Report 2747
Project 11150

EFFECTIVE PERCEIVED NOISE LEVEL VERSUS DISTANCE CURVES FOR CIVIL AIRCRAFT

Dwight E. Bishop
John F. Mills
Jane M. Beckmann

July 1974

Submitted to:
Mr. Damon Gray
Office of Noise Abatement
Environmental Protection Agency
Washington, D.C. 20460
Reference: EPA Contract 68-01-2265

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EFFECTIVE PERCEIVED NOISE LEVEL VERSUS DISTANCE CURVES FOR CIVIL AIRCRAFT

I. INTRODUCTION

This report provides effective perceived noise level (EPNL) data for civil aircraft in a form useful for noise exposure forecast (NEF) calculations. The EPNL noise data are presented in graphical and tabular form; the report also summarises the data sources and technical analyses used in developing the noise data. The noise data will also be furnished to the EPA as a punched card deck, directly suitable for use in the USAF/EPA/NEF computer program.[1,2]*

Noise data are included for all major current U.S. civil transport and business jet aircraft and for most general aviation aircraft. Data are also provided for possible retrofit of four-engine low bypass ratio (LBPR) turbofan aircraft, with acoustically lined nacelles.

The correlation of noise level data with aircraft operations (in terms of aircraft speed and engine operating parameters) varies in detail, from specific curves for different engine parameters and speeds for major civil transport aircraft to generalized noise curves for rather broad categories of propeller aircraft.

Section II presents the noise data. Section III describes the sources of noise data, describes analysis methods used to develop the curves and discusses some of the technical problems involved in developing the noise curves.

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*References are listed together at the end of the text.

II. NOISE DATA PRESENTATION

The noise exposure forecast (NEF) procedure for calculating the noise environment in the vicinity of the airport utilizes the effective perceived noise level as the basic noise event description for a moving aircraft. Since this noise information is needed at varying distances from the aircraft, the general input requirement is for a set of EPNL values tabulated at various distances (typically from 200 feet to 25,000 feet). The NEF aircraft model assumes that, for a given civil aircraft, an effective perceived noise level can be defined from the knowledge of the type of aircraft, basic engine operating parameters, air speed and atmospheric propagation conditions. Two sets of EPNL versus distance curves are used:

a. Air-to-ground propagation.

b. Ground-to-ground propagation.

In the program, algorithms are provided for the transition between air-to-ground and ground-to-ground curves.* The air-to-ground propagation curves assume atmospheric absorption in accordance with SAE ARP 866[3]. The ground-to-ground propagation curves assume similar atmospheric absorption plus excess ground attenuation[1].

The noise level versus distance curves given in this report are developed for standard day conditions (59°F and 70% relative humidity). Curves developed for these conditions generally provide rather conservative estimates of noise levels for the range

*Briefly, air-to-ground curves are used for elevation angles (at ground positions) of greater than approximately 7 degrees. Ground-to-ground curves are used for angles of less than approximately 4 degrees, with interpolation between curves for intermediate angles. No shielding adjustment of engine noise sources for multi-engine aircraft is provided in the current model.

of temperatures and humidity often encountered in civil airports in this country[1]. The basic NEF computer program does permit entry of separate noise level curves for special conditions, when deemed desirable.

The noise data are presented in graphical and tabular form in Appendix A. Table A-1 provides a guide to the selection of noise information for both general aircraft classifications and specific aircraft types. EPNL curves for air-to-ground propagation are shown in Figures A-1 through A-19. For many aircraft, the ground-to-ground curves are also shown in the graphs. Table A-2 includes tabulation of both air and ground propagation curves.

For the turbojet and turbofan aircraft, noise curves are referenced in terms of an engine operating parameter, typically net thrust.* The specific thrust values to use for a particular takeoff or landing profile, taking into account specific operating procedures, operating weights, airspeed, flap settings, etc., can be determined from the calculation procedure and aircraft data provided in Reference 4.

For most aircraft included in this report, noise data are tabulated for typical takeoff and approach thrust settings. However, for the two, three and four-engine low bypass ratio turbofan transport aircraft, a more complete set of curves is provided. For these aircraft, typical approach and takeoff curves are also indicated, to be used when more detailed information about specific engine operating parameters is not known.

In the current NEF computer programs, one additional correction is applied to the noise data. The EPNL values are adjusted for

*See Section III.C for further discussion.

aircraft altitude on the basis of an acoustic impedance correction, $\Delta_{\rho c}$:

$$\Delta_{\rho c} = 10 \log \frac{\rho c}{\rho_o c_o} = 10 \log \left(\frac{\rho}{\rho_o}\right) \sqrt{\frac{T}{T_o}}$$

where:

ρ = air density at aircraft altitude

c = speed of sound at aircraft altitude

T = absolute temperature at aircraft altitude

and subscript "o" refers to sea level standard day unless specially adjusted.

III. TECHNICAL BACKGROUND

A. General Approach

For NEF calculation, EPNL values as a function of distance are needed over a range of distances varying from the order of 200 feet to the order of 25,000 feet, as a general case. Field noise data for any particular aircraft and operating condition are typically available only at one, or at most, a few distances. Thus, to generate curves there is a need for both:

a. Accurate noise level measurements at one or more distances.

b. An analytic model for generating EPNL values as a function of distance.

Even for those few cases, from elaborate test programs, where EPNL values have been measured over a rather wide range of distances, a model for generating EPNL values as a function of distance is valuable.

Analytic models of varying complexity can be developed for predicting aircraft noise. The more complex models often require more complete noise information than is generally available from most reported field measurements. The basic approach for this study has been to utilize a relatively simple analytic model to generate sets of EPNL curves from selected sets of noise data. Where available, noise data from several different sources have been used, particularly in developing the noise curves for the major transport aircraft. The resulting noise versus distance curves have then been compared with noise curves from previous studies. As a general case, this procedure will disclose differences and inconsistencies among sets of noise curves. Engineering judgment has been made to select what is believed to be the most representative set of curves. Because the amount of noise data and the number of check points varies considerably with the type of aircraft, the degree of cross checking and comparison varies considerably among the different aircraft.

As will be shown later, the EPNL curves developed with the analytic models will often show minor "kinks" in curves or variations in slopes over small distance ranges that result from details of the particular noise spectra used. Sometimes such kinks result from the use of the current tone correction procedures used in calculating EPNL's.* A number of these "kinks" or irregularities in curves have been removed.

B. Analytical Noise Model

The model assumed for developing EPNL values at the different distances assumes that the EPNL at any distance is equal to the maximum tone-corrected perceived noise level, PNLTM, plus a "duration factor", D:

$$EPNL = PNLTM + D$$

If the quantities in the above equation are known at one distance, x_o, and the PNLTM can be estimated for another distance, x, the duration adjustment, ΔD, is assumed to be simply 10 times the logarithm of the ratio of the two distances:

$$\Delta D = 10 \log \frac{x}{x_o}$$

The working equations can be developed in more complete form with reference to Figure 1. For simplicity of discussion we assume

*The tone corrections used in calculating the tone corrected perceived noise levels are those given in FAR 36. The improved tone correction procedures, of SAE ARP 1071[5], have not been employed.

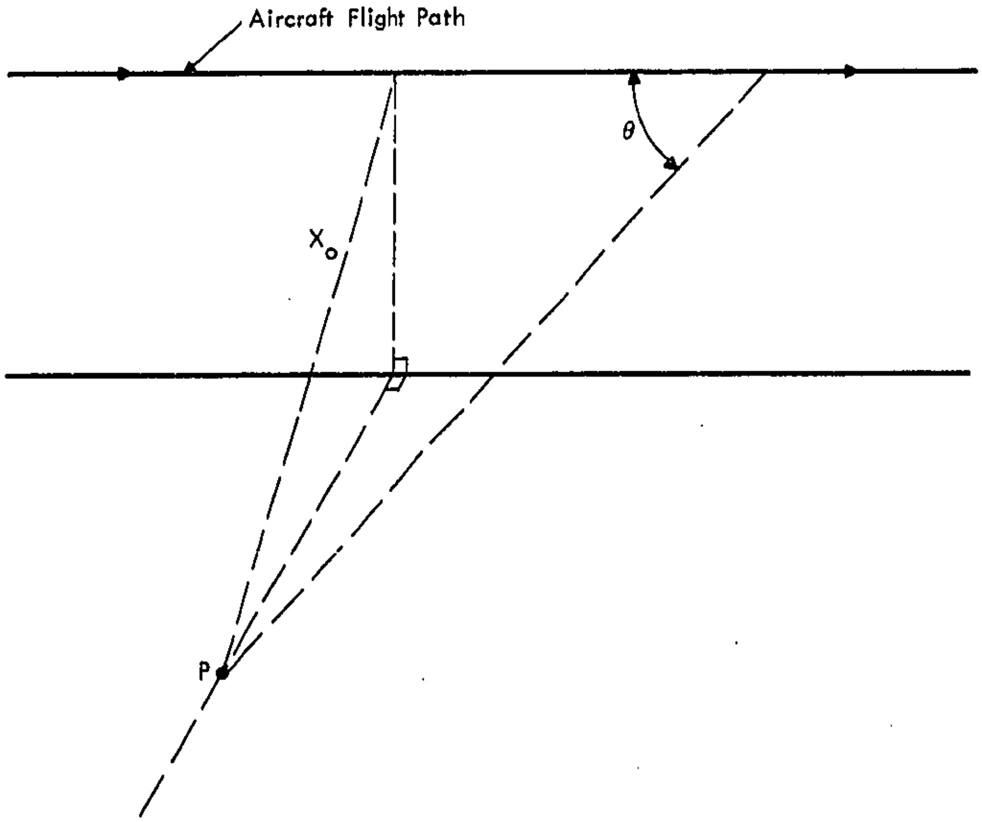

FIGURE 1. SIMPLIFIED LEVEL FLIGHT GEOMETRY FOR CALCULATING EPNL VALUES AT VARYING DISTANCES

level flight noise data has been obtained at position P (see Figure 1) with all data adjusted to standard day conditions and the desired aircraft altitude and reference air speed.* At P, the distance of closest approach, x_o, is known. Also, corrected values of the effective perceived noise level, $EPNL_{x_o}$, and the one-third octave band spectra at the time of PNLTM, SPL_{ix_o}, are known. The angle of radiation from the aircraft that produced SPL_{ix_o}, θ, is also known.**

At any distance x, it is assumed that the PNLTM at x can be calculated from the corresponding one-third octave band levels:

$$SPL_{ix} = SPL_{ix_o} - \frac{\alpha_i}{\sin\theta}(x-x_o) - 20 \log \frac{x}{x_o} \qquad (1)$$

where α_i are the one-third octave band atmospheric absorption coefficients at standard day conditions.

With $PNLTM_x$ known, $EPNL_x$ is given by:

$$EPNL_x = EPNL_{x_o} + PNLT_x - PNLT_{x_o} + 10 \log \frac{x}{x_o} \qquad (2)$$

This model, then, requires knowledge of the one-third octave band spectrum observed at the time of the maximum tone corrected perceived noise level, and the angle of radiation, either known or assumed. In applying the model to available data, values of θ were often not known, and estimates of θ were then used.

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* Reference 6 outlines the calculation steps for correcting level flight data to reference conditions.

**As discussed in Reference 6, a choice of θ and accompanying noise spectra based upon PNLM, rather than PNLTM, will reduce the extent of underestimation of EPNL values at large distances. For simplicity, this distinction is ignored in the analysis given above.

C. Net Thrust

In this report, the EPNL curves for turbojet and turbofan aircraft are identified with a net thrust value (F_n). In many of the curves published by airframe manufacturers, the noise curves are given in terms of the "referred net thrust", F_n/δ, where δ is the ratio of the atmospheric pressure at aircraft altitude to the sea level atmospheric pressure. For turbofan aircraft, airframe manufacturers often reference the noise curves to the "corrected low pressure rotor speed", $N_1/\sqrt{\theta}$, where θ is the ratio of the absolute temperature at the aircraft altitude to the absolute temperature at sea level.

It is beyond the scope of this report to examine, in any detail, the reasons for the choice of reference condition. Most controlled field noise measurements are taken at relatively low altitudes (between 400 and 2,000 feet), where the δ and θ adjustments are relatively small. Thus, it is difficult to show conclusively, from examination of such field data, the need for the pressure and temperature adjustments.

The argument for using F_n as the basic engine parameter rests on the assumption that the sound power output from the engine is most likely to be proportional to the actual net thrust produced rather than a (fictitious) thrust corrected back to sea level conditions. In other words, it is assumed that as the aircraft climbs at a constant air speed, and net thrust decreases as atmospheric pressure decreases, the noise output will also decrease.

It is recognized that the actual variation of noise output, for complex engine designs, will not vary simply with any single parameter over the entire range of possible operating conditions. However, net thrust appears to be the most useful simple parameter for many engines.

D. Sources of Noise Data

A number of sources of noise data have been used in developing EPNL versus distance curves. The sources of data, with reference to the general type of measurement condition, can be classified as (a) controlled tests and (b) airport measurements (uncontrolled). The use of the word 'controlled' implies control, and/or knowledge of aircraft performance and engine operating parameters. The quality of the noise data in terms of accuracy of the acoustic measurements often is not significantly different between the controlled or airport tests, but aircraft information is less detailed in the latter.

