9
4.25	111.9	110.3	107.5	102.2	97.8	94.4	91.6	89.3	87.3	85.6	84.0	82.6	81.3	80.1	79.0	78.0	77.0
4.50	111.2	109.9	107.2	102.7	98.1	94.6	91.8	89.5	87.5	85.7	84.2	82.7	81.4	80.3	79.2	78.1	77.2
4.75	110.6	109.4	106.9	103.1	98.3	94.8	92.0	89.7	87.7	85.9	84.3	82.9	81.6	80.4	79.3	78.3	77.3
5.00	110.0	108.9	106.6	103.8	98.6	95.0	92.2	89.8	87.8	86.0	84.5	83.0	81.7	80.6	79.4	78.4	77.5
5.25	109.5	108.5	106.3	103.6	98.9	95.2	92.3	90.0	88.0	86.2	84.6	83.2	81.9	80.7	79.6	78.6	77.6
5.50	108.9	108.1	105.9	103.4	99.2	95.4	92.5	90.1	88.1	86.3	84.7	83.3	82.0	80.8	79.7	78.7	77.7
5.75	108.5	107.7	105.5	103.2	99.5	95.6	92.7	90.3	88.2	86.5	84.9	83.4	82.1	80.9	79.8	78.8	77.8
6.00	108.0	107.3	105.2	103.0	100.4	95.8	92.8	90.4	88.4	86.6	85.0	83.6	82.3	81.1	79.9	78.9	78.0
6.25	107.6	106.8	104.9	102.7	100.3	96.0	93.0	90.6	88.5	86.7	85.1	83.7	82.4	81.2	80.1	79.0	78.1
6.50	107.1	106.4	104.6	102.5	100.1	96.3	93.2	90.7	88.6	86.8	85.2	83.8	82.5	81.3	80.2	79.1	78.2
6.75	106.6	105.9	104.3	102.2	99.9	96.5	93.3	90.8	88.7	86.9	85.3	83.9	82.6	81.4	80.3	79.2	78.3
7.00	106.1	105.4	104.0	101.9	99.7	96.7	93.5	91.0	88.9	87.0	85.4	84.0	82.7	81.5	80.4	79.3	78.4
7.25	105.6	105.0	103.7	101.6	99.5	97.5	93.7	91.1	89.0	87.2	85.5	84.1	82.8	81.6	80.4	79.4	78.4
7.50	105.2	104.7	103.3	101.4	99.3	97.3	93.9	91.3	89.1	87.3	85.6	84.2	82.9	81.7	80.5	79.5	78.5
7.75	104.8	104.3	103.0	101.1	99.1	97.2	94.1	91.4	89.2	87.4	85.7	84.3	83.0	81.7	80.6	79.6	78.6
8.00	104.4	103.9	102.7	100.8	98.9	97.1	94.3	91.6	89.3	87.5	85.8	84.4	83.0	81.8	80.7	79.7	78.7
8.25	104.0	103.6	102.3	100.6	98.7	96.9	94.3	91.7	89.5	87.6	85.9	84.5	83.1	81.9	80.8	79.8	78.8
8.50	103.6	103.2	102.0	100.3	98.5	96.7	95.1	91.9	89.6	87.7	86.0	84.6	83.2	82.0	80.9	79.8	78.9
8.75	103.2	102.8	101.6	100.0	98.3	96.6	95.0	92.1	89.7	87.8	86.1	84.6	83.3	82.1	81.0	79.9	78.9
9.00	102.8	102.4	101.3	99.8	98.1	96.4	94.9	92.3	89.9	87.9	86.2	84.7	83.4	82.2	81.0	80.0	79.0
9.25	102.4	102.0	100.9	99.5	97.9	96.3	94.7	92.4	90.0	88.0	86.3	84.8	83.5	82.2	81.1	80.1	79.1
9.50	102.0	101.6	100.6	99.2	97.7	96.1	94.6	93.2	90.2	88.1	86.4	84.9	83.5	82.3	81.2	80.1	79.2
9.75	101.6	101.3	100.3	99.0	97.5	96.0	94.5	93.1	90.4	88.3	86.5	85.0	83.6	82.4	81.3	80.2	79.2
10.00	101.2	100.9	100.0	98.7	97.3	95.8	94.3	93.0	90.5	88.4	86.6	85.1	83.7	82.5	81.3	80.3	79.3
10.25	100.9	100.5	99.7	98.5	97.1	95.6	94.2	92.9	90.6	88.5	86.7	85.2	83.8	82.5	81.4	80.3	79.4
10.50	100.5	100.2	99.4	98.2	96.9	95.5	94.1	92.8	90.6	88.7	86.8	85.3	83.9	82.6	81.5	80.4	79.4
10.75	100.1	99.9	99.1	98.0	96.7	95.3	94.0	92.7	91.4	88.8	86.9	85.3	83.9	82.7	81.5	80.5	79.5
11.00	99.8	99.5	98.8	97.7	96.5	95.1	93.8	92.5	91.3	89.0	87.1	85.4	84.0	82.8	81.6	80.5	79.5
11.25	99.5	99.2	98.5	97.5	96.3	95.0	93.7	92.4	91.2	89.1	87.2	85.5	84.1	82.8	81.7	80.6	79.6
11.50	99.1	98.9	98.2	97.2	96.1	94.8	93.6	92.3	91.2	89.1	87.3	85.6	84.2	82.9	81.7	80.7	79.7
11.75	98.8	98.6	98.0	97.0	95.9	94.6	93.4	92.2	91.1	90.0	87.4	85.7	84.3	83.0	81.8	80.7	79.7
12.00	98.5	98.3	97.7	96.8	95.7	94.5	93.3	92.1	91.0	89.9	87.6	85.8	84.4	83.1	81.9	80.8	79.9
12.25	98.2	98.0	97.4	96.5	95.5	94.3	93.1	92.0	90.9	89.8	87.7	86.0	84.5	83.1	81.9	80.9	79.9
12.50	97.9	97.7	97.2	96.3	95.3	94.2	93.0	91.9	90.8	89.7	87.8	86.1	84.5	83.2	82.0	80.9	79.9
12.75	97.6	97.4	96.9	96.1	95.1	94.0	92.9	91.8	90.7	89.6	87.8	86.2	84.6	83.3	82.1	81.0	80.0
13.00	97.4	97.2	96.6	95.9	94.9	93.8	92.7	91.6	90.6	89.6	88.6	86.3	84.7	83.4	82.2	81.0	80.0
13.25	97.1	96.9	96.4	95.6	94.7	93.7	92.6	91.5	90.5	89.5	88.5	86.4	84.8	83.5	82.2	81.1	80.1
13.50	96.8	96.6	96.2	95.4	94.5	93.5	92.5	91.4	90.4	89.4	88.4	86.5	85.0	83.5	82.3	81.2	80.1
13.75	96.5	96.4	95.9	95.2	94.3	93.4	92.3	91.3	90.3	89.3	88.4	86.5	85.1	83.6	82.4	81.2	80.2
14.00	96.3	96.1	95.7	95.0	94.1	93.2	92.2	91.2	90.2	89.2	88.3	87.4	85.2	83.7	82.4	81.3	80.3
14.25	96.0	95.9	95.4	94.8	94.0	93.0	92.1	91.1	90.1	89.1	88.2	87.3	85.3	83.8	82.5	81.4	80.3
14.50	95.8	95.6	95.2	94.6	93.8	92.9	91.9	90.9	90.0	89.0	88.1	87.3	85.4	83.9	82.6	81.4	80.4
14.75	95.5	95.4	95.0	94.4	93.6	92.7	91.8	90.8	89.9	89.0	88.1	87.2	85.4	84.0	82.7	81.5	80.5
15.00	95.3	95.2	94.8	94.2	93.4	92.6	91.7	90.7	89.8	88.9	88.0	87.1	85.4	84.1	82.8	81.6	80.5
15.25	95.1	94.9	94.6	94.0	93.2	92.4	91.5	90.6	89.7	88.8	87.9	87.1	86.2	84.2	82.9	81.7	80.6
15.50	94.8	94.7	94.3	93.8	93.1	92.3	91.4	90.5	89.6	88.7	87.8	87.0	86.2	84.3	83.0	81.7	80.6
15.75	94.6	94.5	94.1	93.6	92.9	92.1	91.2	90.4	89.5	88.6	87.7	86.9	86.1	84.4	83.1	81.8	80.7
16.00	94.4	94.3	93.9	93.4	92.7	91.9	91.1	90.2	89.4	88.5	87.7	86.8	86.1	84.4	83.1	81.9	80.8
16.25	94.2	94.0	93.7	93.2	92.6	91.8	91.0	90.1	89.3	88.4	87.6	86.8	86.0	85.2	83.2	82.0	80.9
16.50	93.9	93.8	93.5	93.0	92.4	91.6	90.8	90.0	89.2	88.3	87.5	86.7	85.9	85.2	83.3	82.1	80.9
16.75	93.7	93.6	93.3	92.8	92.2	91.5	90.7	89.9	89.1	88.2	87.4	86.6	85.9	85.1	83.4	82.2	81.0
17.00	93.5	93.4	93.1	92.7	92.0	91.3	90.6	89.8	89.0	88.2	87.4	86.6	85.8	85.1	83.4	82.2	81.1
17.25	93.3	93.2	92.9	92.5	91.9	91.2	90.5	89.7	88.9	88.1	87.3	86.5	85.7	85.0	83.4	82.3	81.2
17.50	93.1	93.0	92.7	92.3	91.7	91.1	90.3	89.6	88.8	88.0	87.2	86.4	85.7	85.0	84.3	82.4	81.2
17.75	92.9	92.8	92.5	92.1	91.6	90.9	90.2	89.4	88.7	87.9	87.1	86.4	85.6	84.9	84.2	82.5	81.3
18.00	92.7	92.6	92.4	91.9	91.4	90.8	90.1	89.3	88.6	87.8	87.0	86.3	85.6	84.8	84.2	82.5	81.4

TAKEOFF EPNL GRID VALUE SET D4

CURRENT FOUR ENGINE AIRCRAFT

SIDELINE DISTANCE (MILES)