Data from airport measurements serve well in obtaining typical shapes of EPNL versus distance curves. However, to peg the EPNL curve as a function of known engine parameters, the controlled tests are often most useful.* Table I provides a brief summary of the sources of the data for different major aircraft types. BBN-supplied data includes airport measurements obtained at airports such as Los Angeles International Airport, San Jose Municipal Airport, Orange County Airport and Anchorage, Alaska, among others. The business jet information provided by BBN came largely from certification tests conducted in full accordance with FAR 36, plus other controlled and airport tests. Most propeller aircraft measurements were airport measurements; however, results from some controlled measurements were also utilized.

The data from the aircraft manufacturers includes noise spectra information furnished informally by Boeing and Douglas. The data also includes noise curves and spectral information contained in

*Even here, the airport data serves as a check upon controlled tests where data may not have been obtained during realistic aircraft operating conditions.

TABLE I

SUMMARY OF AIRCRAFT NOISE DATA SOURCES

Aircraft Type	BBN	Airframe Manufacturer	Other
4-Engine LBPR (707, DC-8) Transport	Airport	Controlled	Controlled
4-Engine LBPR (707, DC-8) Transport Retrofit	-	Controlled	--
2, 3-Engine LBPR Transport (737, DC-9, 727)	Airport	Controlled	Controlled
4-Engine HBPR (747)	Airport	Controlled	--
3-Engine HBPR (DC-10)	Airport	Controlled	--
Business Jet Aircraft	Controlled[1] Airport	--	--
Propeller Aircraft	Airport, Controlled[1]	--	Controlled

[1]Controlled includes noise certification tests (FAR 36) as well as other formal aircraft flight test measurements.

a number of draft reports prepared for the FAA[7-12]* and data reported to NASA[13]. Other sources of information include tests conducted for the FAA[14-17].

Some comparisons of noise curves derived from different sources will be given in the next section. In general, there are inconsistencies in the noise data and there is lack of agreement in noise curves reported by different airframe manufacturers for aircraft utilizing the same engines. Even for aircraft which have been in service for a number of years (civil turbofan transports powered with JT-3D and JT-8D engines for example) there is considerable disagreement and current controversy about noise output.

Where a choice had to be made between differing and conflicting data sources, or curves, we have selected curves that predict higher levels rather than lower levels. Generally where there was large disagreement in data sources, we have been able to cross check curves by reference to data from other sources or from other aircraft having engines of nearly similar characteristics.

With regard to the general slope of the EPNL versus distance curves, there is good consistency in curves for:

- turbojet aircraft (high thrust only)
- high bypass ratio turbofan aircraft
- piston-powered propeller aircraft

There are more inconsistencies in EPNL curves among engines and power settings for:

- turbojet aircraft (intermediate and low thrust)

*In some cases, the draft report noise data may differ from that appearing in the final reports.

- low bypass ratio turbofan aircraft
- turboprop aircraft

E. Comparisons of Noise Curves

In this section, some EPNL versus distance curves from different sources and for different assumptions will be compared.

The EPNL versus distance curves are somewhat sensitive to the choice of the radiation angle in the analytic model used. Figure 2 illustrates this sensitivity by showing curves developed from takeoff and approach spectra[1] for two assumptions as to the PNLTM radiation angles for each spectra. It can be seen that the curves are not extremely sensitive to choice of the angle of radiation. Obviously, as angles are either made larger or smaller than 90°, the slope of the curves as a function of distance gradually will increase.

To illustrate the effect of differences in spectrum shape, Figures 3 and 4 compare EPNL curves for typical approach and takeoff conditions for four-engine LBPR aircraft (707 and DC-8's). The noise spectra used in generating the curves are presented in Figures 5 and 6.

Of most interest in Figures 3 and 4 are the curve shapes rather than the absolute levels. Note that the approach curves, in particular, show sizeable differences in shape in the distance range between approximately 2,000 feet and 10,000 feet.

F. Comparison of EPNL Curves from Different Sources

The EPNL curves presented in this report differ in varying degrees from curves developed previously. Figures 7, 8, 9 and 10 compare the curves developed in this study for two, three and four-engine

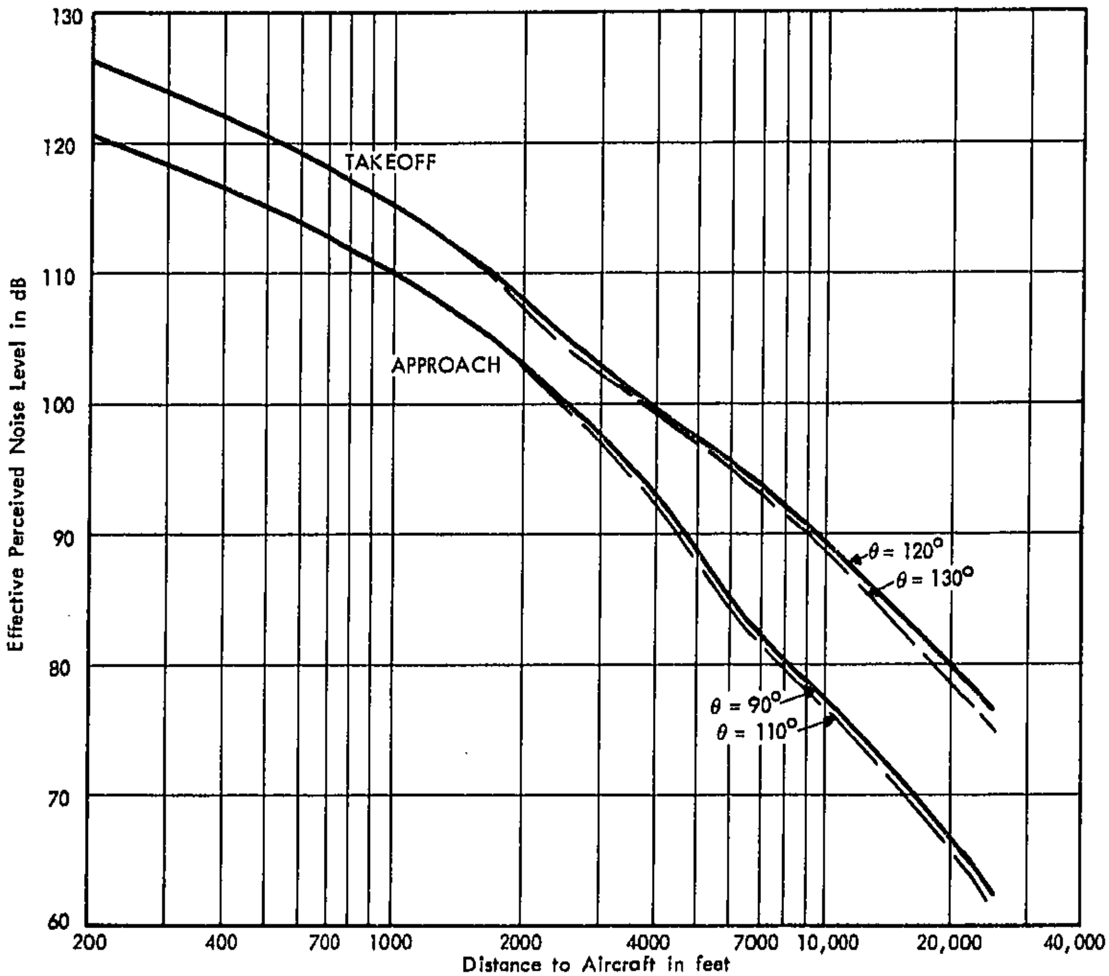

FIGURE 2. COMPARISON OF EPNL VS DISTANCE CURVES FOR DIFFERENT ASSUMED ANGLES OF PNLTM NOISE RADIATION - DC-8 AIRCRAFT NOISE DATA

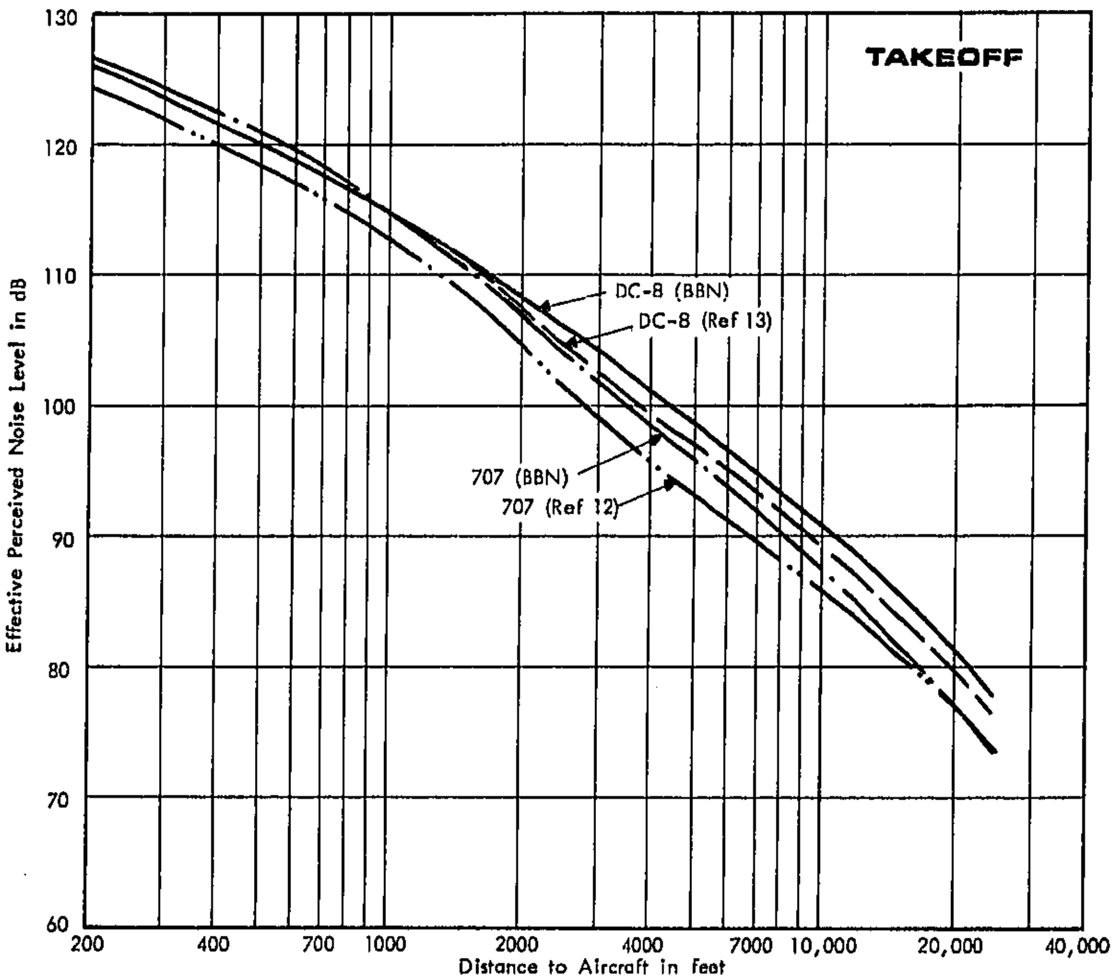

FIGURE 3. COMPARISON OF EPNL VS DISTANCE CURVES BASED ON NOISE SPECTRA FROM DIFFERENT SOURCES - DC-8 AND 707 TAKEOFFS

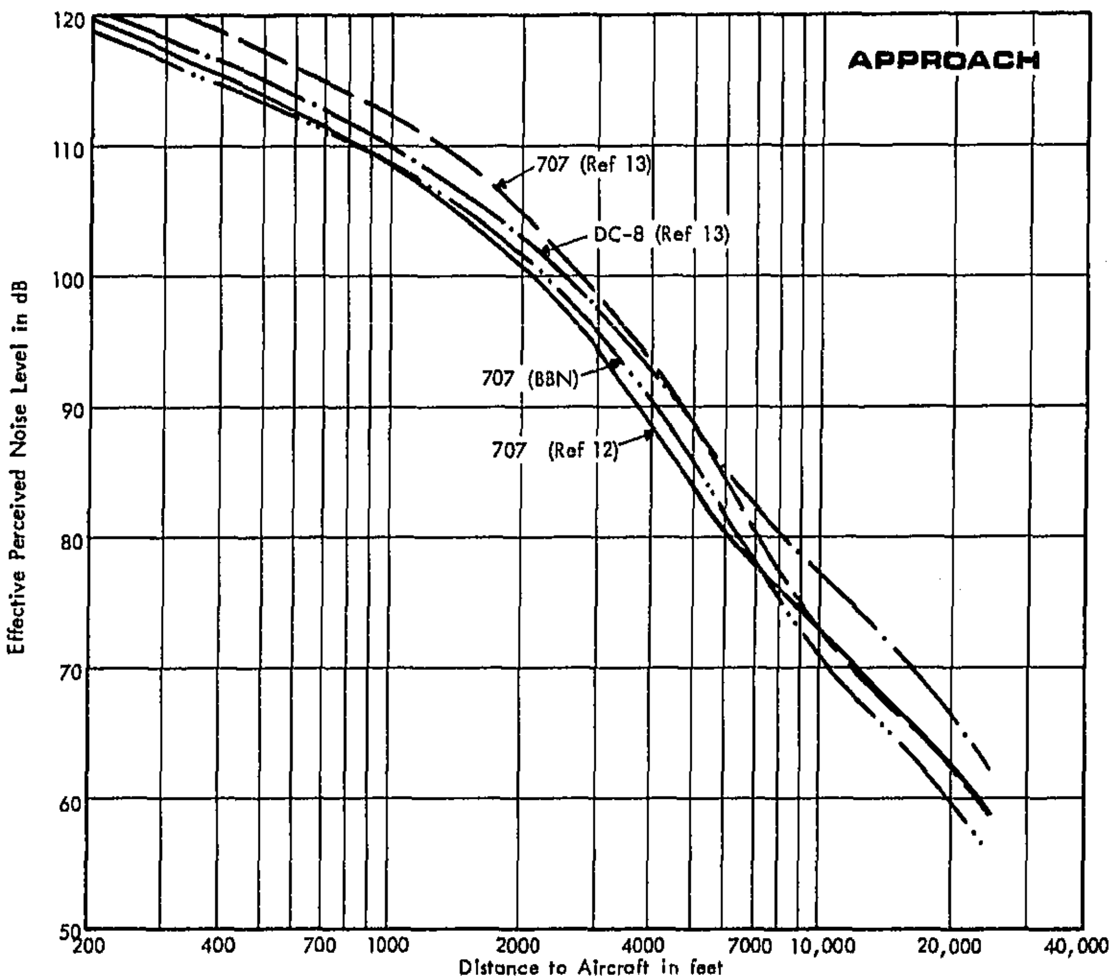

FIGURE 4. COMPARISON OF EPNL VS DISTANCE CURVES BASED ON NOISE SPECTRA FROM DIFFERENT SOURCES - DC-8 AND 707 APPROACHS

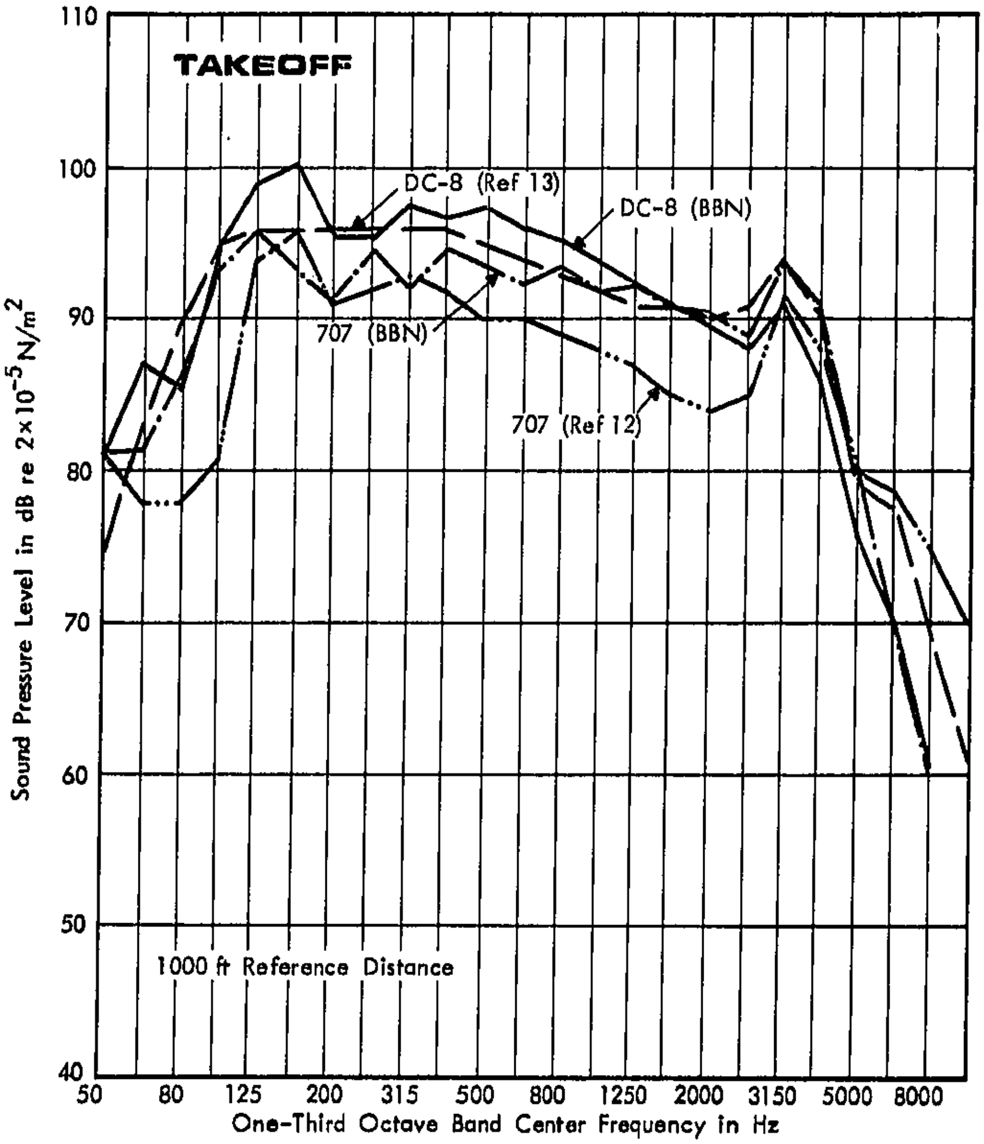

FIGURE 5. NOISE SPECTRA FOR DEVELOPMENT OF EPNL VS DISTANCE CURVES - DC-8 AND 707 TAKEOFFS

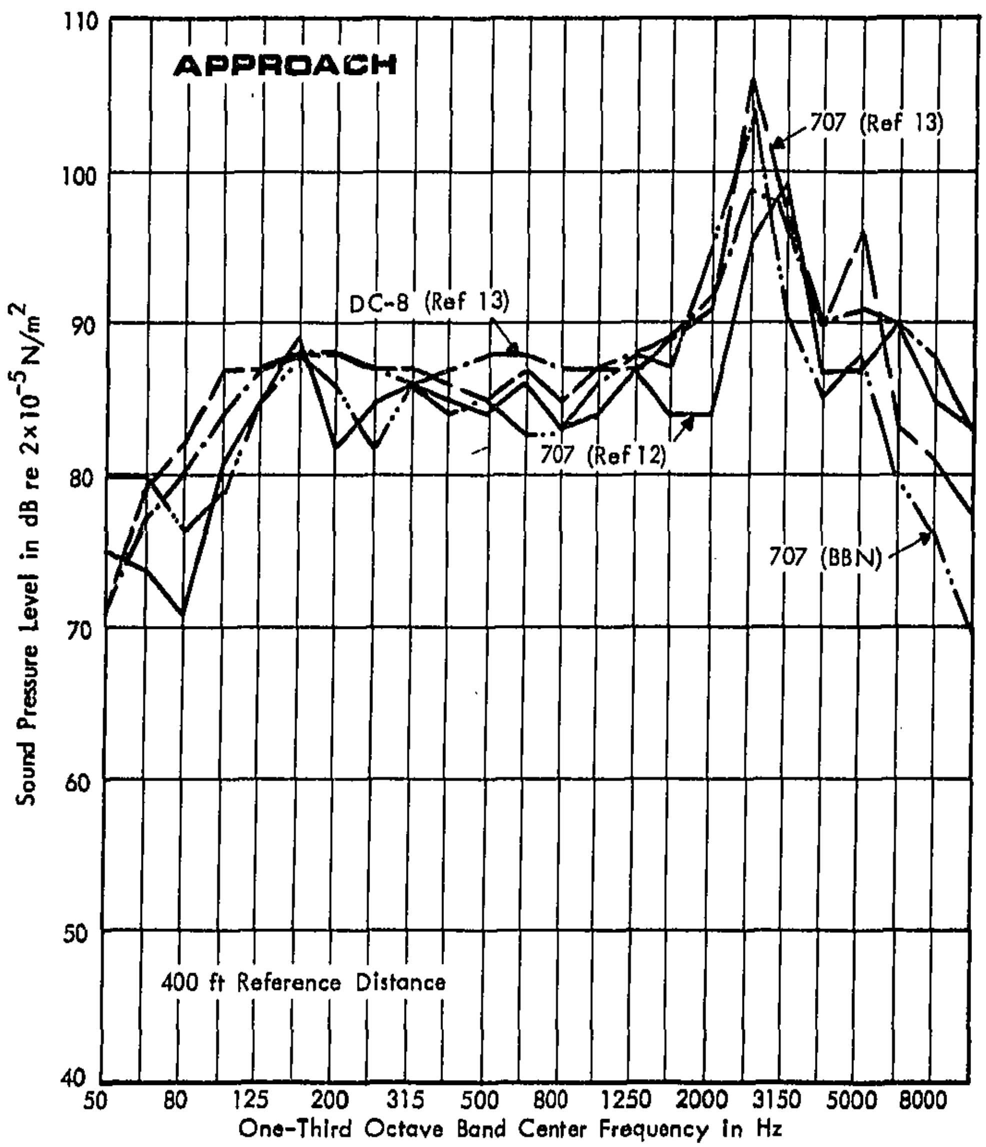

FIGURE 6. NOISE SPECTRA FOR DEVELOPMENT OF EPNL VS DISTANCE CURVES - DC-8 AND 707 APPROACH

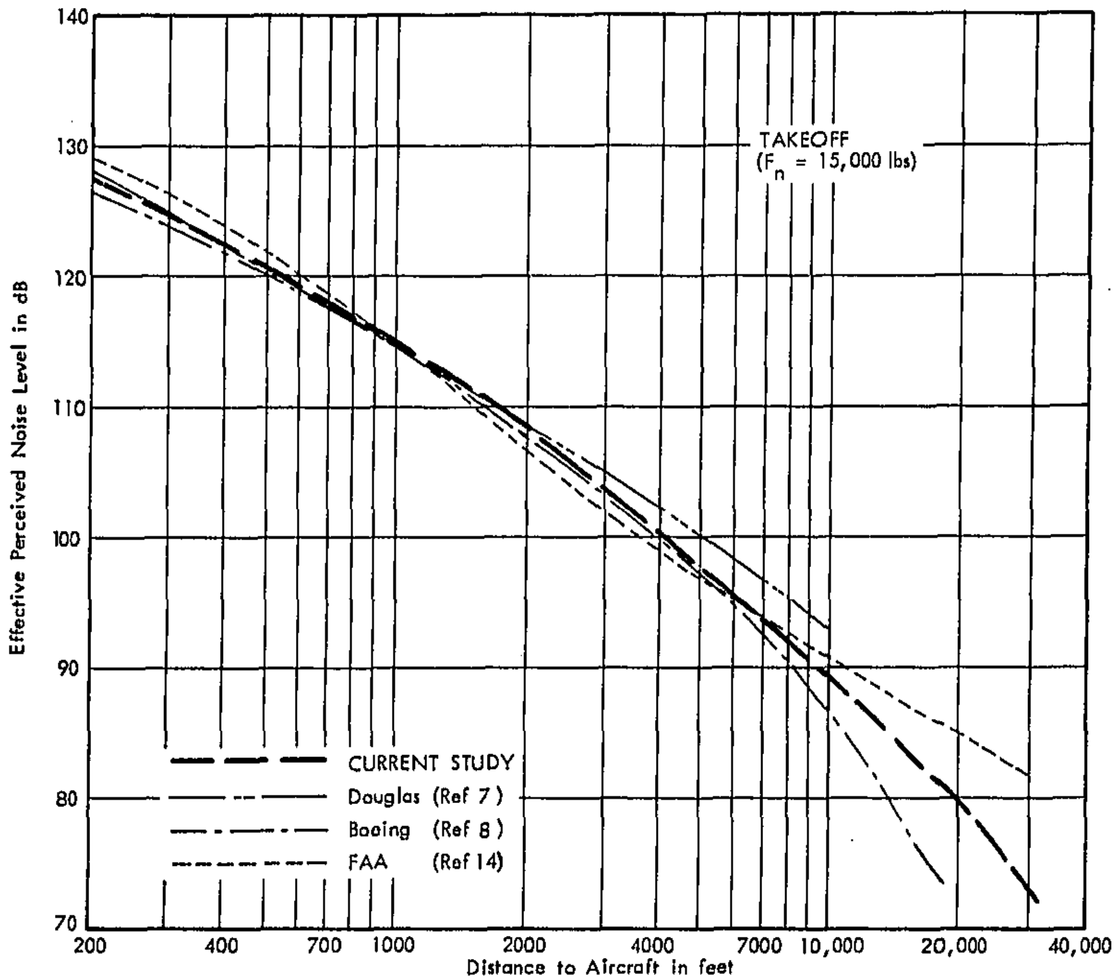

FIGURE 7. COMPARISON OF EPNL VERSUS DISTANCE CURVES FROM DIFFERENT SOURCES - 707 AND DC-8 AIRCRAFT WITH JT3D SERIES ENGINES - TAKEOFF