Dist. From Start of T/O Roll (Miles)	0	1/4	1/2	3/4	1	1 1/4	1 1/2	2 3/4	2	2 1/4	2 1/2	2 3/4	3	3 1/4	3 1/2	3 3/4	4
2.00	136.7	108.4	100.6	96.3	92.9	89.8	87.2	85.1	83.3	81.7	80.2	78.9	77.8	76.7	75.6	74.7	73.9
2.25	129.5	109.6	101.9	97.4	93.9	90.7	88.1	85.9	84.1	82.4	80.9	79.6	78.4	77.3	76.3	75.3	74.4
2.50	125.3	110.5	102.8	98.2	94.6	91.3	88.7	86.5	84.6	82.9	81.4	80.1	78.9	77.7	76.7	75.7	74.8
2.75	122.6	111.2	103.4	98.8	95.1	91.8	89.2	86.9	85.0	83.3	81.8	80.5	79.2	78.1	77.1	76.1	75.2
3.00	120.5	112.0	104.0	99.2	95.5	92.2	89.6	87.3	85.4	83.7	82.2	80.8	79.5	78.4	77.3	76.4	75.5
3.25	118.8	113.4	104.5	99.7	95.9	92.6	89.9	87.6	85.7	84.0	82.4	81.1	79.8	78.7	77.6	76.6	75.7
3.50	117.4	113.0	105.0	100.0	96.2	92.9	90.2	87.9	86.0	84.2	82.7	81.3	80.1	78.9	77.8	76.8	75.9
3.75	116.2	112.7	105.4	100.4	96.5	93.2	90.5	88.2	86.2	84.5	82.9	81.5	80.3	79.1	78.0	77.0	76.1
4.00	115.3	112.3	106.0	100.7	96.8	93.4	90.7	88.4	86.4	84.7	83.1	81.7	80.5	79.3	78.2	77.2	76.3
4.25	114.5	111.9	106.6	101.0	97.0	93.6	90.9	88.6	86.6	84.9	83.3	81.9	80.7	79.5	78.4	77.4	76.5
4.50	113.7	111.5	107.1	101.3	97.2	93.9	91.1	88.8	86.8	85.1	83.5	82.1	80.9	79.7	78.6	77.6	76.6
4.75	113.0	111.1	107.9	101.6	97.4	94.1	91.3	89.0	87.0	85.2	83.7	82.3	81.0	79.8	78.7	77.7	76.8
5.00	112.4	110.7	107.7	101.9	97.6	94.2	91.5	89.2	87.2	85.4	83.8	82.4	81.1	80.0	78.9	77.9	76.9
5.25	111.9	110.3	107.5	102.2	97.8	94.4	91.6	89.3	87.3	85.6	84.0	82.6	81.3	80.1	79.0	78.0	77.0
5.50	111.3	110.0	107.3	102.6	98.0	94.6	91.8	89.5	87.5	85.7	84.1	82.7	81.4	80.2	79.1	78.1	77.2
5.75	110.8	109.6	107.1	103.0	98.2	94.7	91.9	89.6	87.6	85.8	84.3	82.8	81.5	80.4	79.3	78.2	77.3
6.00	110.4	109.2	106.8	103.9	98.4	94.9	92.1	89.7	87.7	86.0	84.4	83.0	81.7	80.5	79.4	78.4	77.4
6.25	109.9	108.8	106.5	103.8	98.7	95.0	92.2	89.9	87.9	86.1	84.5	83.1	81.8	80.6	79.5	78.5	77.5
6.50	109.4	108.5	106.2	103.6	98.9	95.2	92.4	90.0	88.0	86.2	84.6	83.2	81.9	80.7	79.6	78.6	77.6
6.75	109.0	108.2	105.9	103.5	99.1	95.4	92.5	90.1	88.1	86.3	84.7	83.3	82.0	80.8	79.7	78.7	77.7
7.00	108.6	107.8	105.6	103.3	99.4	95.5	92.6	90.2	88.2	86.4	84.8	83.4	82.1	80.9	79.8	78.8	77.8
7.25	108.2	107.5	105.4	103.1	99.6	95.7	92.7	90.4	88.3	86.5	84.9	83.5	82.2	81.0	79.9	78.9	77.9
7.50	107.9	107.1	105.1	102.9	100.4	95.9	92.9	90.5	88.4	86.6	85.0	83.6	82.3	81.1	80.0	79.0	78.0
7.75	107.5	106.8	104.9	102.7	100.2	96.1	93.0	90.6	88.5	86.7	85.1	83.7	82.4	81.2	80.1	79.0	78.1
8.00	107.1	106.4	104.6	102.5	100.1	96.3	93.1	90.7	88.6	86.8	85.2	83.8	82.5	81.3	80.2	79.1	78.2
8.25	106.7	106.0	104.4	102.2	99.9	96.5	93.3	90.8	88.7	86.9	85.3	83.9	82.6	81.4	80.2	79.2	78.2
8.50	106.3	105.6	104.1	102.0	99.8	96.7	93.4	90.9	88.8	87.0	85.4	84.0	82.6	81.4	80.3	79.3	78.3
8.75	105.9	105.3	103.8	101.8	99.6	96.7	93.6	91.0	88.9	87.1	85.5	84.0	82.7	81.5	80.4	79.4	78.4
9.00	105.5	104.9	103.6	101.6	99.5	97.5	93.8	91.1	89.0	87.2	85.6	84.1	82.8	81.6	80.5	79.4	78.5
9.25	105.1	104.6	103.3	101.4	99.3	97.3	93.9	91.3	89.1	87.3	85.6	84.2	82.9	81.7	80.5	79.5	78.5
9.50	104.8	104.3	103.1	101.1	99.1	97.2	94.1	91.4	89.2	87.4	85.7	84.3	82.9	81.7	80.6	79.6	78.6
9.75	104.5	104.0	102.8	100.9	99.0	97.1	94.3	91.5	89.3	87.4	85.8	84.3	83.0	81.8	80.7	79.6	78.7
10.00	104.2	103.7	102.5	100.7	98.8	97.0	94.4	91.7	89.4	87.5	85.9	84.4	83.1	81.9	80.8	79.7	78.7
10.25	103.9	103.4	102.2	100.5	98.6	96.9	95.2	91.8	89.5	87.6	86.0	84.5	83.2	81.9	80.8	79.8	78.8
10.50	103.6	103.2	101.9	100.3	98.5	96.7	95.1	91.9	89.6	87.7	86.0	84.6	83.2	82.0	80.9	79.8	78.9
10.75	103.2	102.8	101.6	100.0	98.3	96.6	95.0	92.1	89.7	87.8	86.1	84.6	83.3	82.1	81.0	79.9	78.9
11.00	102.9	102.5	101.4	99.8	98.1	96.5	94.9	92.2	89.8	87.9	86.2	84.7	83.4	82.1	81.0	80.0	79.0
11.25	102.6	102.2	101.1	99.6	98.0	96.3	94.8	92.4	90.0	88.0	86.3	84.8	83.4	82.2	81.1	80.0	79.1
11.50	102.3	101.9	100.8	99.4	97.8	96.2	94.7	92.4	90.1	88.1	86.4	84.8	83.5	82.3	81.1	80.1	79.1
11.75	101.9	101.6	100.6	99.2	97.6	96.1	94.6	93.2	90.2	88.2	86.4	84.9	83.6	82.3	81.2	80.1	79.2
12.00	101.6	101.3	100.3	99.0	97.5	95.9	94.5	93.1	90.4	88.3	86.5	85.0	83.6	82.4	81.3	80.2	79.2
12.25	101.3	101.0	100.0	98.8	97.3	95.8	94.4	93.0	90.5	88.4	86.6	85.1	83.7	82.5	81.3	80.3	79.3
12.50	101.0	100.7	99.8	98.6	97.1	95.7	94.3	92.9	90.6	88.5	86.7	85.1	83.8	82.5	81.4	80.3	79.3
12.75	100.7	100.4	99.5	98.3	97.0	95.6	94.2	92.8	90.7	88.6	86.8	85.2	83.8	82.6	81.4	80.4	79.4
13.00	100.4	100.1	99.3	98.1	96.8	95.4	94.1	92.7	91.5	88.7	86.9	85.3	83.9	82.6	81.5	80.4	79.4
13.25	100.1	99.8	99.1	97.9	96.6	95.3	93.9	92.6	91.4	88.8	87.0	85.4	84.0	82.7	81.5	80.5	79.5
13.50	99.8	99.6	98.8	97.7	96.5	95.2	93.8	92.6	91.3	88.9	87.0	85.4	84.0	82.7	81.6	80.5	79.5
13.75	99.6	99.3	98.6	97.5	96.3	95.0	93.7	92.5	91.3	89.0	87.1	85.5	84.1	82.8	81.6	80.6	79.6
14.00	99.3	99.0	98.4	97.3	96.2	94.9	93.6	92.4	91.2	89.1	87.2	85.6	84.2	82.9	81.7	80.6	79.6
14.25	99.0	98.8	98.1	97.2	96.0	94.8	93.5	92.3	91.1	89.1	87.4	85.7	84.2	82.9	81.8	80.7	79.7
14.50	98.8	98.5	97.9	97.0	95.8	94.6	93.4	92.2	91.0	89.9	87.5	85.8	84.3	83.0	81.8	80.7	79.7
14.75	98.5	98.3	97.7	96.8	95.7	94.5	93.3	92.1	91.0	89.9	87.6	85.8	84.4	83.1	81.9	80.8	79.8
15.00	98.3	98.1	97.5	96.6	95.5	94.4	93.2	92.0	90.9	89.8	87.7	85.9	84.4	83.1	81.9	80.8	79.8
15.25	98.0	97.8	97.3	96.4	95.4	94.2	93.1	91.9	90.8	89.7	87.7	86.0	84.5	83.2	82.0	80.9	79.9
15.50	97.8	97.6	97.0	96.2	95.2	94.1	93.0	91.8	90.7	89.7	87.8	86.1	84.6	83.2	82.0	80.9	79.9
15.75	97.6	97.4	96.8	96.0	95.0	94.0	92.8	91.7	90.7	89.6	87.7	86.2	84.7	83.3	82.1	81.0	80.0
16.00	97.3	97.2	96.6	95.8	94.9	93.8	92.7	91.6	90.6	89.5	88.6	86.3	84.7	83.4	82.2	81.0	80.0
16.25	97.1	96.9	96.4	95.7	94.7	93.7	92.6	91.5	90.5	89.5	88.5	86.4	84.8	83.4	82.2	81.1	80.1
16.50	96.9	96.7	96.2	95.5	94.6	93.6	92.5	91.5	90.4	89.4	88.4	86.5	84.9	83.5	82.3	81.2	80.1
16.75	96.7	96.5	96.0	95.3	94.4	93.4	92.4	91.4	90.3	89.3	88.4	86.5	85.0	83.6	82.3	81.2	80.2
17.00	96.5	96.3	95.8	95.1	94.3	93.3	92.3	91.3	90.3	89.3	88.3	86.5	85.1	83.7	82.4	81.3	80.2
17.25	96.3	96.1	95.6	95.0	94.1	93.2	92.2	91.2	90.2	89.2	88.3	87.4	85.2	83.7	82.5	81.3	80.3
17.50	96.0	95.9	95.5	94.8	94.0	93.0	92.1	91.1	90.1	89.1	88.2	87.3	85.3	83.8	82.5	81.4	80.3
17.75	95.8	95.7	95.3	94.6	93.8	92.9	92.0	91.0	90.0	89.1	88.1	87.3	85.3	83.9	82.6	81.4	80.4
18.00	95.6	95.5	95.1	94.5	93.7	92.8	91.8	90.9	89.9	89.0	88.1	87.2	85.4	84.0	82.7	81.5	80.4

TABLE 14D

TAKEOFF EPNL GRID VALUE SET E4

CURRENT FOUR ENGINE AIRCRAFT

SIDELINE DISTANCE (MILES)