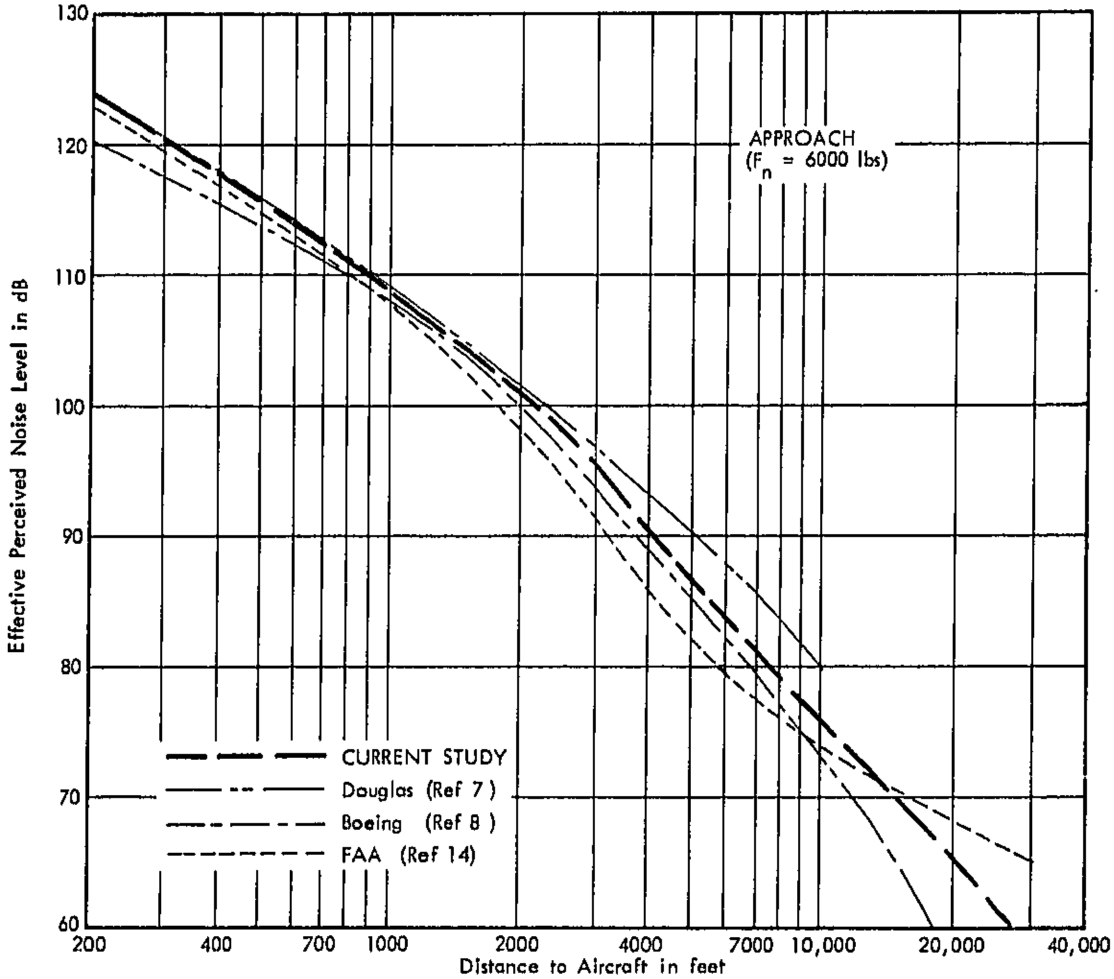

FIGURE 8. COMPARISON OF EPNL VERSUS DISTANCE CURVES FROM DIFFERENT SOURCES - 707 AND DC-8 AIRCRAFT WITH JT3D SERIES ENGINES-APPROACH

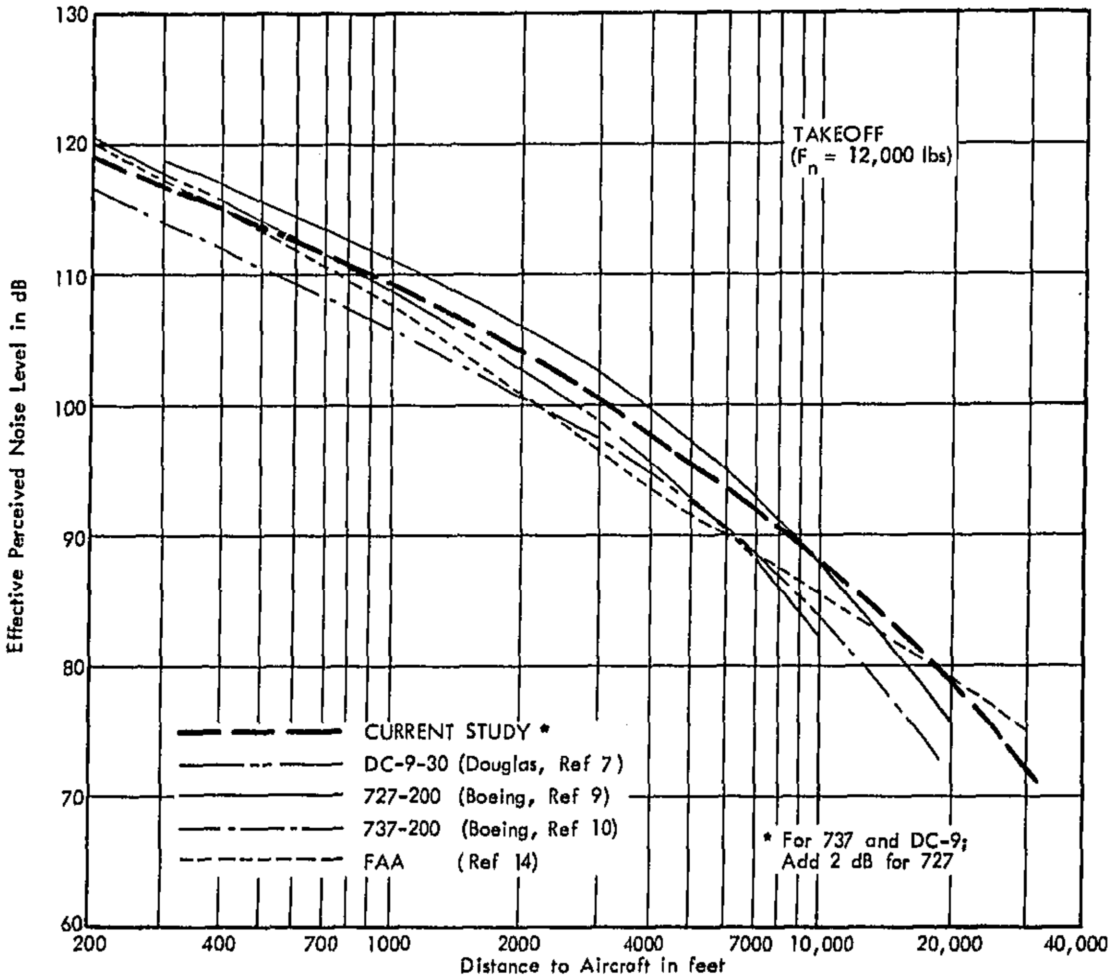

FIGURE 9. COMPARISON OF EPNL VERSUS DISTANCE CURVES FROM DIFFERENT SOURCES - 737, DC-9 AND 727 AIRCRAFT WITH JT8D SERIES ENGINES-TAKEOFF

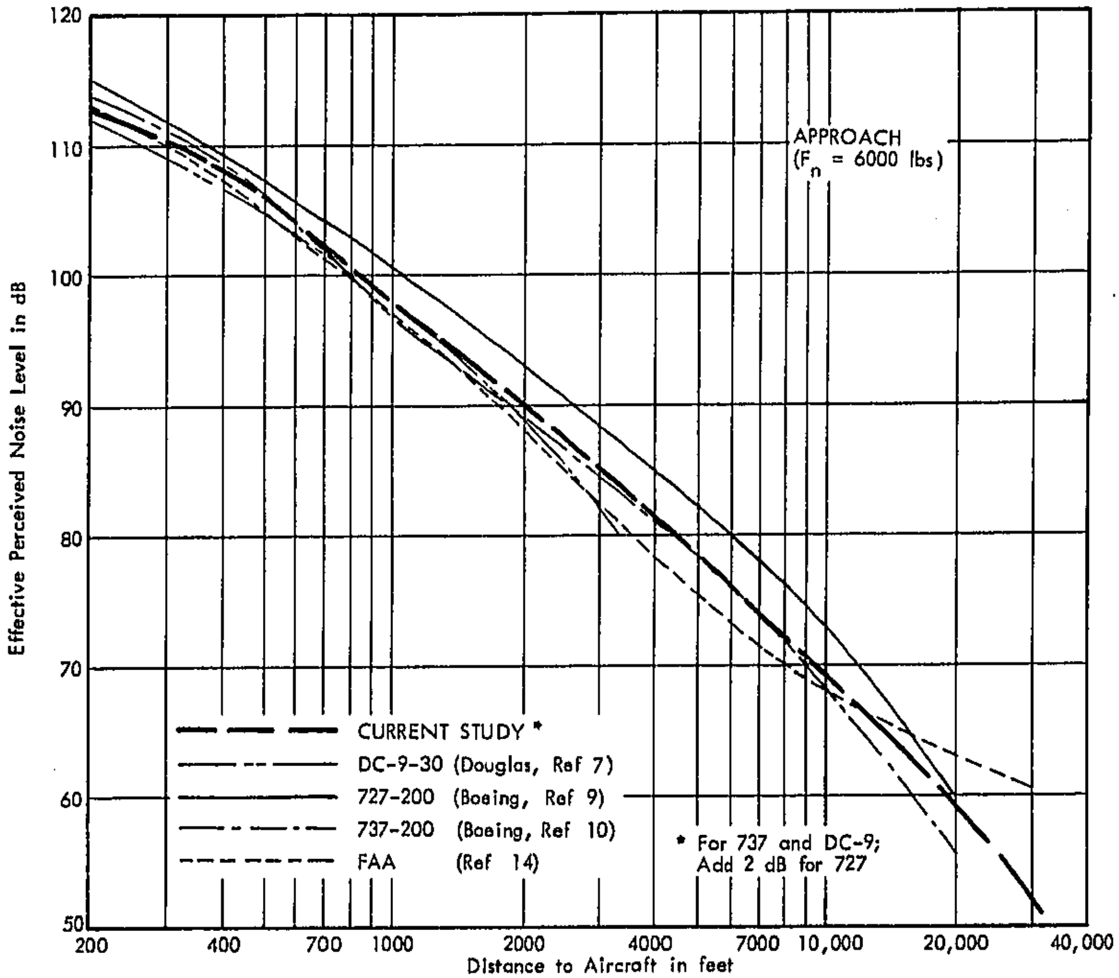

FIGURE 10. COMPARISON OF EPNL VERSUS DISTANCE CURVES FROM DIFFERENT SOURCES - 737, DC-9 AND 727 AIRCRAFT WITH JT8D SERIES ENGINES-APPROACH

LBPR aircraft with curves reported from several other sources. Figures 7 and 8 compare the noise curves for four-engine LBPR aircraft (707 and DC-8 series aircraft) with those developed earlier under FAA sponsorship and widely used in NEF computations.[14] Also shown are curves reported by Douglas and Boeing in draft reports to the FAA.[7-8]*

With reference to the FAA curves, the takeoff curve of Figure 7 shows slightly higher noise levels in the range from about 1,000 feet to 6,000 feet with slightly lower levels at either smaller or greater distances. The increased slope of the EPNL curve at large distances results from consideration of air absorption at lower frequencies (500 Hz and lower) which was generally neglected in the earlier FAA curve development.

Comparison of the approach curve with the earlier FAA curve (Figure 8) show that the current curves lie above the FAA curve over the entire slant distance range, except at very large slant distances. The differences amount to several dB in the frequency range from approximately 2,000 to 8,000 feet.

Comparison of the curves for two and three-engine aircraft, shown in Figures 9 and 10, show that the current curve for takeoff generally exceeds the FAA curve for distances between about 500 feet to 20,000 feet. Differences in excess of 2 dB occur in the range from about 1200 feet to 10,000 feet.

The differences between the current and FAA curves for approach noise for the two and three-engine LBPR aircraft (Figure 10) are most significant in the range from about 2,000 to 8,000 feet

*Note that these curves are identified with a particular draft report and may differ from those in the final version of the reports.

where the newer curves are typically of the order of 2 to 3 dB higher than the FAA curves.

In general, the current curves agree well with the Boeing and Douglas curves (with the exception of the Boeing curve for 737 takeoff noise) for distances of about 2,000 feet or less. At larger distances, differences tend to increase.*

G. DC-8 and 707 Aircraft Retrofit with Acoustically Lined Nacelles

Figure A-2 in the Appendix presents sets of EPNL curves for DC-8 and 707 turbofan aircraft retrofit with acoustically-lined nacelles (sound absorption material [SAM] retrofit). These curves are based upon measurements on a 707 reported by Boeing in Reference 12. The acoustic performance of similar retrofits for DC-8 series aircraft may differ due to differences in nacelle design.

Figure 11 compares the curves for retrofit and non-retrofit aircraft for takeoff thrust and a representative approach thrust. At takeoff, the retrofit is moderately effective (producing reduction of 2 dB or more) only at distances of less than about 1,500 feet. Sizeable reduction in approach noise (5 dB or more) occurs at distances less than about 6,000 feet.

*Again, the curves given in final drafts of References 7 to 12 may differ from those shown in this report, thus larger differences may exist between the curves developed in this report and those given in final versions of these references.