Dist. From Start of T/O Roll (Miles)	0	1/4	1/2	3/4	1	1 1/4	1 1/2	1 3/4	2	2 1/4	2 1/2	2 3/4	3	3 1/4	3 1/2	3 3/4	4
2.00	134.4	104.9	97.4	93.6	90.5	87.6	85.3	83.3	81.6	80.0	78.7	77.4	76.3	75.3	74.3	73.4	72.6
2.25	137.4	107.7	100.0	95.8	92.4	89.3	86.8	84.7	82.9	81.3	79.9	78.6	77.5	76.4	75.4	74.4	73.6
2.50	132.3	109.1	101.4	97.0	93.4	90.3	87.7	85.6	83.7	82.1	80.6	79.3	78.1	77.0	76.0	75.1	74.2
2.75	128.0	110.0	102.2	97.7	94.1	90.9	88.3	86.1	84.3	82.6	81.1	79.8	78.6	77.5	76.4	75.5	74.6
3.00	124.8	110.6	102.9	98.3	94.7	91.4	88.8	86.6	84.7	83.0	81.5	80.2	78.9	77.8	76.8	75.9	75.0
3.25	122.6	111.2	103.4	98.8	95.1	91.8	89.2	86.9	85.0	83.3	81.8	80.5	79.2	78.1	77.0	76.1	75.2
3.50	120.8	111.8	103.9	99.2	95.5	92.2	89.5	87.2	85.3	83.6	82.1	80.7	79.5	78.3	77.3	76.3	75.4
3.75	119.4	112.6	104.3	99.5	95.8	92.5	89.8	87.5	85.6	83.9	82.3	81.0	79.7	78.6	77.5	76.5	75.6
4.00	118.1	113.2	104.7	99.8	96.1	92.7	90.0	87.8	85.8	84.1	82.6	81.2	79.9	78.8	77.7	76.7	75.8
4.25	117.0	112.9	105.1	100.1	96.3	93.0	90.3	88.0	86.0	84.3	82.8	81.4	80.1	79.0	77.9	76.9	76.0
4.50	116.1	112.6	105.5	100.4	96.5	93.2	90.5	88.2	86.2	84.5	83.0	81.6	80.3	79.1	78.1	77.1	76.1
4.75	115.4	112.3	105.9	100.6	96.8	93.4	90.7	88.4	86.4	84.7	83.1	81.7	80.5	79.3	78.2	77.2	76.3
5.00	114.7	112.0	106.4	100.9	97.0	93.6	90.9	88.6	86.6	84.8	83.3	81.9	80.6	79.4	78.4	77.4	76.4
5.25	114.0	111.6	106.9	101.1	97.1	93.8	91.0	88.7	86.7	85.0	83.4	82.0	80.8	79.6	78.5	77.5	76.6
5.50	113.4	111.3	108.0	101.4	97.3	93.9	91.2	88.9	86.9	85.1	83.6	82.2	80.9	79.7	78.6	77.6	76.7
5.75	112.9	111.0	107.9	101.6	97.5	94.1	91.3	89.0	87.0	85.3	83.7	82.3	81.0	79.8	78.8	77.7	76.8
6.00	112.4	110.7	107.7	101.9	97.7	94.2	91.5	89.2	87.2	85.4	83.8	82.4	81.1	80.0	78.9	77.9	76.9
6.25	111.9	110.4	107.5	102.2	97.8	94.4	91.6	89.3	87.3	85.5	84.0	82.6	81.3	80.1	79.0	78.0	77.0
6.50	111.5	110.1	107.4	102.5	98.0	94.5	91.8	89.4	87.4	85.7	84.1	82.7	81.4	80.2	79.1	78.1	77.1
6.75	111.1	109.7	107.2	102.8	98.1	94.7	91.9	89.5	87.5	85.8	84.2	82.8	81.5	80.3	79.2	78.2	77.2
7.00	110.7	109.4	107.0	103.1	98.3	94.8	92.0	89.7	87.7	85.9	84.3	82.9	81.6	80.4	79.3	78.3	77.3
7.25	110.3	109.1	106.8	103.9	98.5	94.9	92.1	89.8	87.8	86.0	84.4	83.0	81.7	80.5	79.4	78.4	77.4
7.50	109.9	108.8	106.5	103.8	98.7	95.0	92.2	89.9	87.9	86.1	84.5	83.1	81.8	80.6	79.5	78.5	77.5
7.75	109.5	108.5	106.3	103.7	98.8	95.2	92.3	90.0	88.0	86.2	84.6	83.2	81.9	80.7	79.6	78.6	77.6
8.00	109.1	108.3	106.0	103.5	99.1	95.3	92.4	90.1	88.1	86.3	84.7	83.3	82.0	80.8	79.7	78.6	77.7
8.25	108.8	108.0	105.8	103.4	99.3	95.4	92.6	90.2	88.1	86.4	84.8	83.3	82.0	80.8	79.7	78.7	77.8
8.50	108.5	107.7	105.6	103.2	99.5	95.6	92.7	90.3	88.2	86.5	84.9	83.4	82.1	80.9	79.8	78.9	77.8
8.75	108.2	107.4	105.3	103.1	99.6	95.7	92.8	90.4	88.3	86.5	84.9	83.5	82.2	81.0	79.9	78.9	77.9
9.00	107.9	107.2	105.1	102.9	100.4	95.9	92.9	90.5	88.4	86.6	85.0	83.6	82.3	81.1	80.0	78.9	78.0
9.25	107.6	106.9	104.9	102.7	100.3	96.0	93.0	90.6	88.5	86.7	85.1	83.7	82.4	81.2	80.1	79.0	78.1
9.50	107.3	106.5	104.7	102.6	100.1	96.2	93.1	90.6	88.6	86.8	85.2	83.7	82.4	81.2	80.1	79.1	78.1
9.75	107.0	106.2	104.5	102.4	100.0	96.4	93.2	90.7	88.7	86.9	85.3	83.8	82.5	81.3	80.2	79.2	78.2
10.00	106.6	105.9	104.3	102.2	99.9	96.5	93.3	90.8	88.7	86.9	85.3	83.9	82.6	81.4	80.3	79.2	78.3
10.25	106.3	105.6	104.1	102.0	99.8	96.7	93.4	90.9	88.8	87.0	85.4	84.0	82.6	81.4	80.3	79.3	78.3
10.50	105.9	105.3	103.9	101.8	99.6	96.7	93.6	91.0	88.9	87.1	85.5	84.0	82.7	81.5	80.4	79.4	78.4
10.75	105.6	105.0	103.7	101.6	99.5	97.5	93.7	91.1	89.0	87.2	85.5	84.1	82.8	81.6	80.5	79.4	78.4
11.00	105.3	104.8	103.4	101.5	99.4	97.4	93.9	91.2	89.1	87.2	85.6	84.2	82.8	81.6	80.5	79.5	78.5
11.25	105.0	104.5	103.2	101.3	99.2	97.3	94.0	91.3	89.1	87.3	85.7	84.2	82.9	81.7	80.6	79.5	78.6
11.50	104.7	104.3	103.0	101.1	99.1	97.2	94.1	91.4	89.2	87.4	85.7	84.3	83.0	81.8	80.6	79.6	78.6
11.75	104.5	104.0	102.8	100.9	99.0	97.1	94.3	91.5	89.3	87.4	85.8	84.3	83.0	81.8	80.7	79.6	78.7
12.00	104.2	103.8	102.5	100.7	98.8	97.0	94.4	91.6	89.4	87.5	85.9	84.4	83.1	81.9	80.7	79.7	78.7
12.25	104.0	103.5	102.3	100.5	98.7	96.9	94.3	91.8	89.5	87.6	85.9	84.5	83.1	81.9	80.8	79.8	78.8
12.50	103.7	103.3	102.1	100.4	98.6	96.8	95.1	91.9	89.6	87.7	86.0	84.5	83.2	82.0	80.9	79.8	78.8
12.75	103.5	103.1	101.8	100.2	98.4	96.7	95.1	92.0	89.7	87.7	86.1	84.6	83.3	82.0	80.9	79.9	78.9
13.00	103.2	102.8	101.6	100.0	98.3	96.6	95.0	92.1	89.8	87.8	86.1	84.6	83.3	82.1	81.0	79.9	78.9
13.25	102.9	102.5	101.4	99.8	98.1	96.5	94.9	92.2	89.8	87.9	86.2	84.7	83.4	82.1	81.0	80.0	79.0
13.50	102.7	102.2	101.1	99.6	98.0	96.4	94.8	92.3	89.9	88.0	86.3	84.8	83.4	82.2	81.1	80.0	79.0
13.75	102.4	102.0	100.9	99.5	97.9	96.3	94.7	92.4	90.0	88.0	86.3	84.8	83.5	82.2	81.1	80.1	79.1
14.00	102.1	101.7	100.7	99.3	97.7	96.2	94.6	93.2	90.2	88.1	86.4	84.9	83.5	82.3	81.2	80.1	79.1
14.25	101.8	101.5	100.5	99.1	97.6	96.0	94.6	93.1	90.3	88.2	86.5	84.9	83.6	82.3	81.2	80.2	79.2
14.50	101.6	101.2	100.3	98.9	97.5	95.9	94.5	93.1	90.4	88.3	86.5	85.0	83.6	82.4	81.3	80.2	79.2
14.75	101.3	101.0	100.1	98.8	97.3	95.8	94.4	93.0	90.5	88.4	86.6	85.1	83.7	82.4	81.3	80.3	79.3
15.00	101.1	100.7	99.9	98.6	97.2	95.7	94.3	92.9	90.6	88.5	86.7	85.1	83.7	82.5	81.4	80.3	79.3
15.25	100.8	100.5	99.6	98.4	97.0	95.6	94.2	92.9	90.6	88.5	86.7	85.2	83.8	82.5	81.4	80.3	79.4
15.50	100.6	100.3	99.4	98.3	96.9	95.5	94.1	92.8	90.6	88.6	86.8	85.2	83.8	82.6	81.4	80.4	79.4
15.75	100.3	100.0	99.2	98.1	96.8	95.4	94.0	92.7	91.5	88.7	86.9	85.3	83.9	82.6	81.5	80.4	79.4
16.00	100.1	99.8	99.0	97.9	95.6	95.3	93.9	92.6	91.4	88.8	87.0	85.4	84.0	82.7	81.5	80.5	79.5
16.25	99.9	99.6	98.8	97.8	95.5	95.2	93.8	92.6	91.4	88.9	87.0	85.4	84.0	82.7	81.6	80.5	79.5
16.50	99.6	99.4	98.7	97.6	95.4	95.1	93.8	92.5	91.3	89.0	87.1	85.5	84.1	82.8	81.6	80.6	79.6
16.75	99.4	99.2	98.5	97.4	95.2	95.0	93.7	92.4	91.2	89.1	87.2	85.6	84.1	82.8	81.7	80.6	79.6
17.00	99.2	99.0	98.3	97.3	95.1	94.8	93.6	92.3	91.2	89.1	87.3	85.6	84.2	82.9	81.7	80.7	79.7
17.25	99.0	98.8	98.1	97.1	95.0	94.7	93.5	92.3	91.1	89.1	87.4	85.7	84.2	82.9	81.8	80.7	79.7
17.50	98.8	98.5	97.9	97.0	95.8	94.6	93.4	92.2	91.0	89.9	87.5	85.8	84.3	83.0	81.8	80.7	79.7
17.75	98.6	98.3	97.7	96.8	95.7	94.5	93.3	92.1	91.0	89.9	87.5	85.8	84.3	83.0	81.9	80.8	79.8
18.00	98.4	98.2	97.5	96.6	95.6	94.4	93.2	92.0	90.9	89.8	87.6	85.9	84.4	83.1	81.9	80.9	79.9

APPROACH EPNL GRID VALUE SET 4

CURRENT FOUR ENGINE AIRCRAFT

Distance From Landing Threshold (Miles)	SIDELINE DISTANCE (MILES) 0	1/4	1/2	3/4	1	1 1/4	1 1/2	2 3/4	2	2 1/4	2 1/2	2 3/4	3	3 1/4	3 1/2	3 3/4	4
2.00	127.8	96.3	83.8	75.3	70.4	66.7	63.5	60.8	58.4	56.3	54.4	52.7	51.1	49.6	48.1	46.9	45.8
2.25	127.1	98.0	85.7	77.2	72.2	68.3	65.1	62.3	59.9	57.7	55.8	54.0	52.4	50.9	49.6	48.3	47.2
2.50	121.2	99.0	86.9	78.3	73.2	69.3	66.1	63.3	60.8	58.6	56.7	54.9	53.3	51.8	50.4	49.2	48.0
2.75	119.0	99.7	87.7	79.1	74.0	70.1	66.8	64.0	61.5	59.3	57.3	55.6	53.9	52.4	51.1	49.8	48.7
3.00	117.6	100.3	88.4	79.8	74.7	70.7	67.4	64.6	62.1	59.9	57.9	56.1	54.5	53.0	51.6	50.3	49.2
3.25	116.3	100.8	88.9	80.4	75.3	71.3	68.0	65.1	62.6	60.4	58.4	56.6	55.0	53.4	52.1	50.8	49.6
3.50	114.9	101.2	89.4	80.9	75.7	71.8	68.4	65.6	63.1	60.9	58.9	57.0	55.4	53.9	52.5	51.2	50.0
3.75	113.7	101.7	89.9	81.4	76.2	72.2	68.9	66.0	63.5	61.3	59.3	57.4	55.8	54.2	52.9	51.6	50.4
4.00	112.6	102.2	90.3	81.8	76.6	72.6	69.3	66.4	63.9	61.6	59.6	57.8	56.1	54.6	53.2	51.9	50.7
4.25	111.5	102.9	90.7	82.2	77.0	72.9	69.6	66.7	64.2	62.0	60.0	58.1	56.5	54.9	53.5	52.2	51.0
4.50	110.6	103.9	91.0	82.5	77.3	73.3	69.9	67.1	64.5	62.3	60.3	58.4	56.8	55.2	53.8	52.5	51.3
4.75	109.8	103.6	91.4	82.9	77.6	73.6	70.2	67.4	64.8	62.6	60.6	58.7	57.1	55.5	54.1	52.8	51.5
5.00	109.0	103.3	91.7	83.2	77.9	73.9	70.5	67.6	65.1	62.9	60.8	59.0	57.3	55.8	54.4	53.1	51.8
5.25	108.2	103.0	92.0	83.5	78.2	74.2	70.8	67.9	65.4	63.1	61.1	59.3	57.6	56.0	54.6	53.3	52.1
5.50	107.6	102.7	92.4	83.8	78.5	74.4	71.1	68.2	65.6	63.4	61.4	59.5	57.8	56.3	54.9	53.6	52.4
5.75	107.0	102.4	92.8	84.1	73.8	74.7	71.3	68.4	65.9	63.6	61.6	59.7	58.1	56.5	55.1	53.9	52.6
6.00	106.3	102.1	93.2	84.3	79.0	74.9	71.5	68.6	66.1	63.8	61.8	60.0	58.3	56.7	55.3	54.0	52.8
6.25	105.7	101.8	93.6	84.6	79.2	75.2	71.8	68.9	66.3	64.1	62.0	60.2	58.5	56.9	55.5	54.2	53.0
6.50	105.1	101.5	94.1	84.9	79.5	75.4	72.0	69.1	66.5	64.3	62.2	60.4	58.7	57.1	55.7	54.4	53.2
6.75	104.5	101.2	94.6	85.2	79.7	75.6	72.2	69.3	66.7	64.5	62.4	60.6	58.9	57.3	55.9	54.6	53.4
7.00	103.9	100.9	95.6	85.5	79.9	75.8	72.4	69.5	66.9	64.7	62.6	60.8	59.1	57.5	56.1	54.8	53.6
7.25	103.4	100.5	95.4	85.7	80.2	76.0	72.6	69.7	67.1	64.9	62.8	61.0	59.3	57.7	56.3	55.0	53.7
7.50	102.9	100.2	95.2	86.0	80.4	76.2	72.8	69.9	67.3	65.0	63.0	61.1	59.4	57.9	56.5	55.1	53.9
7.75	102.4	99.9	95.0	86.4	80.6	76.4	73.0	70.0	67.5	65.2	63.2	61.3	59.6	58.1	56.6	55.3	54.1
8.00	101.9	99.6	94.8	86.7	80.8	76.6	73.2	70.2	67.7	65.4	63.3	61.5	59.8	58.2	56.8	55.5	54.2
8.25	101.5	99.2	94.6	87.1	81.0	76.8	73.3	70.4	67.8	65.6	63.5	61.6	59.9	58.4	57.0	55.6	54.4
8.50	101.1	98.9	94.4	87.4	81.3	77.0	73.5	70.6	68.0	65.7	63.7	61.8	60.1	58.5	57.1	55.8	54.5
8.75	100.7	98.6	94.2	87.8	81.5	77.2	73.7	70.7	68.2	65.9	63.8	62.0	60.3	58.7	57.3	55.9	54.7
9.00	100.2	98.3	94.0	88.2	81.7	77.3	73.8	70.9	68.3	66.0	64.0	62.1	60.4	58.8	57.4	56.1	54.8
9.25	99.8	97.9	93.8	88.6	82.0	77.5	74.0	71.0	68.5	66.2	64.1	62.3	60.6	59.0	57.6	56.2	55.0
9.50	99.4	97.6	93.5	88.6	82.2	77.7	74.2	71.2	68.6	66.3	64.3	62.4	60.7	59.1	57.7	56.4	55.1
9.75	99.0	97.3	93.3	89.4	82.5	77.9	74.3	71.4	68.8	66.5	64.4	62.5	60.8	59.3	57.8	56.5	55.3
10.00	98.6	97.0	93.1	89.3	82.7	78.1	74.5	71.5	68.9	66.6	64.6	62.7	61.0	59.4	58.0	56.6	55.4
10.25	98.3	96.6	92.8	89.2	83.0	78.3	74.7	71.7	69.1	66.8	64.7	62.8	61.1	59.5	58.1	56.8	55.5
10.50	97.9	96.3	92.6	89.1	83.3	78.5	74.8	71.8	69.2	66.9	64.8	63.0	61.2	59.7	58.2	56.9	55.7
10.75	97.5	96.0	92.4	88.9	83.6	78.7	75.0	71.9	69.3	67.0	65.0	63.1	61.4	59.8	58.4	57.0	55.8
11.00	97.1	95.7	92.1	88.8	83.9	78.9	75.1	72.1	69.5	67.2	65.1	63.2	61.5	59.9	58.5	57.1	55.9
11.25	96.8	95.3	91.9	88.7	84.3	79.1	75.3	72.2	69.6	67.3	65.2	63.3	61.6	60.0	58.6	57.3	56.0
11.50	96.4	95.0	91.7	88.6	84.6	79.3	75.5	72.4	69.7	67.4	65.3	63.5	61.7	60.2	58.7	57.4	56.1
11.75	96.0	94.7	91.4	88.5	84.8	79.5	75.6	72.5	69.9	67.5	65.5	63.6	61.9	60.3	58.8	57.5	56.3
12.00	95.7	94.4	91.2	88.3	84.9	79.7	75.8	72.7	70.0	67.7	65.6	63.7	62.0	60.4	59.0	57.6	56.4
12.25	95.3	94.1	91.0	88.2	85.7	80.0	76.0	72.8	70.1	67.8	65.7	63.8	62.1	60.5	59.1	57.7	56.5
12.50	95.0	93.7	90.9	88.1	85.6	80.2	76.1	72.9	70.3	67.9	65.8	63.9	62.2	60.6	59.2	57.8	56.6
12.75	94.6	93.4	90.7	88.0	85.5	80.5	76.3	73.1	70.4	68.0	65.9	64.1	62.3	60.7	59.3	57.9	56.7
13.00	94.3	93.1	90.5	87.9	85.4	80.7	76.5	73.2	70.5	68.2	66.1	64.2	62.4	60.9	59.4	58.0	56.8
13.25	93.9	92.8	90.3	87.7	85.4	81.0	76.7	73.4	70.7	68.3	66.2	64.3	62.5	61.0	59.5	58.2	56.9
13.50	93.6	92.5	90.1	87.6	85.3	81.3	76.8	73.5	70.8	68.4	66.3	64.4	62.7	61.1	59.6	58.3	57.0
13.75	93.2	92.1	89.9	87.5	85.2	81.5	77.0	73.7	70.9	68.5	66.4	64.5	62.8	61.2	59.7	58.4	57.1
14.00	92.9	91.8	89.8	87.4	85.1	81.8	77.2	73.8	71.0	68.6	66.5	64.6	62.9	61.3	59.8	58.5	57.2
14.25	92.5	91.6	89.6	87.2	85.0	82.0	77.4	74.0	71.2	68.8	66.6	64.7	63.0	61.4	59.9	58.6	57.3
14.50	92.2	91.3	89.4	87.1	84.9	82.0	77.7	74.1	71.3	68.9	66.7	64.8	63.1	61.5	60.0	58.7	57.4
14.75	91.9	91.0	89.2	87.0	84.8	82.8	77.9	74.3	71.4	69.0	66.9	64.9	63.2	61.6	60.1	58.8	57.5
15.00	91.6	90.8	89.0	86.9	84.8	82.8	78.1	74.4	71.6	69.1	67.0	65.0	63.3	61.7	60.2	58.9	57.6
15.25	91.3	90.6	88.9	86.8	84.7	82.7	78.3	74.6	71.7	69.2	67.1	65.1	63.4	61.8	60.3	59.0	57.7
15.50	91.0	90.4	88.7	86.6	84.6	82.6	78.6	74.8	71.8	69.3	67.2	65.2	63.5	61.9	60.4	59.0	57.8
15.75	90.8	90.1	88.5	86.5	84.5	82.6	78.8	75.0	72.0	69.5	67.3	65.3	63.6	62.0	60.5	59.1	57.9
16.00	90.5	89.9	88.3	86.4	84.4	82.5	79.0	75.1	72.1	69.6	67.4	65.4	63.7	62.1	60.6	59.2	58.0
16.25	90.3	89.7	88.2	86.3	84.3	82.4	79.3	75.3	72.2	69.7	67.5	65.6	63.8	62.2	60.7	59.3	58.1
16.50	90.1	89.5	88.0	86.1	84.2	82.4	79.5	75.5	72.4	69.9	67.6	65.7	63.9	62.3	60.8	59.4	58.2
16.75	89.9	89.3	87.8	86.0	84.1	82.3	79.6	75.7	72.5	70.0	67.7	65.8	64.0	62.4	60.9	59.5	58.2
17.00	89.6	89.1	87.7	85.9	84.0	82.2	79.7	75.9	72.7	70.1	67.8	65.9	64.1	62.5	61.0	59.6	58.3
17.25	89.4	88.9	87.5	85.8	83.9	82.2	80.5	76.1	72.8	70.2	67.9	66.0	64.2	62.5	61.1	59.7	58.4
17.50	89.2	88.7	87.4	85.7	83.9	82.1	80.4	76.3	73.0	70.3	68.1	66.1	64.3	62.6	61.1	59.8	58.5
17.75	89.0	88.5	87.2	85.5	83.8	82.0	80.4	76.5	73.1	70.5	68.2	66.2	64.4	62.7	61.2	59.9	58.6
18.00	88.8	88.3	87.1	85.4	83.7	81.9	80.3	76.7	73.3	70.6	68.3	66.3	64.5	62.8	61.3	59.9	58.7

APPENDIX E

SELECTION OF APPROPRIATE TAKEOFF NOISE CONTOURS

ON THE BASIS OF RANGE

This Appendix provides an alternate method by which appropriate EPNL contours can be selected on the basis of a forecast of operating ranges of an aircraft rather than gross takeoff weights. If a forecast of gross takeoff weight information is available, the procedure given in Appendix C is preferable.

All range information in this Appendix is given in terms of equivalent still air distances. The presence of headwinds or tailwinds between any two city pairs must be considered. Additionally, aircraft do not always refuel at every stop on any particular route. In such cases, it would be more accurate to consider the range to the next fuel stop rather than the range to the next stop. A distance of 100 miles should be added for each intermediate stop to account for the additional fuel requirements associated with the takeoff and landing operation at the intermediate stops.

While there are many combinations of engines and payload capabilities within the category of four engine commercial jet transports, the perceived noise levels for any given range fall rather neatly into two classes. The first class includes all those aircraft powered by turbojet engines and all those which are designed primarily for domestic operations. The second class includes the intercontinental turbofan-powered aircraft.

Figure 1E shows EPNL relative to the level occurring during takeoff at maximum gross weight and at a distance of 20,000 feet from brake release as a function of range for the various four engine jets. These curves of relative EPNL are based on the data in Appendices B and C. With the exception of the aircraft powered by the RCo 12 engine and by the JT3D-3B engine with long fan discharge ducts, all aircraft fall into one of the two classes with very little scatter. It is not anticipated that either of these aircraft will account for a sufficient amount of traffic to merit special evaluations.

The curves in Figure 1E are based on a full complement of passengers and their baggage, fuel for long range cruise operations and normal fuel reserves. There will be variations from these curves for different aircraft operators as a result of differing interior configurations, fuel reserves and operating policies. These factors will not have a major influence on noise levels.

There are two factors which should be considered in this part of the analysis. These are the addition of cargo on passenger airplanes and all cargo operations. In the case of passenger aircraft, if it is anticipated that both a full passenger load and maximum cargo capacity is utilized, a correction factor is required. This correction factor may be conveniently included by adding up to 500 miles to the flight range, depending on the degree of loading. Because there is generally a difference of no more than 2 EPNdB units with a 500 mile range increase, this correction technique should not introduce any appreciable loss in accuracy.

In the case of all cargo operations, payload accounts for a much higher percentage of gross takeoff weight and the selection of an appropriate noise contour set by range becomes more difficult. A current four engine jet transport in an all-cargo operation will reach maximum gross takeoff weight at a range of only 2,000 to 3,000 miles with a capacity load. If gross weight data are not available, an appropriate correction for an all-cargo operation can be estimated by increasing the actual range by 1,000 miles and using Figure 1E.

Figure 2E combines the data from Figure 1E into two classes of aircraft and adds a step function indicating the noise contours to be used for a given range. The contour designations refer to those noise contours given in Appendix D for four engine jet transports. Table 1E tabulates the information from Figure 2E and can be used to select the appropriate noise contour for any operation.

In the case of aircraft powered by the JT3C-7 engine, noise as a function of range can be approximated by using contour set C4 for ranges up to 500 miles, contour set D4 for ranges from 500 to 1,000 miles and contour set E4 for ranges above 1,000 miles.

Information similar to that for four engine jet aircraft has been developed for two and three engine jet aircraft. Figure 3E shows the relative EPNL's at a distance of 20,000 feet from brake release as a function of range for two and for three engine jet transports. These data are also for a 100 percent passenger loading with baggage. The primary reason for the spread within each category is the difference in weight between standard and extended fuselage lengths. This effect was included in the four engine data but was overshadowed by the differences in engines. Because the differences are not large a mean line has been drawn for each category to represent the aircraft in that category. This mean line was used to develop the noise contour set selection data in Table 2E. The noise contour sets listed in Table 2E refer to the appropriate contours of Appendix D for two and three engine jet aircraft.

Two engine jet passenger aircraft carrying extra cargo may be accounted for by adding 300 miles to the range. For all-cargo operations maximum range should be used. In the case of three engine jet aircraft these corrections would be about 400 miles for passenger aircraft and maximum range for all-cargo aircraft.