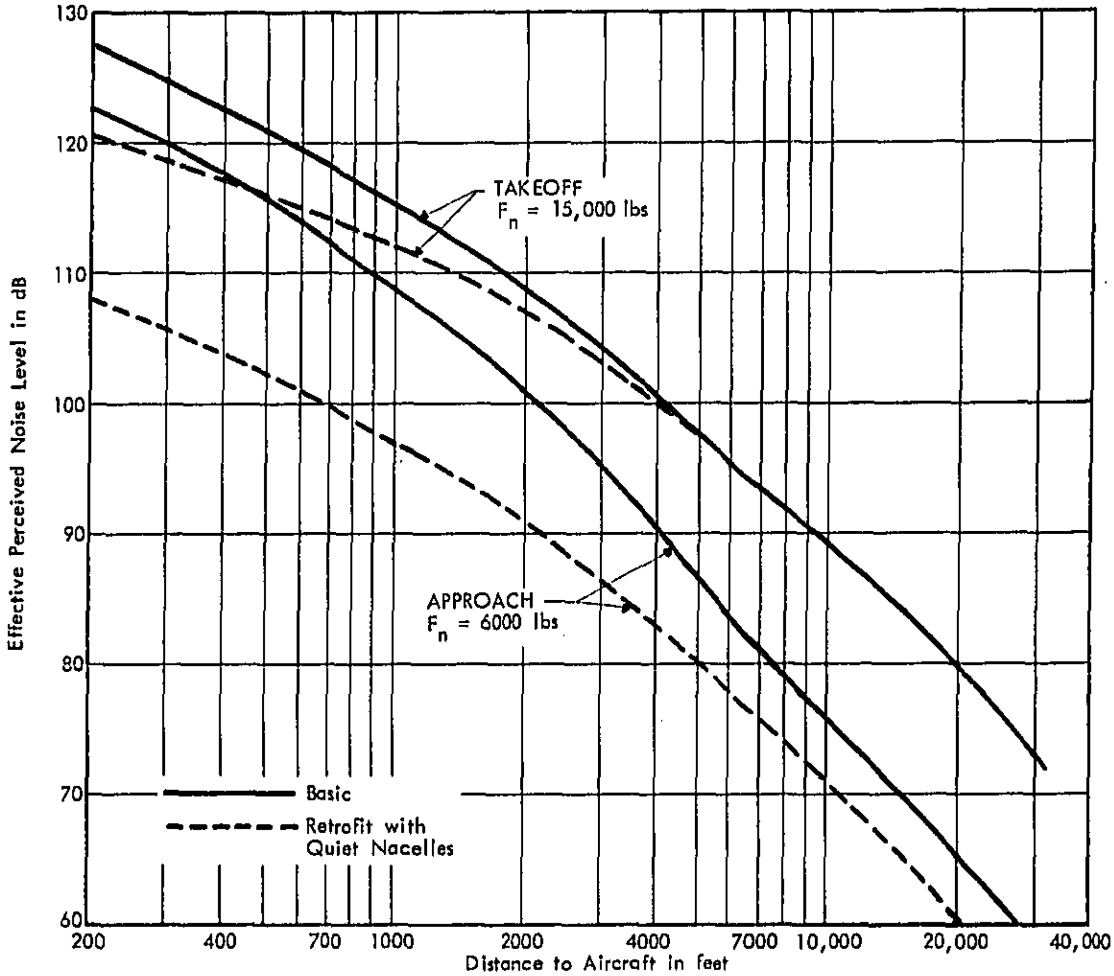

FIGURE 11. COMPARISON OF TYPICAL TAKEOFF AND APPROACH NOISE FOR 707 AND DC-8 AIRCRAFT WITH AND WITHOUT QUIET NACELLE RETROFIT

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APPENDIX A

TABULATION AND GRAPHS OF EPNL VERSUS DISTANCE DATA FOR CIVIL AIRCRAFT

This Appendix contains EPNL versus distance data for civil aircraft in both tabular and graphical formats. The noise data are presented in Figures A-1 through A-19, and in Table A-II. Table A-I is a guide to the selection of the appropriate graph or section of Table A-II. Aircraft are identified by general classification and by specific model where appropriate.

Engine thrust settings for jet aircraft are identified either in terms of net thrust (Fn) *per engine*, or, in the case of high bypass ratio (HBPR) turbofan transport aircraft, in terms of the engine low pressure rotor speed (N_1).

For most aircraft, two sets of data are provided: one set for typical takeoffs, and the other for typical approaches. For the larger civil transport aircraft, additional sets of noise data at intermediate engine thrusts are provided.

The EPNL values are stated for a reference airspeed V_o. For another airspeed, V, the EPNL values should be adjusted, by the addition of ΔV, where:

$$\Delta V = 10 \log \frac{V_o}{V} \qquad \text{(dB)}$$

TABLE A-I

INDEX TO AIRCRAFT EPNL VERSUS DISTANCE CURVES

General Aircraft Type	Specific Aircraft Type	Aircraft Engine Type	Noise Curve Figures	Refer to Table
4-Engine LBPR Turbofan Transport	Boeing 707 Series Douglas DC-8 Series	JT3D Series JT3D Series	A-1	A-II-1
4-Engine LBPR Turbofan Transport with Retrofit Nacelles	Boeing 707 Series Douglas DC-8 Series	JT3D Series JT3D Series	A-2	A-II-2
3-Engine LBPR Turbofan Transport	Boeing 727 Series	JT8D Series	A-3	A-II-3
2-Engine LBPR Turbofan Transport	Boeing 737 Douglas DC-9	JT8D Series JT8D Series	A-3	A-II-4
4-Engine HBPR Transport	Boeing 747-100A Boeing 747-100D,-200B	JT9D-3A JT9D-3A,-7	A-4	A-II-5
3-Engine HBPR Transport	Douglas DC-10-10,-30 Douglas DC-10-40	CF6-6D JT9D-20	A-5 A-6	A-II-6
Business Jets	Cessna Citation	(2) JT15D-1 Turbofans	A-7	A-II-7
	Commodore Jet Commander 1121	(2) CJ610-5 Turbojets	A-8	"
	Dassault Fan Jet Falcon 20	(2) CF700-2 Turbofans	A-9	"
	Gates Learjet 24/25	(2) CJ610-6 Turbojets	A-10	A-II-8
	Grumman Gulfstream II	(2) Spey 511-8 Turbojets	A-11	"
	Lockheed Jetstar 1	(4) PT 12A-6A Turbojets	A-12	A-II-9
	North American Sabre 60	(2) PT 12A-8 Turbojets	A-13	"
	North American Sabre 80	(2) CJ700-2D-2 Turbofans	A-14	"
4-Engine Turboprop Transport	Lockheed Electra, Lockheed Hercules (C-130)	Allison T56 Series	A-15	A-II-10
2-Engine Turboprop Transport	Fairchild F-27, HS-748	Rolls Royce Dart Series	A-16	A-II-10
	DeHavilland DHC-6 Twin Otter	PT6 Series	A-17	"
4-Engine Piston Transport	DC-6, DC-7, Constellation		A-18	A-II-11
2-Engine Piston Transport (>12,500 lbs max. gross weight)	Convair 340, 440, DC-3		A-18	A-II-11
2-Engine Piston Aircraft (<12,500 lbs max. gross weight)	Cessna 310, Cessna 337, Piper Aztec, Beech Queen Air		A-19	A-II-12
1-Engine Piston Aircraft	Cessna 182 Piper Cherokee Beech Bonanza	<180 horsepower	A-19	A-II-12

TABLE A-II-1

TABULATION OF EPNL VALUES FOR DIFFERENT AIRCRAFT

Aircraft: Four Engine LBPR Turbofan Transport Aircraft - 707 & DC-8 with JT3D Series Engines (Note: Subtract 2 dB for DC-8-63 Aircraft)

Operation:			Approach								Takeoff	
Airspeed:	160 Kt		160 Kt		160 Kt		160 Kt		160 Kt		160 Kt	
Power:	Fn = 4000 lbs		Fn = 6000 lbs		Fn = 8000 lbs		Fn = 10000 lbs		Fn = 12000 lbs		Fn = 15000 lbs	
	EPNL, dB		EPNL, dB		EPNL, dB		EPNL, dB		EPNL, dB		EPNL, dB	
Distance, ft.	Air to Ground	Ground to Ground	Air to Ground	Ground to Ground	Air to Ground	Ground to Ground	Air to Ground	Ground to Ground	Air to Ground	Ground to Ground	Air to Ground	Ground to Ground
200	120.0	120.0	122.5	122.5	124.5	124.5	126.0	126.0	127.0	127.0	127.5	127.5
250	118.5	118.5	121.0	121.0	122.9	122.9	124.4	124.4	125.4	125.4	125.9	125.9
315	116.9	116.9	119.4	119.4	121.2	121.2	122.7	122.7	123.7	123.7	124.2	124.2
400	115.0	115.0	117.5	117.5	119.5	119.5	121.0	121.0	122.0	122.0	122.5	122.5
500	112.9	112.9	115.4	115.4	117.7	117.7	119.2	119.2	120.2	120.2	120.7	120.7
630	110.7	110.7	113.2	113.2	115.7	115.7	117.3	117.3	118.4	118.4	118.9	118.9
800	108.4	108.3	110.9	110.8	113.4	113.3	115.2	115.1	116.5	116.4	117.0	116.9
1,000	106.0	105.8	108.5	108.3	111.0	110.8	113.0	112.8	114.5	114.3	115.0	114.7
1,250	103.6	103.3	106.1	105.8	108.9	108.6	110.8	110.5	112.3	112.0	113.0	112.5
1,600	101.1	100.7	103.6	103.2	106.2	105.8	108.5	108.1	110.0	109.6	110.8	110.1
2,000	98.5	97.9	101.0	100.4	103.5	102.9	106.0	105.4	107.5	106.9	108.5	107.5
2,500	95.5	94.6	98.0	97.1	100.5	99.6	102.9	102.0	104.6	103.7	106.0	104.4
3,150	92.0	90.7	94.5 96.3	93.2	97.0	95.7	99.3	98.0	101.4	100.1	103.3	100.7
4,000	88.0	86.0	90.5 91.2	88.5	93.0	91.0	95.5	93.5	98.0	96.0	100.8	96.9
5,000	84.0	81.2	86.5	83.7	89.0	86.2	91.5	88.7	94.4	91.6	97.7	92.5
6,300	80.2	75.2	82.7	78.7	85.2	81.2	87.5	83.5	90.5	86.5	94.8	88.3
8,000	76.5	71.0	79.0	73.5	81.5	76.0	83.9	78.4	86.9	81.4	91.9	83.6
10,000	73.0	65.8	75.5	68.3	78.0	70.8	80.5	73.3	83.5	76.3	89.0	79.2
12,500	69.5	60.0	72.0	62.5	74.5	65.0	77.3	67.8	80.3	70.8	86.1	74.6
16,000	66.0	54.3	68.5	56.8	71.0	59.3	74.0	62.3	77.0	65.3	83.0	69.0
20,000	62.5	48.0	65.0	50.5	67.5	53.0	70.6	56.1	73.6	59.1	79.6	63.4
25,000	58.9	40.9	61.4	43.4	63.9	45.9	67.0	49.0	70.0	52.0	76.0	57.5

4300'

TABLE A-II-2

TABULATION OF EPNL VALUES FOR DIFFERENT AIRCRAFT

Aircraft: Four Engine LBPR Turbofan Transport Aircraft - 707 & DC-8 with JT3D Series Engines with Retrofit Lined Nacelles

Operation:	Approach										Takeoff	
Airspeed:	160 Kt		160 Kt		160 Kt		160 Kt		160 Kt		160 Kt	
Power:	Fn = 4000 lbs		Fn = 6000 lbs		Fn = 8000 lbs		Fn = 10000 lbs		Fn = 12000 lbs		Fn = 15000 lbs	
	EPNL, dB		EPNL, dB		EPNL, dB		EPNL, dB		EPNL, dB		EPNL, dB	
Distance, ft.	Air to Ground	Ground to Ground	Air to Ground	Ground to Ground	Air to Ground	Ground to Ground	Air to Ground	Ground to Ground	Air to Ground	Ground to Ground	Air to Ground	Ground to Ground
200	104.5	104.5	108.0	108.0	111.5	111.5	114.5	114.5	117.5	117.5	120.5	120.5
250	103.3	103.3	106.8	106.8	110.3	110.3	113.3	113.3	116.3	116.3	119.4	119.4
315	101.9	101.9	105.5	105.5	109.0	109.0	112.0	112.0	115.0	115.0	118.2	118.2
400	100.5	100.5	104.0	104.0	107.5	107.5	110.5	110.5	113.5	113.5	117.0	117.0
500	99.1	99.1	102.3	102.3	105.7	105.7	108.8	108.8	111.8	111.8	115.8	115.8
630	97.6	97.5	100.6	100.5	103.8	103.7	107.1	107.0	110.1	110.0	114.6	114.5
800	96.1	95.9	98.8	98.6	101.9	101.7	105.3	105.1	108.3	108.1	113.3	113.1
1,000	94.8	94.4	97.0	96.6	100.0	99.6	103.5	103.1	106.5	106.1	112.0	111.6
1,250	92.6	91.9	95.1	94.4	98.0	97.3	101.6	100.9	104.7	104.0	110.6	109.9
1,600	90.7	89.6	93.2	92.1	96.0	94.9	99.7	98.6	102.9	101.8	109.0	107.9
2,000	88.5	86.8	91.0	89.3	94.0	92.3	97.5	95.8	101.0	99.3	107.0	105.3
2,500	86.1	83.4	88.6	85.9	91.6	88.9	95.2	92.5	98.8	96.1	104.8	102.1
3,150	83.3	79.5	85.8	82.0	88.8	85.0	92.7	88.9	96.5	92.7	102.5	98.7
4,000	80.5	75.5	83.0	78.0	86.0	81.0	90.0	85.0	94.0	89.0	100.0	95.0
5,000	77.6	71.4	80.1	73.9	83.1	76.9	87.1	80.9	91.1	84.9	97.4	91.2
6,300	74.6	67.1	77.1	69.6	80.1	72.6	83.9	76.4	87.9	80.4	94.7	87.2
8,000	71.6	62.8	74.1	65.3	77.1	68.3	80.7	71.9	84.7	75.9	91.9	83.1
10,000	68.5	58.4	71.0	60.9	74.0	63.9	77.5	67.4	81.5	71.4	89.0	78.9
12,500	65.1	53.6	67.6	56.1	70.6	59.1	74.3	62.8	78.3	66.8	86.1	74.6
16,000	61.5	48.5	64.0	51.0	67.0	54.0	71.0	58.0	75.0	62.0	83.0	70.0
20,000	57.9	43.1	60.4	45.2	63.4	48.6	67.6	52.8	71.6	56.8	79.6	64.8
25,000	54.3	36.8	56.8	39.3	59.8	42.3	64.0	46.5	68.0	50.5	76.0	58.5

TABLE A-II-3

TABULATION OF EPNL VALUES FOR DIFFERENT AIRCRAFT

Aircraft: Three Engine LBPR Turbofan Aircraft - 727 with JT8D Series Engines

Operation:			Approach						Takeoff	
Airspeed:	160 Kt		160 Kt		160 Kt		160 Kt		160 Kt	
Power:	Fn = 4000 lbs		Fn = 6000 lbs		Fn = 8000 lbs		Fn = 10000 lbs		Fn = 12000 lbs	
	EPNL, dB		EPNL, dB		EPNL, dB		EPNL, dB		EPNL, dB	
Distance, ft.	Air to Ground	Ground to Ground	Air to Ground	Ground to Ground	Air to Ground	Ground to Ground	Air to Ground	Ground to Ground	Air to Ground	Ground to Ground
200	112.0	112.0	114.5	114.5	116.5	116.5	118.5	118.5	121.0	121.0
250	110.7	110.7	113.2	113.2	115.2	115.2	117.3	117.3	119.8	119.8
315	109.2	109.2	111.7	111.7	113.7	113.7	115.9	115.9	118.4	118.4
400	107.5	107.5	110.0	110.0	112.0	112.0	114.5	114.5	117.0	117.0
500	105.3	105.3	107.8	107.8	109.8	109.8	112.7	112.7	115.6	115.6
630	102.7	102.6	105.2	105.1	107.6	107.5	110.8	110.7	114.1	114.0
800	100.1	99.9	102.6	102.4	105.3	105.1	108.9	108.7	112.6	112.4
1,000	97.5	97.1	100.0	99.6	103.0	102.6	107.0	106.6	111.0	110.6
1,250	94.8	94.4	97.4	96.8	100.7	100.1	105.0	104.4	109.4	108.8
1,600	92.0	91.1	94.7	93.8	98.4	97.5	103.0	102.1	107.7	106.8
2,000	89.0	87.8	92.0	90.8	96.0	94.8	101.0	99.8	106.0	104.8
2,500	85.9	83.8	89.2	87.1	93.4	91.3	98.9	96.8	104.0	101.9
3,150	82.7	79.8	86.4	83.5	100.7	87.8	96.8	93.9	101.8	98.9
4,000	79.5	75.0	83.5	79.0	88.0	83.5	94.5	90.0	99.5	95.0
5,000	76.2	70.5	80.5	74.8	85.3	79.6	92.2	86.5	97.2	91.5
6,300	72.8	65.7	77.4	70.3	82.6	75.5	89.9	82.8	94.9	87.8
8,000	69.4	60.9	74.2	65.7	79.8	71.3	87.5	79.0	92.5	84.0
10,000	66.0	56.2	71.0	61.2	77.0	67.2	87.5	75.2	90.0	80.2
12,500	62.5	51.4	67.8	56.7	74.2	63.1	82.2	71.1	87.2	76.1
16,000	59.0	46.2	64.5	51.7	71.0	58.2	79.0	66.2	84.0	71.2
20,000	55.2	40.5	60.9	46.2	67.6	52.9	75.6	60.9	80.6	65.9
25,000	51.3	33.4	57.1	39.2	64.0	46.1	72.0	54.1	77.0	59.1

TABLE A-II-4

TABULATION OF EPNL VALUES FOR DIFFERENT AIRCRAFT

Aircraft: Two Engine LBPR Turbofan Aircraft - 737 & DC-9 with JT8D Series Engines

Operation: Airspeed: Power:	160 Kt Fn = 4000 lbs		Approach 160 Kt Fn = 6000 lbs		160 Kt Fn = 8000 lbs		160 Kt Fn = 10000 lbs		Takeoff 160 Kt Fn = 12000 lbs	
	EPNL, dB		EPNL, dB		EPNL, dB		EPNL, dB		EPNL, dB	
Distance, ft.	Air to Ground	Ground to Ground	Air to Ground	Ground to Ground	Air to Ground	Ground to Ground	Air to Ground	Ground to Ground	Air to Ground	Ground to Ground
200	110.0	110.0	112.5	112.5	114.5	114.5	116.5	116.5	119.0	119.0
250	108.7	108.7	111.2	111.2	113.2	113.2	115.3	115.3	117.8	117.8
315	107.2	107.2	109.7	109.7	111.7	111.7	113.9	113.9	116.4	116.4
400	105.5	105.5	108.0	108.0	110.0	110.0	112.5	112.5	115.0	115.0
500	103.3	103.3	105.8	105.8	107.8	107.8	110.7	110.7	113.6	113.6
630	100.7	100.6	103.2	103.1	105.6	105.5	108.8	108.7	112.1	112.0
800	98.1	97.9	100.6	100.4	103.3	103.1	106.9	106.7	110.6	110.4
1,000	95.5	95.1 4000	98.0	97.6	101.0	100.6	105.0	104.6	109.0	108.6
1,250	92.8	92.2 94.8	95.4	94.8	98.7	98.1	103.0	102.4	107.4	106.8
1,600 1500	90.8 90.0	89.1	92.7	91.8	96.4	95.5	101.0	100.1	105.7	104.8
2,000	87.0	85.5	90.0	88.8	94.0	92.8	99.0	97.8	104.0	102.8
2,500	83.9	81.8	87.2	85.1	91.4	89.3	96.9	94.8	102.0	99.9
3,150	80.7	77.8	84.4	81.5	88.7	85.8	94.8	91.9	99.8	96.9
4,000	77.5	73.0	81.5	77.0	86.0	81.5	92.5	88.0	97.5	93.0
5,000	74.2	68.5	78.5	72.8	83.3	77.6	90.2	84.5	95.2	89.5
6,300	70.8	63.7	75.4	68.3	80.6	73.5	87.9	80.8	92.9	85.8
8,000	67.4	58.9	72.2	63.7	77.8	69.3	85.5	77.0	90.5	82.0
10,000	64.0	54.2	69.0	59.2	75.0	65.2	83.0	73.2	88.0	78.2
12,500	60.5	49.4	65.8	54.7	72.2	61.1	80.2	69.1	85.2	74.1
16,000	57.0	44.2	62.5	49.7	69.0	56.2	77.0	64.2	82.0	69.2
20,000	53.2	38.5	58.9	44.2	65.6	50.9	73.6	58.9	78.6	63.9
25,000	49.3	31.4	55.1	37.2	62.0	44.1	70.0	52.1	75.0	57.1

TABLE A-II-5

TABULATION OF EPNL VALUES FOR DIFFERENT AIRCRAFT

Four Engine HBPR Turbofan Transport Aircraft

Aircraft:	Boeing 747-100A Blow-in-Door Nacelles JT9D Engines		Boeing 747-100A Blow-in-Door Nacelles JT9D Engines		Boeing 747-100D Fixed Lip Nacelles JT9D Engines		Boeing 747-100D Fixed Lip Nacelles JT9D Engines	
Operation:	Takeoff		Approach		Takeoff		Approach	
Airspeed:	160 Kt		160 Kt		160 Kt		160 Kt	
Power:	N_1 = 3300		N_1 = 2400		N_1 = 3350		N_1 = 2400	
	EPNL, dB		EPNL, dB		EPNL, dB		EPNL, dB	
Distance, ft.	Air to Ground	Ground to Ground	Air to Ground	Ground to Ground	Air to Ground	Ground to Ground	Air to Ground	Ground to Ground
200	123.5	123.5	117.5	117.5	118.0	118.0	110.5	110.5
250	122.5	122.5	116.4	116.4	117.0	117.0	109.4	109.4
315	121.3	121.3	115.1	115.1	115.8	115.8	108.1	108.1
400	120.0	120.0	113.5	113.5	114.5	114.5	106.5	106.5
500	118.5	118.5	111.7	111.7	113.0	113.0	104.7	104.7
630	116.9	116.8	109.9	109.9	111.4	111.3	102.9	102.9
800	115.2	115.0	108.0	107.9	109.7	109.5	101.0	100.9
1,000	113.5	113.1	106.0	105.7	108.0	107.6	99.0	98.7
1,250	111.8	111.2	103.9	103.4	106.2	105.6	96.9	96.4
1,600	109.8	108.9	101.7	100.9	104.4	103.5	94.8	94.0
2,000	107.0	105.5	99.5	98.4	102.5	101.0	92.5	91.4
2,500	104.3	101.9	97.0	95.4	100.6	98.2	90.1	88.5
3,150	101.5	97.7	93.7	90.6	98.6	94.8	87.6	84.5
4,000	98.0	93.8	90.5	85.9	96.5	92.3	84.5	79.9
5,000	95.5	89.9	86.9	80.8	94.3	88.7	81.9	75.8
6,300	92.4	85.4	83.3	75.7	91.9	84.9	79.2	71.6
8,000	89.5	81.1	79.7	70.6	89.5	81.1	76.4	67.3
10,000	87.0	76.2	76.0	65.4	87.0	76.2	74.0	63.4
12,500	84.3	72.3	72.5	61.3	84.3	72.3	70.9	59.7
16,000	81.5	67.9	69.0	55.9	81.5	67.9	67.5	54.4
20,000	78.5	63.0	65.6	50.3	78.3	62.8	64.1	48.8
25,000	74.5	56.3	62.0	41.6	74.5	56.3	60.5	40.1

TABLE A-II-6

TABULATION OF EPNL VALUES FOR DIFFERENT AIRCRAFT

	Three Engine HBPR Turbofan Transport Aircraft									
Aircraft:	DC-10-10 CF6 Series Engines		DC-10-10 CF6 Series Engines (50° Flaps)		DC-10-10 CF6 Series Engines (25° Flaps)		DC-10-40 JT8D Series Engines		DC-10-40 JT8D Series Engines	
Operation:	Takeoff		Approach		Approach		Takeoff		Approach	
Airspeed:	160 Kt		160 Kt		160 Kt		160 Kt		160 Kt	
Power:	N_1 = 3420		N_1 = 2600		N_1 = 2300		N_1 = 3350		N_1 = 2400	
	EPNL, dB		EPNL, dB		EPNL, dB		EPNL, dB		EPNL, dB	
Distance, ft.	Air to Ground	Ground to Ground	Air to Ground	Ground to Ground	Air to Ground	Ground to Ground	Air to Ground	Ground to Ground	Air to Ground	Ground to Ground
200	112.0	112.0	109.5	109.5	106.0	106.0	113.0	113.0	108.5	108.5
250	111.0	111.0	108.4	108.4	104.7	104.7	112.0	112.0	107.4	107.4
315	109.8	109.8	107.1	107.1	103.2	103.2	110.8	110.8	106.1	106.1
400	108.5	108.5	105.5	105.5	101.5	101.5	109.5	109.5	104.5	104.5
500	107.0	107.0	103.7	103.7	99.7	99.7	108.0	108.0	102.7	102.7
630	105.4	105.3	101.9	101.9	97.9	97.9	106.4	106.3	100.9	100.9
800	103.7	103.5	100.0	99.9	96.0	95.9	104.7	104.5	99.0	98.9
1,000	102.0	101.6	98.0	97.7	94.0	93.7	103.0	102.6	97.0	96.7
1,250	100.2	99.6	95.9	95.4	91.9	91.4	101.2	100.6	94.9	94.4
1,600	98.4	97.5	93.8	93.0	89.8	89.0	99.4	98.5	92.8	92.0
2,000	96.5	95.0	91.5	90.4	87.5	86.4	97.5	96.0	90.5	89.4
2,500	94.6	92.2	89.1	87.5	85.0	83.4	95.6	93.2	88.1	86.5
3,150	92.6	88.8	86.6	83.5	82.3	79.2	93.6	89.8	85.6	82.5
4,000	90.5	86.3	84.0	79.4	79.5	74.9	91.5	87.3	83.0	78.4
5,000	88.3	82.7	81.4	75.3	76.7	70.6	89.3	83.7	80.4	74.3
6,300	85.9	78.9	78.7	71.1	73.8	66.2	86.9	79.9	77.7	70.1
8,000	83.5	75.1	75.9	66.8	70.9	61.8	84.5	76.1	74.9	65.8
10,000	81.0	70.2	73.0	62.4	68.0	57.4	82.0	71.2	72.0	61.4
12,500	78.3	76.3	69.9	58.7	64.6	53.4	79.3	67.3	68.9	57.7
16,000	75.5	61.9	66.5	53.4	61.0	47.9	76.5	62.9	65.5	52.4
20,000	72.3	56.8	63.1	47.8	57.4	42.1	73.3	57.8	62.1	46.8
25,000	68.5	53.3	59.5	39.1	53.8	33.4	69.5	51.3	58.5	38.1