CURRENT FOUR ENGINE JET TRANSPORT AIRCRAFT

RELATIVE EFFECTIVE PERCEIVED NOISE LEVEL 20,000 FEET FROM

BRAKE RELEASE VERSUS RANGE

100% PASSENGERS AND BAGGAGE LOADING

LONG RANGE CRUISE

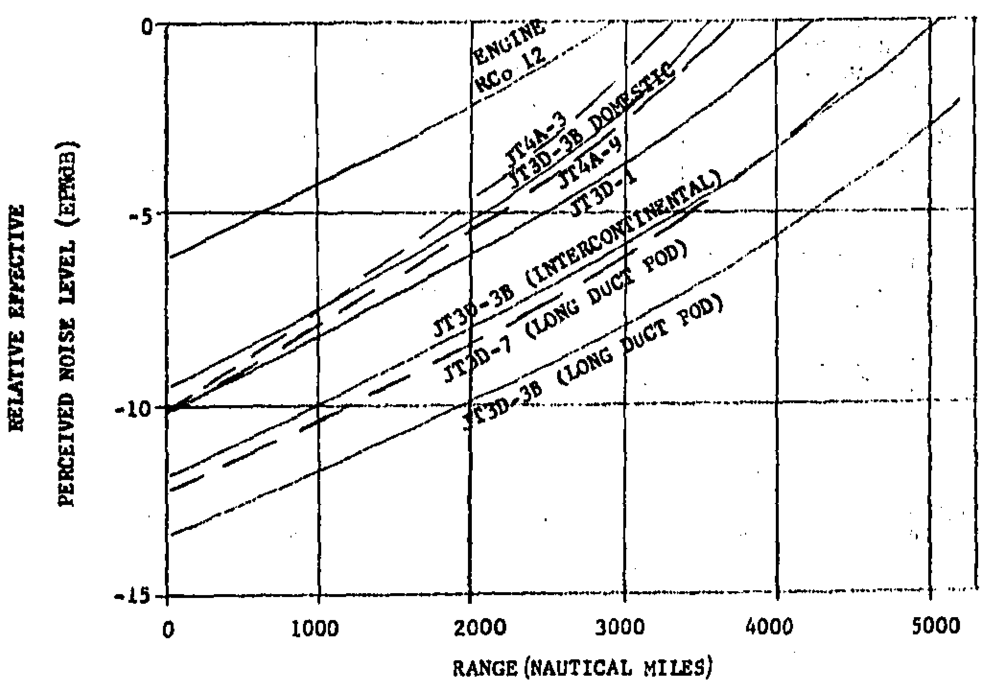


FIGURE 1E

CURRENT FOUR ENGINE JET TRANSPORT AIRCRAFT

APPROPRIATE NOISE LEVEL CONTOUR SET AS A

FUNCTION OF RANGE

100% PASSENGERS AND BAGGAGE LOADING

LONG RANGE CRUISE

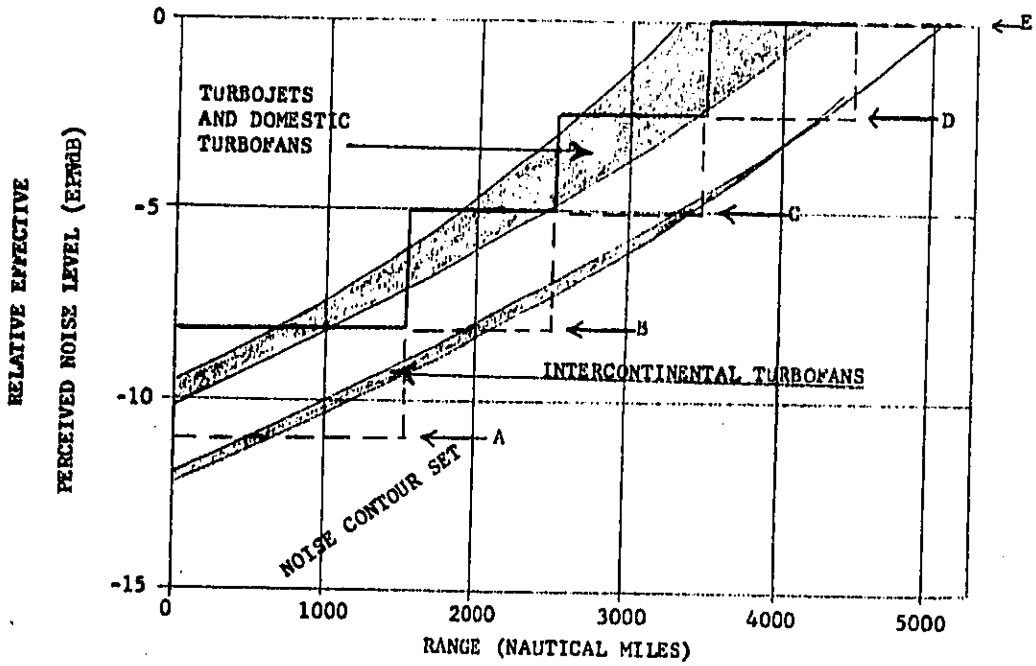


FIGURE 2E

CURRENT TWO AND THREE ENGINE JET TRANSPORT AIRCRAFT

RELATIVE EFFECTIVE PERCEIVED NOISE LEVEL 20,000 FEET FROM

BRAKE RELEASE VERSUS RANGE

100% PASSENGERS AND BAGGAGE LOADING

LONG RANGE CRUISE

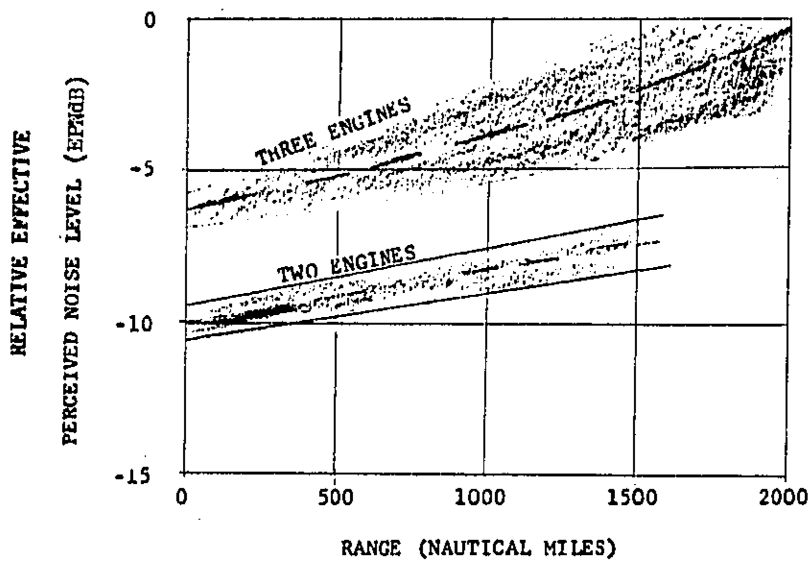


FIGURE 3E

TABLE 1E

CURRENT FOUR ENGINE JET TRANSPORT AIRCRAFT

APPROPRIATE NOISE CONTOUR SET AS A FUNCTION OF RANGE

STILL AIR RANGE (NAUTICAL MILES)	0-1500	1500-2500	2500-3500	3500-4500	ABOVE 4500
TYPE I AIRCRAFT ALL TURBOJETS AND DOMESTIC TURBOFANS	B	C	D	E	E
TYPE II AIRCRAFT ALL INTERCONTINENTAL TURBOFAN AIRCRAFT	A	B	C	D	E

NOTE: APPLICABLE TO PASSENGER AIRCRAFT OPERATIONS ONLY – TO ACCOUNT FOR ADDITIONAL CARGO LOADING ON PASSENGER AIRCRAFT ADD UP TO 500 MILES TO RANGE

TABLE 2E

CURRENT TWO AND THREE ENGINE JET TRANSPORT AIRCRAFT

APPROPRIATE NOISE CONTOUR SET AS A FUNCTION OF RANGE

STILL AIR RANGE (NAUTICAL MILES)	0-350	350-1350	ABOVE 1350
TWO ENGINE	A	B	B
THREE ENGINE	B	C	D

NOTE: APPLICABLE TO PASSENGER AIRCRAFT OPERATIONS ONLY – TO ACCOUNT FOR ADDITIONAL CARGO LOADING ON PASSENGER AIRCRAFT ADD UP TO 300 MILES OF RANGE

APPENDIX F

COMPUTER PROGRAM

The method outlined for calculating NEF's does not require the use of a computer. EPNL grids are included for each aircraft type and profile to facilitate hand computations. Also profile contours are plotted for "quick look" considerations.

For large airports and complete computations of small airports the computer program described in this section should be used because of the large amount of computations involved.

The input sheet (Figure 1F) and flow diagram (Figure 2F) are sufficient to allow use of the program for complete NEF computations about any airport. The discussion which follows develops the problem and describes the computer solution in a manner required by an analyst to update, change, or utilize parts of the program in a different way.

The problem can best be assimilated by thoughtful contemplation of Figure 3F. Here the analyst can imagine being a resident at a point on a "giant grid" within 8 miles of the center of the airport.

The annoyance from noise that the resident is subjected to depends on questions such as: how far is the resident from the runways?; how busy are the runways?; what is the flight profile?; what is the engine configuration?, etc. Answers to these questions form the input to the computer program.

However annoyed the resident is, one can imagine another point on the grid that is just as bad. In fact one could reside at an infinite number of such points all around the airport. This continuous series of points defines a contour of constant annoyance. Coordinates of three such annoyance contours form the answer to the problem and are the output from the computer program.

To further assimilate the problem imagine that a constant annoyance contour of "15 NEF" were required. Where does this curve lie? In fact what reference line do we have from which to describe this contour? If the community noise were caused by flights along a single flight path the contour could be described as a constant distance from the flight path. Any observer at that distance from the path would be annoyed "15 NEF". The distance would be a function of the plane type. But what if there were several different types? Although the "15

NEF" contour would still be at a constant distance from the flight path and form an ellipse on the ground below the flight path, the required distance from the path (a combination of two or more noise characteristics) would be complicated to obtain.

The method of combining noise from two or more different airplane types is defined in terms of a single observer, not in terms of the effect on a constant annoyance contour. Even for a single flight path, then, if more than one aircraft type is present the procedure must be to find the annoyance at a finite number of points on the ground and interpolate for constant annoyance contours. The program finds the total annoyance at each 1/4 mile grid point, considering all paths, and interpolates at 0, 15 and 25 NEF to find coordinates of constant NEF.

The discussion and pictures have been aimed at leading the analyst through the first thoughts of contour prediction. The direct approach from contour required, to contour coordinated was bypassed in this program for the better defined approach which gets there by way of noise computations at grid points.

The program finds the annoyance at a grid point by finding the noise for a single flight path, adding the energy from another path, and so on until all paths about the airport have been considered. To find the noise from a single path the program finds the distance to the path and uses the appropriate noise versus distance curve. It adds energy from all planes of this type on the path. It uses another noise curve for another plane type on the path, etc.

The question to be answered is: what is the "distance" to the path. See Figure 3F.

The answer is that the distance to a path from an observer is the minimum distance to the path. If the distances from the observer to points on the path have two minimums then assume the plane has passed by the observer twice and use noise contributions from both minimums.

With the above discussion, the flow diagram, input forms and the source program comments, an analyst can adapt the program to his needs. If further information is required the original programmer can be reached through SAE Headquarters by reference to this report.

The program was compiled and run on a Univac 1108. A single airport of the size and flight complexity of Kennedy International takes approximately 1-1/2 minutes per path on an Univac 1108.*

The program outputs coordinates without sequence on punch cards. These coordinates are normalized to plot on a Benson-Lehrner Electro-Plotter mod II. Since there is only one plot per airport the plotting can be done by hand without great loss of efficiency. The fact that the coordinates are not sequenced makes connecting the plotted coordinates impractical with a machine. The connection is done by hand with the aid of a second display of grid noise characteristics.

A magnetic tape of the EPNL levels is written for each path in order to facilitate the changing of inputs for indivudual paths if desired.

---

*For future requirements the program is being re-evaluated to determine reduction in running time possibilities.

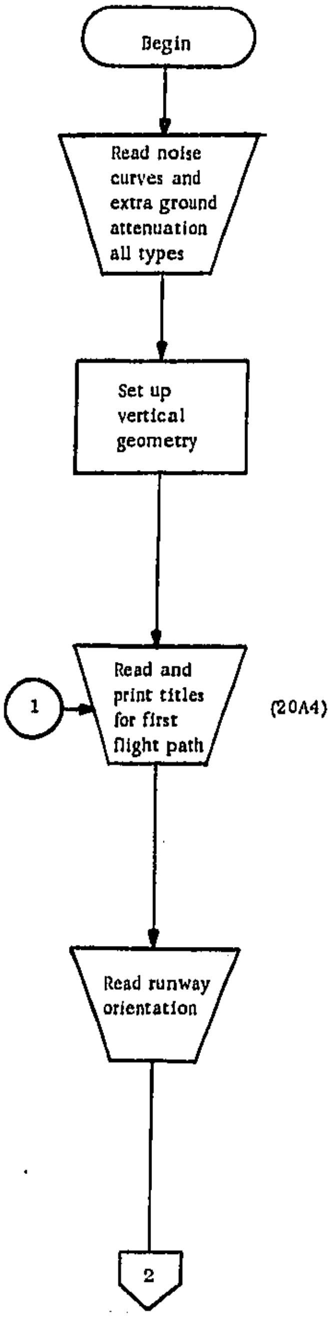
COMMUNITY NEF PREDICTION

1 8	9 16	17 24	25 32	33 40	41 48	49 56	57 64	65 72	73 80
Card #	Airport	Runway T.O.	Runway Approach	Dispersion Number	Prediction Period	Date of Run			
1.									
	Runway Length	Runway Azimuth	North Coord.	East Coord.	Number of Segments	Last Case =1.	Last Airport =1.		
2.									
	Straight Length	Curve Radius	Curve Angle	Straight Length	Curve Radius	Curve Angle	Straight Length	Curve Radius	Curve Angle
3.									
	Profile	4 Engine No. of Day Flights	4 Engine No. of Night Flights	3 Engine No. of Day Flights	3 Engine No. of Night Flights	2 Engine No. of Day Flights	2 Engine No. of Night Flights		
4.	A								
5.	B								
6.	C								
7.	D								
8.	E								
9.	L								

Ground profile geometry for both takeoff and approach are referenced to the start of takeoff roll. (i.e. think of an approach as a reverse takeoff in supplying flight path data). Number of flights may contain a fractional part of a flight since it represents an average. All numbers must have decimal points.

FIGURE 1F

COMMUNITY NEF PROGRAM



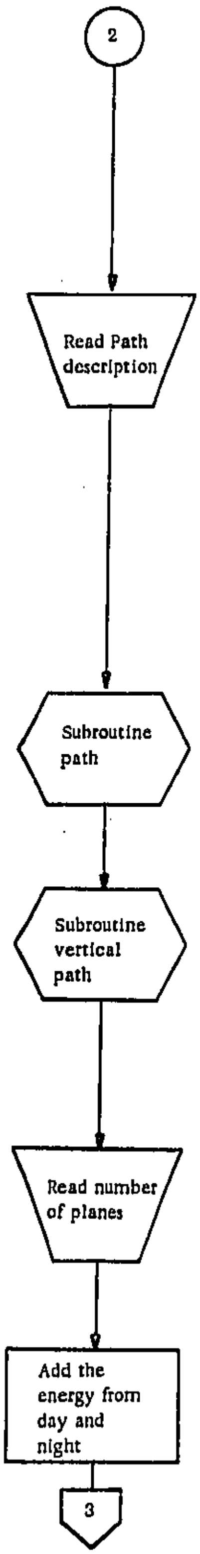
The noise curves for 3 airplane types are read in as data. These data are supplied to the user with the program. The routine to evaluate points in this curve is explained near routine "unbar".

The vertical geometry (DSTOR vs. altitude profile) is required for a standard 5 profile take-off and a single approach. This geometry is not read in but is set by the program.

This title defines the runway, prediction period, etc. For dispersions about a runway use a numbering system within each runway title -- i.e. 14L-1, 14L-2 etc.

Read runway orientation. Runway length is used to compute touchdown point relative to the start of takeoff roll. Each flight path is oriented in this way, making an approach path a "reverse takeoff". All paths begin at zero altitude including approach paths.

FIGURE 2F



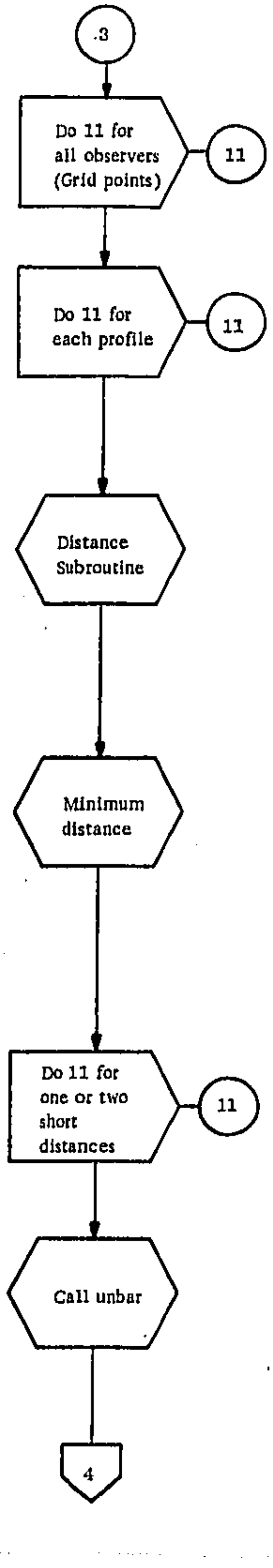
The paths are made up of alternating straight and circular segments. Give the length of the straight segments, the radius and angle of turns. The last segment is added by the program as a straight portion from the end of the users last segment to 30 miles. The path is used only 20 miles, however, so describing an accurate path to 20 miles will suffice from the users standpoint.

This routine computes the x, y coordinates along the flight at 1/4 mile points along the path.

Computes the altitude of the plane at each 1/4 mile point along the path. This is done for 6 takeoff profiles and one approach.

This is the number of planes using each profile, day and night, 4, 3 and 2 engine planes.

FIGURE 2F



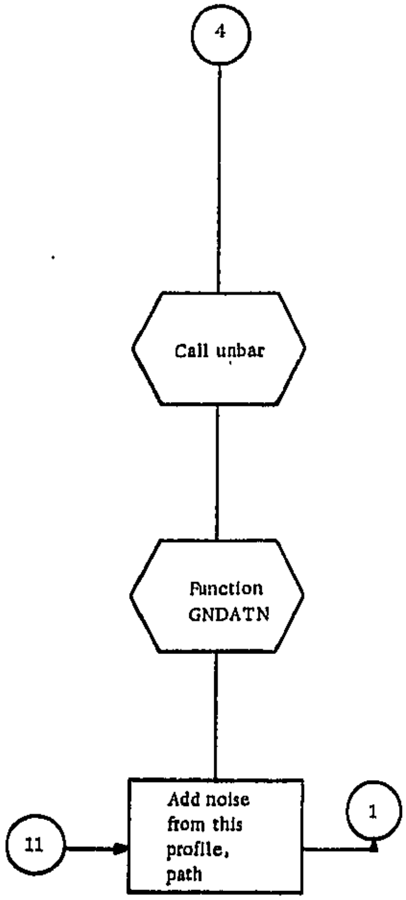
The distance subroutine evaluates, from a single observer, distances to 80 equally spaced points on the path.

This routine is used to find the one or two distances to the path that are shortest. These distances will usually be perpendicular to the path, but may be otherwise in turn or for specific observers behind the path.

Two short distances indicate that the path passes by the observer twice. Energy from both passes must be combined.

This routine evaluates the noise level curves at the given shortest distance. The routine is a quadratic

FIGURE 2F



fit using 3 points near the shortest distance. Unbar stands for univariate, bivariate.

This time for extra ground attenuation at zero degrees angle from observer. The x value is given the shortest distance.

This function computes total ground attenuation at the actual angle from observer. The function uses data from the previous step.

This is a logarithmic addition to update the grid for this path and the total grid for all paths.

When all grid points have been updated for this path print out a display of the area affected by this path, and return to read another path description.

When all paths have been read print the display of the total community, the coordinates of equal NEF and the plot cards for machine plot.

FIGURE 2F

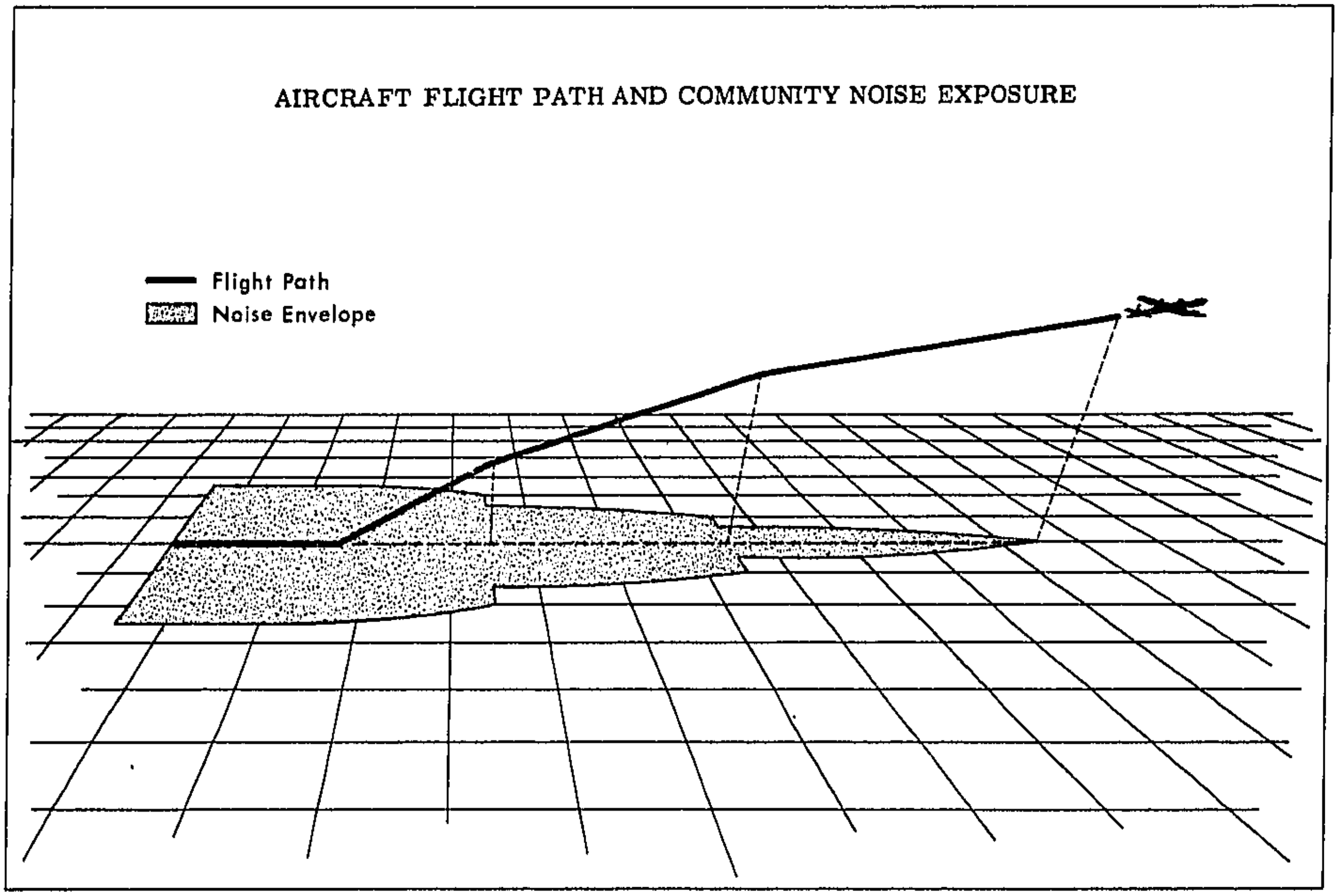

AIRCRAFT FLIGHT PATH AND COMMUNITY NOISE EXPOSURE
Flight Path
Noise Envelope

FIGURE 3F

APPENDIX G

EXAMPLE OF PROCEDURE FOR CALCULATION OF NOISE EXPOSURE FORECASTS

NEF values for current jet transports for any airport can be calculated either manually or through the use of a computer. An example of a manual calculation is described below. The computer program described in Appendix F represents the same procedure.