TABLE A-II-7

TABULATION OF EPNL VALUES FOR DIFFERENT AIRCRAFT

Business Jet Aircraft

Aircraft:	Cessna Citation Two JT15OD-1 Turbofan Eng.		Cessna Citation Two JT15OD-1 Turbofan Eng.		Commodore Jet Commander 1121 Two CJ610-5 Turbojet Eng.		Commodore Jet Commander 1121 Two CJ610-5 Turbojet Eng.		Dassault Fan Jet Falcon, Two CJ700-2B Turbofan Eng.		Dassault Fan Jet Falcon, Two CJ700-2B Turbofan Eng.	
Operation:	Takeoff		Approach		Takeoff		Approach		Takeoff		Approach	
Airspeed:	115 Kt		115 Kt		145 Kt		140 Kt		140 Kt		140 Kt	
Power:	Fn = 1550 lbs.		Fn = 510 lbs		Fn = 2470 lbs.		FN = 1170 lbs.					
	EPNL, dB		EPNL, dB		EPNL, dB		EPNL, dB		EPNL, dB		EPNL, dB	
Distance, ft.	Air to Ground	Ground to Ground	Air to Ground	Ground to Ground	Air to Ground	Ground to Ground	Air to Ground	Ground to Ground	Air to Ground	Ground to Ground	Air to Ground	Ground to Ground
200	101.0	101.0	91.2	91.2	123.3	123.3	110.5	110.5	111.4	111.4	108.0	108.0
250	99.7	99.7	89.9	89.9	121.9	121.9	109.3	109.3	109.7	109.7	106.6	106.6
315	98.4	98.4	88.5	88.5	120.4	120.4	108.1	108.1	107.8	107.8	105.1	105.1
400	97.0	97.0	87.1	87.1	118.9	118.9	106.7	106.7	106.0	106.0	103.6	103.6
500	95.6	95.5	85.6	85.5	117.3	117.3	105.3	105.3	104.3	104.3	101.9	101.9
630	93.9	93.8	83.9	83.8	115.6	115.6	103.8	103.7	102.5	102.5	100.1	100.0
800	92.4	92.2	82.2	82.0	113.8	113.7	102.3	102.0	100.4	100.2	98.0	97.9
1,000	90.8	90.4	80.3	80.0	111.8	111.6	100.6	100.3	98.3	98.0	95.7	95.5
1,250	89.1	88.5	78.4	78.0	109.6	109.2	98.9	98.4	96.1	95.5	93.2	92.9
1,600	87.4	86.4	76.7	76.0	107.2	106.7	97.0	96.3	93.7	92.5	90.4	89.8
2,000	85.5	84.2	74.8	73.9	104.7	103.9	95.0	94.0	91.1	89.9	87.2	86.4
2,500	83.6	81.6	72.8	70.9	102.4	101.0	92.7	91.3	88.9	87.1	83.7	82.4
3,150	81.5	78.3	70.7	67.4	100.0	98.0	90.3	88.3	86.4	83.9	80.2	77.8
4,000	79.3	74.7	68.6	63.4	98.6	94.3	87.6	84.8	83.9	79.9	76.9	73.3
5,000	77.0	70.6	65.9	58.5	95.0	90.2	85.0	80.8	81.2	75.5	73.8	68.7
6,300	74.5	66.2	63.1	52.8	92.3	85.7	82.3	76.5	78.6	70.8	70.5	63.7
8,000	71.6	62.7	60.1	47.9	89.3	81.9	79.5	73.1	75.8	66.9	67.6	59.5
10,000	68.6	58.4	56.7	43.2	86.1	77.7	76.5	69.2	72.7	62.7	64.6	54.7
12,500	65.3	53.3	52.8	36.8	82.5	73.2	73.2	64.6	69.5	58.0	61.3	48.9
16,000	61.4	47.2	48.5	28.8	78.5	68.2	69.4	59.1	65.9	52.2	57.6	42.2
20,000	56.8	38.8	43.7	0	74.0	62.4	65.2	53.1	61.8	44.8	53.6	30.5
25,000	51.6	24.3	36.7	0	69.4	55.4	60.4	44.5	56.8	34.5	48.5	13.9

TABLE A-II-8

TABULATION OF EPNL VALUES FOR DIFFERENT AIRCRAFT

Business Jet Aircraft

Aircraft:	Gates Learjet 24 & 25 Two CJ610-6 Turbojet Eng.		Gates Learjet 24 & 25 Two CJ610-6 Turbojet Eng.		Grumman Gulfstream II Two SPEY 511-8 Turbojet Eng.		Grumman Gulfstream II Two SPEY 511-8 Turbojet Eng.	
Operation:	Takeoff		Approach		Takeoff		Approach	
Airspeed:	155 Kt		150 Kt		175 kt		155 kt	
Power:	Fn = 2500 lbs.		Fn = 1050 lbs		Fn = 9300 lbs.		Fn = 3200 lbs.	
	EPNL, dB		EPNL, dB		EPNL, dB		EPNL, dB	
Distance, ft.	Air to Ground	Ground to Ground	Air to Ground	Ground to Ground	Air to Ground	Ground to Ground	Air to Ground	Ground to Ground
200	123.3	123.3	105.0	105.0	120.3	120.3	102.8	102.8
250	121.9	121.9	103.8	103.8	119.2	119.2	101.6	101.6
315	120.4	120.4	102.6	102.6	118.1	118.1	100.3	100.3
400	118.9	118.9	101.2	101.2	117.0	117.0	99.0	98.9
500	117.3	117.3	99.8	99.8	115.9	115.7	97.6	97.5
630	115.6	115.6	98.3	98.2	114.7	114.5	96.1	96.0
600	113.8	113.7	96.8	96.5	113.5	113.1	94.5	94.3
1,000	111.8	111.6	95.1	94.8	112.2	111.7	92.9	92.5
1,250	109.6	109.2	93.4	92.9	110.9	110.1	91.0	90.4
1,600	107.2	106.7	91.5	90.8	109.3	108.1	89.2	88.4
2,000	104.7	103.9	89.5	88.5	107.8	106.2	87.5	86.3
2,500	102.4	101.0	87.2	85.8	106.1	103.5	85.6	83.7
3,150	100.0	98.0	84.8	82.8	104.3	100.6	83.6	80.8
4,000	97.6	94.3	82.1	79.3	102.5	97.3	81.5	77.5
5,000	95.0	90.2	79.5	75.3	100.7	94.3	79.3	73.8
6,300	92.3	85.7	76.8	71.0	98.5	90.5	76.9	69.9
8,000	89.3	81.9	74.0	67.6	96.4	86.9	74.3	66.5
10,000	86.1	77.7	71.0	63.7	94.0	82.8	71.5	62.8
12,500	82.5	73.2	67.7	59.1	91.5	79.1	68.3	58.7
16,000	78.5	68.2	63.9	53.6	88.8	74.8	64.9	53.3
20,000	74.0	62.4	59.7	47.3	85.4	70.0	60.9	47.3
25,000	69.4	55.4	54.9	39.0	81.8	64.5	56.2	39.8

TABLE A-II-9

TABULATION OF EPNL VALUES FOR DIFFERENT AIRCRAFT

Business Jet Aircraft

Aircraft:	Lockheed Jetstar I/C-140 Four PT 12A-6A Turbojet Eng.		Lockheed Jetstar I/C-140 Four PT 12A-6A Turbojet Eng.		North American Sabre 80 Two CF700-2D-2 Turbofan Eng.		North American Sabre 80 Two CF700-2D-2 Turbofan Eng.		North American Sabre 60 Two PT124-8 Turbojet Eng.		North American Sabre 60 Two PT124-8 Turbojet Eng.	
Operation:	Takeoff		Approach		Takeoff		Approach		Takeoff		Approach	
Airspeed:	145 Kt		135 Kt		140 kt.		140 kt.		145 kt.		135 kt.	
Power:	Fn = 2800 lbs.		Fn = 1270 lbs.		Fn = 3450 lbs.		Fn = 865 lbs.		Fn = 2800 lbs.		Fn = 800 lbs.	
	EPNL, dB		EPNL, dB		EPNL, dB		EPNL, dB		EPNL, dB		EPNL, dB	
Distance, ft.	Air to Ground	Ground to Ground	Air to Ground	Ground to Ground	Air to Ground	Ground to Ground	Air to Ground	Ground to Ground	Air to Ground	Ground to Ground	Air to Ground	Ground to Ground
200	123.9	123.9	109.7	109.7	116.4	116.4	104.1	104.1	121.9	121.9	104.7	104.7
250	122.6	122.6	108.5	108.5	114.7	114.7	102.7	102.7	120.6	120.6	103.5	103.5
315	121.2	121.2	107.3	107.3	112.8	112.8	101.2	101.2	119.2	119.2	102.3	102.3
400	119.8	119.8	106.0	106.0	111.0	111.0	99.7	99.7	117.8	117.8	101.0	101.0
500	118.3	118.2	104.7	104.7	109.3	109.3	98.0	98.0	116.3	116.2	99.7	99.7
630	116.7	116.6	103.3	103.2	107.5	107.5	96.2	96.1	114.7	114.6	98.3	98.2
800	115.0	114.8	101.7	101.6	105.4	105.2	94.1	94.0	113.0	112.8	96.7	96.6
1,000	113.1	112.8	100.1	99.9	103.3	103.0	91.8	91.6	111.1	110.8	95.1	94.9
1,250	111.1	110.7	98.4	98.0	101.1	100.5	89.3	89.0	109.1	108.7	93.4	93.0
1,600	109.0	108.3	96.5	96.0	98.7	97.5	86.5	85.9	107.0	106.3	91.5	91.0
2,000	106.8	105.7	94.5	93.7	96.1	94.9	83.3	82.5	104.8	103.7	89.5	88.7
2,500	104.6	102.9	92.2	91.2	93.9	92.1	79.8	78.5	102.6	100.9	97.2	86.2
3,150	102.3	99.7	89.8	88.3	91.4	88.9	76.3	73.9	100.3	97.7	84.8	83.3
4,000	100.0	96.1	86.7	84.6	88.9	84.9	73.0	69.4	98.0	94.1	81.7	79.6
5,000	97.6	91.9	83.5	80.6	86.2	80.5	69.9	64.8	95.6	89.9	78.5	75.6
6,300	94.9	87.4	80.1	76.3	83.6	75.8	66.6	59.8	92.9	85.4	75.1	71.3
8,000	92.0	83.7	77.0	71.9	80.8	71.9	63.7	55.6	90.0	81.7	72.0	66.9
10,000	88.8	79.7	73.9	67.3	77.7	67.7	60.7	50.8	86.8	77.7	68.9	62.3
12,500	85.4	75.3	70.3	61.6	74.5	63.0	57.4	45.0	83.4	73.3	65.3	56.6
16,000	81.8	70.2	66.2	55.7	70.9	57.2	53.7	38.3	79.8	68.2	61.2	50.7
20,000	77.9	64.4	61.5	48.8	66.8	49.8	49.7	26.6	75.9	62.4	56.5	43.8
25,000	73.4	57.5	56.1	37.3	61.8	39.5	44.6	10.0	71.4	55.5	51.1	32.3

TABLE A-II-10

TABULATION OF EPNL VALUES FOR DIFFERENT AIRCRAFT

Aircraft:	4-Engine Turboprop Transport Lockheed Electra, C-130				2-Engine Turboprop Transport with Dart Engines F-27, HS-748				2-Engine Turboprop Aircraft with PT 6 Engines DHC-6 Twin Otter			
Operation: Airspeed: Power:	Takeoff 170 Kt		Approach 140 Kt		Takeoff 140 Kt		Approach 120 Kt		Takeoff 70 Kt		Approach 65 Kt	
	EPNL, dB		EPNL, dB		EPNL, dB		EPNL, dB		EPNL, dB		EPNL, dB	
Distance, ft.	Air to Ground	Ground to Ground	Air to Ground	Ground to Ground	Air to Ground	Ground to Ground	Air to Ground	Ground to Ground	Air to Ground	Ground to Ground	Air to Ground	Ground to Ground
200	104.5	104.5	102.2	102.2	107.4	107.4	107.7	107.7	99.7	99.7	96.3	96.3
250	103.3	103.3	100.9	100.9	106.3	106.3	106.4	106.4	98.5	98.5	95.0	95.0
315	102.2	102.2	99.7	99.7	105.1	105.1	105.0	105.0	97.1	97.1	93.6	93.6
400	101.0	100.9	98.3	98.3	103.9	103.9	103.5	103.4	95.7	95.7	92.1	92.1
500	99.7	99.7	96.9	96.9	102.7	102.7	101.8	101.8	94.3	94.2	90.6	90.5
630	98.4	98.3	95.3	95.3	101.5	101.4	100.0	99.9	92.7	92.6	89.0	88.8
800	97.1	96.9	93.7	93.5	100.2	100.0	98.0	97.8	91.1	90.8	87.2	87.0
1,000	95.7	95.4	91.8	91.5	98.8	98.4	95.8	95.6	89.4	88.9	85.2	85.0
1,250	94.2	93.7	89.9	89.4	97.4	96.7	93.5	93.0	87.7	86.7	83.1	82.7
1,600	92.7	91.9	87.9	87.6	96.0	94.9	90.8	90.1	85.9	84.3	80.8	80.7
2,000	91.1	89.4	85.8	85.2	94.5	92.9	87.9	86.7	84.0	81.6	78.2	77.4
2,500	89.4	86.2	83.5	82.5	92.9	90.0	84.7	82.9	82.1	78.7	75.4	74.3
3,150	87.4	82.8	81.3	79.4	91.2	86.7	81.6	77.7	79.9	75.3	72.5	70.8
4,000	85.3	78.4	79.1	75.5	89.4	82.7	79.0	73.6	77.8	71.6	69.2	66.9
5,000	83.1	74.7	76.8	71.5	87.5	78.4	76.5	69.1	75.5	67.3	65.4	62.0
6,300	80.9	70.7	74.4	67.3	85.4	73.8	73.9	64.2	73.1	62.8	60.9	55.7
8,000	78.5	67.4	71.8	63.9	83.2	71.2	71.1	59.2	70.5	56.6	57.1	49.0
10,000	76.1	63.6	69.0	60.1	80.8	68.2	68.5	53.9	67.7	50.9	53.0	41.6
12,500	73.5	59.6	66.0	56.5	78.1	64.8	65.7	46.8	64.7	43.8	48.0	30.5
16,000	70.8	54.5	62.5	50.4	75.2	61.1	62.6	39.5	60.6	33.4	41.5	
20,000	67.9	48.8	58.6	42.1	71.8	56.6	59.3	26.6	56.1		34.6	
25,000	64.7	41.6	54.4	31.6	66.9	49.0	52.6		50.9		26.2	