As an example, a relatively small airport was considered (see Table 1G) with a total daily movement of 320 aircraft consisting of two and three engine jet aircraft. The omission of larger four engine jet aircraft in this example does not affect the basic procedure but simplifies the calculations. The number of daytime takeoff flights categorized under contour sets A, B, C, D and Approach were tabulated in column (3) of Table 1G, and similarly, the number of nighttime flights in column (4). Both for aircraft type and contour set, the correction for the number of daytime flights for each category was found by taking 10 log M where M is the appropriate number found in column (3) and tabulated in column (5). In similar manner, the correction for the number of nighttime flights was found by calculating 10 log M (where M is the appropriate number found in column (4) and adding 10 dB arithmetically to this, making the total nighttime correction 10 + 10 log M. This result is tabulated in column (6). To arrive at the total correction for a given aircraft type and contour set, the appropriate daytime and nighttime correction factors logarithmically were summed. In this case, the appropriate numbers from columns (5) and (6) are summed and tabulated in column (7).

With the total correction factors tabulated above, it is now possible to apply these to the reference EPNL grid values found in Appendix D.

For the example only a limited number of grid points was chosen since NEF values at other grid locations are calculated in a similar manner. As shown in Tables 2G, 3G and 4G, values of EPNL for two and three engine jet aircraft were tabulated from the reference EPNL grid values from Appendix D for the various contour sets at sideline distances ± 3/4, ± 1/4 and 0 miles, and at distances from start of takeoff roll of 3, 4, and 5 miles. From Table 1G, the total corrections found in column (7) were added arithmetically, in Tables 2G, 3G and 4G, to the corresponding EPNL values for a given aircraft type and contour set.

The next step in the procedure is to add, logarithmically, all the corrected EPNL values for a given grid point for all aircraft types and for all contour sets. For example, to find the total EPNL at a distance from start of takeoff roll of 3 miles and a sideline distance of 3/4 miles, the corrected EPNL values at these coordinates for two engine jet aircraft contour sets A, B, C and Approach and the corrected values at the same coordinates for three engine jet aircraft contour sets A, B, C and Approach were added logarithmically to obtain 127.8. To obtain the NEF grid values for the example airport, the arbitrary value of 113 EPNdB* is algebraically subtracted from the cumulative EPNL value at each location on the grid. In the specific case calculated above the factor 113 is subtracted from 127.8 giving an NEF value of 14.8. When the factor 113 is subtracted from the value at each grid location, the difference then becomes an NEF value. Similarly, NEF values at other grid locations were calculated and are contained in Table 5G. Contours of equal NEF values can be plotted by interpolating between NEF grid values where necessary.

*(See Section 4.1)

TABLE 1G Tabulation of Aircraft Movements at Example Airport

AIRPORT____________________

RUNWAY END: TAKEOFF ____________

APPROACH ____________

(1) Reference Contour	(2)	(3) Number of Flights (M)	(4)	(5) Correction Factor (dB)	(6)	(7)
Aircraft Type	Flight Profile	Daytime 0700-2200	Nighttime 2200-0700	Daytime 10 log M	Nighttime 10 + 10 log M	Total Correction-Logarithmic Sum of Columns (5) and (6)
4 Engine	A					
	B					
	C					
	D					
	E					
	Approach					
3 Engine	A	24	8	13.8	19.0	20.2
	B	16	4	12.0	16.0	17.5
	C	8	--	9.0	----	9.0
	D	--	--	----	----	----
	Approach	48	12	16.8	20.8	22.3
2 Engine	A	24	8	13.8	19.0	20.1
	B	40	8	16.0	19.0	20.8
	C	16	4	12.0	16.0	17.5
	Approach	80	20	19.0	23.0	24.5

TABLE 2G - SAMPLE NEF CALCULATION SHEET - 3 MILES

Distance from Start of Takeoff Roll (Miles)	Side Distance (Miles)	Number of Engines	Profile	EPNL	Total Correction	Corrected EPNL	Profile EPNL Sum	Total Sum EPNL Values for Airport	NEF
3.00	3/4	2	A	100.4	20.1	120.5			
			B	97.9	20.8	118.7	123.2		
			C	96.2	17.5	113.7			
			Approach	75.5	24.5	100.0			
								126.5	13.5
		3	A	102.2	20.2	122.4			
			B	99.7	17.5	117.2			
			C	98.0	9.0	107.0	123.7		
			D	96.8	--	96.8			
			Approach	77.3	22.3	99.6			
	1/4	2	A	103.8	20.1	123.9			
			B	105.6	20.8	126.4	130.2		
			C	107.2	17.5	124.7			
			Approach	92.4	24.5	116.9			
								132.7	19.7
		3	A	105.6	20.2	125.8			
			B	107.4	17.5	124.9			
			C	109.0	9.0	118.0	129.1		
			D	108.6	--	108.6			
			Approach	94.2	22.3	116.5			
	0	2	A	104.6	20.1	124.7			
			B	107.2	20.8	128.0	135.5		
			C	110.6	17.5	128.1			
			Approach	108.5	24.5	133.0			
								138.2	25.2
		3	A	106.4	20.2	126.6			
			B	109.0	17.5	126.5	134.6		
			C	112.4	9.0	121.4			
			D	115.4	--	115.4			
			Approach	110.3	22.3	132.6			

TABLE 3G - SAMPLE NEF CALCULATION SHEET - 4 MILES

Distance from Start of Takeoff Roll (Miles)	Side Distance (Miles)	Number of Engines	Profile	EPNL	Total Correction	Corrected EPNL	Profile EPNL Sum	Total Sum EPNL Values for Airport	NEF
4.00	3/4	2	A	99.0	20.1	119.1			
			B	100.4	20.8	121.2	123.9		
			C	98.0	17.5	115.5			
			Approach	77.4	24.5	101.9			
								126.8	13.8
		3	A	100.8	20.2	121.0			
			B	102.2	17.5	119.7			
			C	99.8	9.0	108.8	123.6		
			D	98.5	--	98.5			
			Approach	79.2	22.3	101.5			
	1/4	2	A	101.6	20.1	121.7			
			B	103.8	20.8	124.6	128.5		
			C	105.5	17.5	123.0			
			Approach	94.2	24.5	118.7			
								131.0	18.0
		3	A	103.4	20.2	123.6			
			B	105.6	17.5	123.1			
			C	107.3	9.0	116.3	127.4		
			D	108.4	--	108.4			
			Approach	96.0	22.3	118.3			
	0	2	A	102.1	20.1	122.2			
			B	104.6	20.8	125.4	131.5		
			C	107.0	17.5	124.5			
			Approach	103.4	24.5	127.9			
								134.1	21.1
		3	A	103.9	20.2	124.1			
			B	106.4	17.5	123.9			
			C	108.8	9.0	117.8	130.6		
			D	111.8	--	111.8			
			Approach	105.2	22.3	127.5			

TABLE 4G - SAMPLE NEF CALCULATION SHEET - 5 MILES

Distance from Start of Takeoff Roll (Miles)	Side Distance (Miles)	Number of Engines	Profile	EPNL	Total Correction	Corrected EPNL	Profile EPNL Sum	Total Sum EPNL Values for Airport	NEF
5.00	3/4	2	A	97.1	20.1	117.2			
			B	99.4	20.8	120.2	123.4		
			C	100.5	17.5	118.0			
			Approach	78.7	24.5	103.2			
								126.0	13.0
		3	A	98.9	20.2	119.1			
			B	101.2	17.5	118.7			
			C	102.3	9.0	111.3	122.4		
			D	99.9	--	99.9			
			Approach	80.5	22.3	102.8			
	1/4	2	A	100.0	20.1	120.1			
			B	102.1	20.8	122.9			
			C	104.2	17.5	121.7	127.3		
			Approach	95.1	24.5	119.6			
								129.8	16.8
		3	A	101.8	20.2	122.0			
			B	103.9	17.5	121.2			
			C	106.0	9.0	115.0	126.2		
			D	107.3	--	107.3			
			Approach	96.9	22.3	119.2			
	0	2	A	100.2	20.1	120.3			
			B	102.6	20.8	123.4			
			C	105.1	17.5	122.6	129.0		
			Approach	100.0	24.5	124.5			
								131.5	18.5
		3	A	102.0	20.2	122.2			
			B	104.4	17.5	121.9			
			C	106.9	9.0	115.9	128.0		
			D	108.6	--	108.6			
			Approach	101.8	22.3	124.1			

TABLE 5 G
NEF GRID VALUES FOR MASTER GRID OF EXAMPLE AIRPORT

Dist. From Start of T/O Roll (Miles)	SIDELINE DISTANCE (MILES)									
	0	1/4	1/2	3/4	1	1-1/4	1-1/2	1-3/4	2	2-1/4
2.00	33.7	21.2	15.2	10.6	7.3	3.9	1.2			
2.25	32.9	20.7	16.2	11.3	7.9	4.4	1.7			
2.50	29.2	20.4	16.3	12.1	8.3	4.9	2.1			
2.75	26.8	20.1	16.5	12.8	8.8	5.2	2.4	.1		
3.00	25.1	19.6	16.7	13.5	9.2	5.6	2.7	.4		
3.25	23.7	19.2	16.5	13.6	9.8	5.9	3.0	.7		
3.50	22.7	18.7	16.3	13.7	10.5	6.3	3.3	.9		
3.75	21.9	18.3	16.3	14.0	10.4	6.7	3.6	1.2		
4.00	21.0	18.0	16.0	13.8	10.4	7.1	3.9	1.4		
4.25	20.2	17.7	15.7	13.5	10.4	7.6	4.3	1.7		
4.50	19.6	17.5	15.4	13.4	10.4	7.6	4.6	1.9		
4.75	19.0	17.1	15.0	13.1	10.6	7.6	4.8	2.2		
5.00	18.5	16.8	14.7	12.9	10.4	7.6	5.3	2.5	.2	
5.25	18.0	16.3	14.3	12.6	10.2	7.6	5.3	2.8	.4	
5.50	17.6	15.9	14.0	12.3	10.0	7.9	5.3	2.4	.7	
5.75	17.2	15.5	13.7	12.0	9.8	7.7	5.3	2.3	.9	
6.00	16.7	15.1	13.4	11.6	9.7	7.5	5.3	3.3	1.1	
6.25	16.2	14.7	13.0	11.3	9.4	7.4	5.3	3.3	1.6	
6.50	15.7	14.3	12.7	11.0	9.2	7.2	5.5	3.3	1.6	
6.75	15.2	13.9	12.3	10.6	8.9	7.0	5.4	3.3	1.6	
7.00	14.7	13.5	12.1	10.3	8.6	6.9	5.2	3.3	1.6	.1
7.25	14.2	13.1	11.8	10.0	8.4	6.8	5.1	3.6	1.6	.1
7.50	13.7	12.7	11.4	9.7	8.1	6.6	4.9	3.5	1.6	.1
7.75	13.2	12.4	11.1	9.4	7.9	6.4	4.8	3.4	1.6	.1
8.00	12.8	12.0	10.8	9.1	7.6	6.2	4.7	3.2	1.6	.1
8.25	12.4	11.7	10.5	8.8	7.3	6.0	4.5	3.1	1.9	.1
8.50	12.0	11.4	10.1	8.6	7.1	5.8	4.5	3.0	1.8	.1
8.75	11.6	11.0	9.8	8.3	6.8	5.5	4.3	2.9	1.6	.1
9.00	11.3	10.7	9.5	8.1	6.6	5.3	4.1	2.8	1.5	.4
9.25	10.9	10.3	9.2	7.8	6.4	5.1	3.9	2.6	1.4	.3
9.50	10.5	10.9	8.9	7.6	6.1	4.9	3.8	2.6	1.3	.2
9.75	10.2	9.6	8.6	7.4	5.9	4.7	3.6	2.5	1.2	.1
10.00	9.8	9.3	8.3	7.2	5.7	4.5	3.4	2.3	1.1	
10.25	9.5	9.0	8.0	6.9	5.5	4.3	3.2	2.2	1.0	
10.50	9.2	8.7	7.7	6.7	5.3	4.1	3.0	2.0	.9	
10.75	8.9	8.4	7.5	6.5	5.1	3.9	2.9	1.9	.9	
11.00	8.6	8.1	7.2	6.2	4.9	3.7	2.7	1.7	.8	
11.25	8.3	7.9	7.0	6.0	4.7	3.5	2.5	1.6	.6	
11.50	8.0	7.6	6.7	5.8	4.5	3.3	2.3	1.4	.5	
11.75	7.7	7.3	6.5	5.5	4.3	3.2	2.2	1.3	.4	
12.00	7.4	7.1	6.2	5.3	4.2	3.0	2.0	1.1	.2	
12.25	7.1	6.8	6.0	5.1	4.1	2.8	1.8	.9	.1	
12.50	6.9	6.5	5.8	4.9	3.9	2.6	1.7	.8		
12.75	6.6	6.3	5.6	4.7	3.7	2.5	1.5	.6		
13.00	6.4	6.1	5.3	4.5	3.5	2.3	1.4	.5		
13.25	6.1	5.8	5.1	4.3	3.3	2.1	1.2	.4		
13.50	5.9	5.6	4.9	4.1	3.1	2.0	1.0	.2		
13.75	5.7	5.4	4.7	3.9	2.9	1.9	.9	.1		
14.00	5.4	5.2	4.5	3.7	2.7	1.7	.7			
14.25	5.2	5.0	4.3	3.5	2.6	1.6	.6			
14.50	5.2	4.7	4.1	3.3	2.4	1.4	.4			
14.75	4.8	4.5	3.9	3.1	2.2	1.4	.3			
15.00	4.6	4.3	3.7	2.9	2.0	1.2	.2			
15.25	4.4	4.1	3.6	2.7	1.9	1.1				
15.50	4.2	3.9	3.4	2.5	1.7	.9				
15.75	4.0	3.7	3.2	2.4	1.5	.7				
16.00	3.8	3.6	3.0	2.2	1.4	.6				
16.25	3.6	3.4	2.8	2.0	1.2	.4				
16.50	3.4	3.2	2.7	1.8	1.0	.3				
16.75	3.2	3.0	2.5	1.7	.9	.1				
17.00	3.0	2.8	2.3	1.5	.7					
17.25	2.8	2.7	2.1	1.3	.6					
17.50	2.7	2.5	1.9	1.2	.4					
17.75	2.5	2.3	1.7	1.0	.3					
18.00	2.3	2.2	1.6	.8	.1					

NEF CONTOURS FOR EXAMPLE AIRPORT RUNWAY END

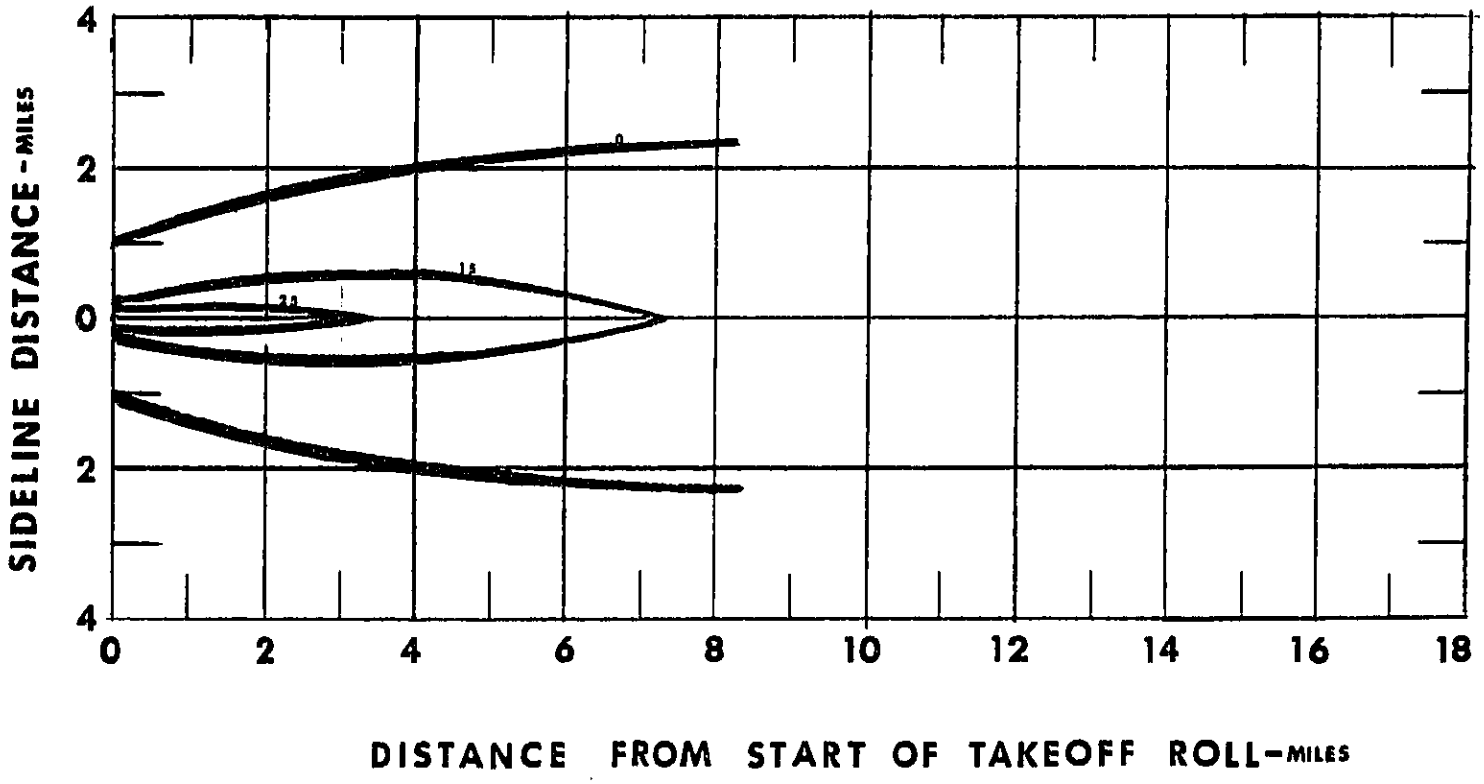


FIGURE 1G

APPENDIX H

EFFECT OF NUMBER OF FLIGHT OPERATIONS

Perhaps the best-known and most comprehensive social survey in the field of subjective reaction to aircraft noise was that conducted in England by A. C. McKennell for the Wilson Committee (Reference 2). Other studies of this nature have been undertaken by several European countries in cooperation with the Office of Economic Cooperation and Development (OECD), but definitive results have not been published. The best summary of activity in a number of countries is found in the German report "Fluglarm" (Reference 3) published in Goettingen in May 1965.

A review and evaluation of the results obtained from the social surveys and subjective tests cited above suggest that frequency of exposure to aircraft noise is related to the amount of annoyance expressed by listeners. Investigators in England and interpreters of the literature in Germany and the Netherlands have concluded that the correction for repeated flyovers lies somewhere between 12 log M and 16 log M. Despite these conclusions, a careful review of the literature reveals little substantial evidence to support a value within this range as being any more valid than that of 10 log M currently employed in Australia, France, and Sweden as well as the United States.

When we look at the raw data from which these values are derived, it is difficult to see how a specific value, whether it be 13.3 log M as used in Germany, or 15 log M as employed in the Netherlands and Britain, can be supported without additional evidence. The data reported in McKennell's 1963 Social Survey (the primary basis for these corrections) are far from conclusive in demonstrating a continuous relationship between number of exposures and annoyance. The realities of the operational situation prevented obtaining consistent or contiguous groupings of exposure frequencies to correlate with degree of annoyance and, as a result, the relationship derived is far from clear-cut. Should future study confirm the conclusions drawn from this investigation for other airports and other populations, then serious consideration should be given to modifying the correction to be used.

This discussion does not imply that 10 log M or any other correction procedure should be firmly established as the proper correction for repeated exposures at this time. Rather, it points out that there remains considerable uncertainty concerning the relationship between the amount of annoyance experienced and the number, or frequency, of exposures. Furthermore, it is a psychological truism that frequency (rate of exposures) and not number of exposures should be considered as the critical influence on the subjective response to noise. Despite the fact that number of exposures is normally related to a given period of time, either for 24 hours or for some portion of a day, the relative frequencies resulting from the calculations are not always clear. One hundred flights a day, for a 24-hour period, is obviously a different rate or frequency than 100 flights a day when referred to a day consisting of the period from 0700 to 2200. Furthermore, the distribution of frequency for relatively short time periods is not accommodated by such calculations. It is logical (again psychologically) that doubling 100 flights evenly distributed over a given extended time period, whether it be 15 or 24 hours, would not have the same impact on a listener as the same number concentrated heavily into one or more high traffic density periods during the same total time span. Yet the number, or even rate, of exposures for the extended time period might be reported as equal in describing these two situations.

Since the subjective response to repeated exposures is influenced by two oppositely acting auditory processes, sensitization and adaptation, the effects of exposure frequency are not simple to predict. For instance, we might anticipate that any apparently simple linear relationship between frequency and annoyance would change when exposure rate increased to the point where separation between exposure approaches the decay time of the auditory mechanism. Noise exposures would then be essentially continuous. Sensitization and fatigue might be expected to interact differently beyond this point, and the relationships pointed out by Kryter and Pearsons, 1963 (Reference 9), for duration effects (i.e., 4.5 dB per doubling) might be expected to apply.

Despite the excellent research that has been performed, the results are not sufficiently conclusive to establish any one noise exposure correction procedure clearly superior to any other over a wide range of numbers of flight operations. Therefore, this report has chosen the procedure currently used in the United States, Australia, France, and Sweden as being the simplest available and as accurate as any, namely, 10 log M.

APPENDIX I

EFFECT OF TIME OF DAY

The results of sociological surveys, and other studies, indicate that community tolerance for aircraft noise is lower at night than it is during the day. This is not surprising when we consider the differences in human activity and general ambient noise level associated with these periods. A major portion of the community is committed to some form of work to which their personal comfort has already been compromised during the daylight hours, and this we might expect them to have greater tolerance for an extraneous intrusion so long as it does not interfere with their accomplishments. Research has demonstrated that human performance suffers little from noise exposure, unless auditory communications are a significant component of the performance being measured.

In the evening hours, man turns to more sedentary activities, frequently designed for his entertainment and pleasure. Furthermore, these activities tend to have a high auditory content, e.g., listening to hi-fi or the radio, "watching" TV or a motion picture, playing cards, visiting, etc. Whatever the primary cause, his tolerance for noise "on his own time" seems to be less than for those periods when he is working.

Finally, during the late evening through the early morning hours, we might expect the threshold of annoyance to be lower because of the effects of noise on the community's sleep habits. It is difficult to assess whether man is annoyed more by an inability to get to sleep or by being awakened because of the noise environment, but it is clear that interference with sleep is a critical determinant of annoyance.

In addition to the direct influence of man's own activities on his apparent tolerance for noise, there is the effect of ambient noise level. This too tends to vary with the time of day. During daylight hours, most communities experience higher ambient noise levels associated with greater activity. At night things tend to "quiet down." As a result, less masking results from background noise, and any individual noise source stands out and becomes more offensive.

Selection of Time Periods - In order to establish realistic noise control criteria, researchers and administrators have attempted to select meaningful segments of the 24-hour day on which to standardize acceptable noise limitations. In the United States and Britain, the 24-hour period is broken into two segments, the periods 2200 to 0700, and 2300 to 0700 respectively being classed as night. In Sweden and Germany, three periods have been selected which are classified as day, evening, and night. Although the actual hours defining the periods differ, they represent comparable segments of the 24-hour period.

If we seriously consider the need for different noise level limits related to the time of day, it is reasonable to suggest that three rather than two periods more precisely define the different activity ambience conditions of concern. There are little data, either experimental or experiental, available on which to base differential criteria for three rather than two periods, despite the apparent desirability for selecting more than two. Therefore, this study uses two time periods with "night" conditions prevailing from 10 P.M. (2200) to 7 A.M. (0700).

Selection of Correction Factors - Although investigators generally conclude that community tolerance is probably lowest during the "evening" hours, as suggested above, the significance of these conclusions and the amount of threshold change has not been established. Since the primary determinants for the differences in response perceived between evening and night appear to be related in a complex manner to the activities in which the exposed community is engaged and the general ambient noise level, considerably more data are required before we can justify separate noise criteria for three periods of the day rather than two. Attempts have been made in some countries to apply weighting factors to various time periods. For instance, in Germany factors 1, 2, and 4 for day, evening, and night are used, while in Sweden factors 1, 3 and 10 are used. These efforts do not improve the situation, but rather tend to complicate it.

In response to the widely accepted belief supported by some social surveys that community tolerance for noise is generally lower at "night," we must resort to the best information we have available to establish a value (correction) for nighttime exposure levels. For this purpose, the demonstrated fact that ambient noise level in selected communities tends to be approximately 10 PNdB lower at night, suggests a reasonable and practical correction value to normal daytime tolerance levels.

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