TABLE A-II-11

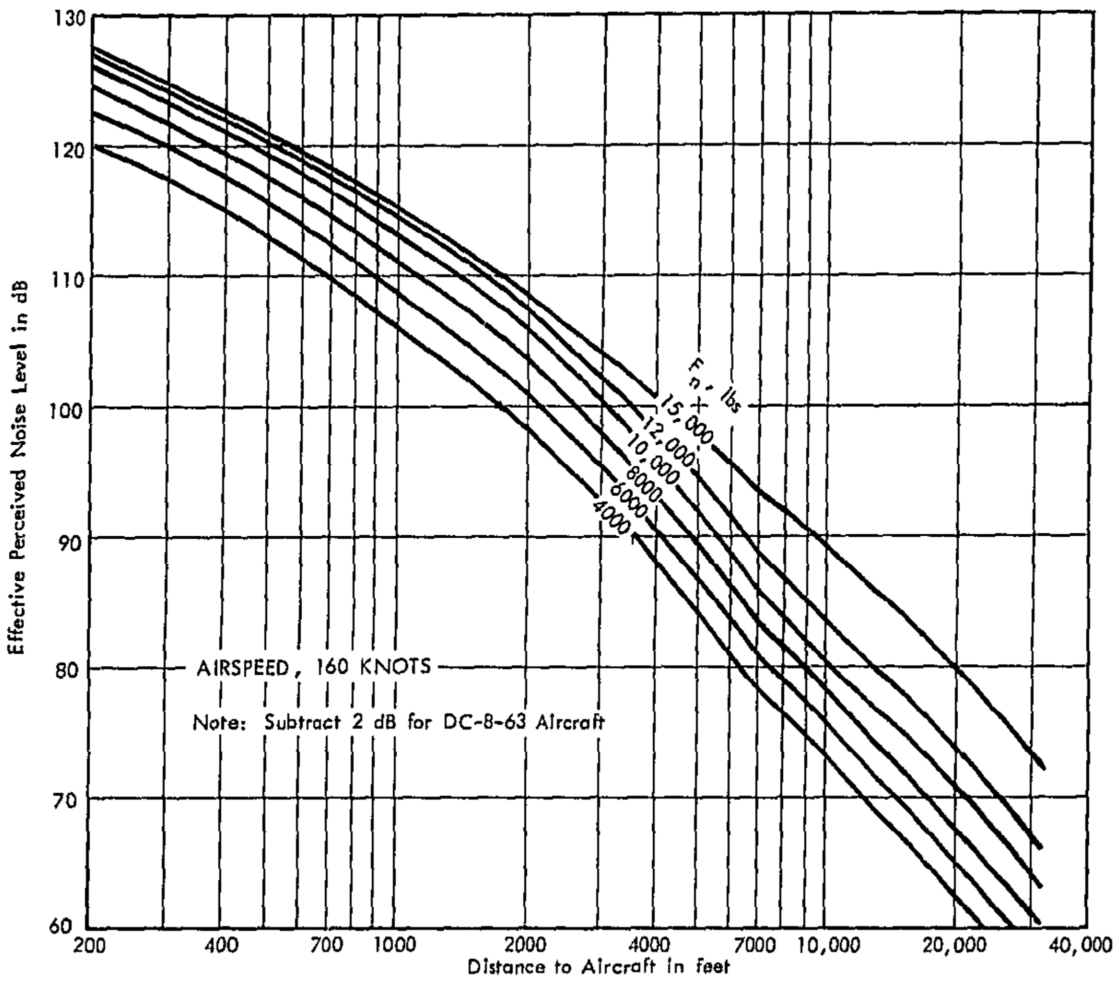
TABULATION OF EPNL VALUES FOR DIFFERENT AIRCRAFT

Aircraft:	4-Engine Piston Transport				2-Engine Piston Transport (>12,500 lbs. Max. Gross Wt.)			
Operation: Airspeed: Power:	Takeoff 140 Kt.		Approach 120 Kt.		Takeoff 140 Kt.		Approach 120 Kt.	
	EPNL, dB		EPNL, dB		EPNL, dB		EPNL, dB	
Distance, ft.	Air to Ground	Ground to Ground	Air to Ground	Ground to Ground	Air to Ground	Ground to Ground	Air to Ground	Ground to Ground
200	111.7	111.7	101.7	101.7	108.7	108.7	98.7	98.7
250	110.6	110.6	100.5	100.5	107.6	107.6	97.5	97.5
315	109.4	109.4	99.3	99.3	106.4	106.4	96.3	96.3
400	108.2	108.2	98.0	98.0	105.2	105.2	95.0	95.0
500	107.0	106.9	96.8	96.7	104.0	103.9	93.8	93.7
630	105.7	105.4	95.4	95.3	102.7	102.4	92.4	92.3
800	104.4	104.0	94.0	93.7	101.4	101.0	91.0	90.7
1,000	103.0	102.4	92.5	92.0	100.0	99.4	89.5	89.0
1,250	101.5	100.5	90.9	90.1	98.5	97.5	87.9	87.1
1,600	100.0	98.6	89.3	88.0	97.0	95.6	86.3	85.0
2,000	98.4	96.4	87.6	85.8	95.4	93.4	84.6	82.8
2,500	96.7	93.5	85.8	82.9	93.7	90.5	82.8	79.9
3,150	95.0	90.4	84.0	79.8	92.0	87.4	81.0	76.8
4,000	93.1	86.8	82.0	76.3	90.1	83.8	79.0	73.3
5,000	91.2	83.3	80.0	72.5	88.2	80.3	77.0	69.5
6,300	89.1	79.8	77.8	68.8	86.1	76.8	74.8	65.8
8,000	86.8	76.3	75.5	65.0	83.8	73.3	72.5	62.0
10,000	84.5	72.9	72.9	61.3	81.5	69.9	69.9	58.3
12,500	81.9	69.3	70.2	57.1	78.9	66.3	67.2	54.1
16,000	79.2	64.9	67.3	52.0	76.2	61.9	64.3	49.0
20,000	76.2	60.4	63.7	44.6	73.2	57.4	60.7	41.6
25,000	72.9	54.4	59.6	35.2	69.9	51.4	56.6	32.2

TABLE A-II-12

TABULATION OF EPNL VALUES FOR DIFFERENT AIRCRAFT

Aircraft:	2-Engine Piston Aircraft (<12,500 lbs. Max. Gross Wt.)				1-Engine Piston Aircraft (180 hp or less)			
Operation:	Takeoff		Approach		Takeoff		Approach	
Airspeed:	110 Kt.		90 Kt.		110 Kt.		90 Kt.	
Power:								
	EPNL, dB		EPNL, dB		EPNL, dB		EPNL, dB	
Distance, ft.	Air to Ground	Ground to Ground	Air to Ground	Ground to Ground	Air to Ground	Ground to Ground	Air to Ground	Ground to Ground
200	97.6	97.6	92.2	92.2	94.6	94.6	89.2	89.2
250	96.5	96.5	91.0	91.0	93.5	93.5	88.0	88.0
315	95.3	95.3	89.8	89.8	92.3	92.3	86.8	86.8
400	94.2	94.2	88.5	88.5	91.2	91.2	85.5	85.5
500	93.0	92.8	87.2	86.9	90.0	89.8	84.2	83.9
630	91.7	91.3	85.8	85.2	88.7	88.3	82.8	82.2
800	90.4	89.9	84.3	83.4	87.4	86.9	81.3	80.4
1,000	89.1	88.3	82.8	81.4	86.1	85.3	79.8	78.4
1,250	87.7	86.5	81.2	79.3	84.7	83.5	78.2	76.3
1,600	86.2	84.6	79.5	76.9	83.2	81.6	76.5	73.9
2,000	84.6	82.3	77.7	74.6	81.6	79.3	74.7	71.6
2,500	83.0	79.6	75.9	71.7	80.0	76.6	72.9	68.7
3,150	81.2	76.3	73.6	68.3	78.2	73.3	70.6	65.3
4,000	79.4	73.0	71.3	64.4	76.4	70.0	68.3	61.4
5,000	77.4	69.5	68.8	60.0	74.4	66.5	65.8	57.0
6,300	75.4	65.9	66.3	54.9	72.4	62.9	63.3	51.9
8,000	73.2	62.1	63.7	49.5	70.2	59.1	60.7	46.5
10,000	70.8	58.1	61.0	44.1	67.8	55.1	58.0	41.1
12,500	68.2	53.8	57.8	37.5	65.2	50.8	54.8	34.5
16,000	65.5	49.0	54.1	28.2	62.5	46.0	51.1	25.2
20,000	62.5	42.6	50.2	18.0	59.5	39.6	47.2	15.0
25,000	58.6	32.5	45.5	8.0	55.6	29.5	42.5	5.0



if L = 100 at 3000'
= 90 at 5500'
SL dist = 4610'

FIGURE A-1 VARIATION IN EFFECTIVE PERCEIVED NOISE LEVELS WITH DISTANCE - FOUR ENGINE LBPR TURBOFAN TRANSPORT AIRCRAFT - 707 AND DC-8 AIRCRAFT WITH JT3D SERIES ENGINES

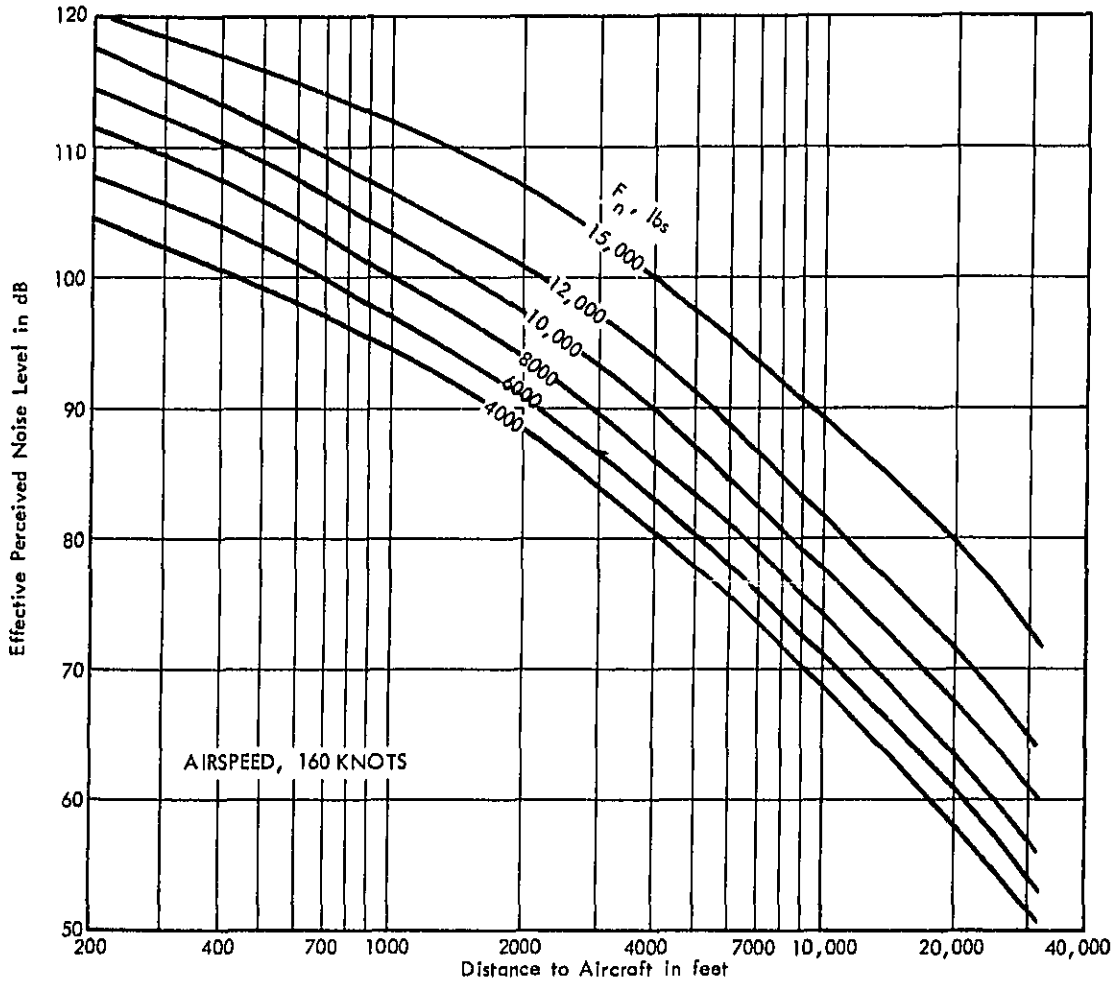


FIGURE A-2 VARIATION IN EFFECTIVE PERCEIVED NOISE LEVELS WITH DISTANCE - FOUR ENGINE LBPR TURBOFAN TRANSPORT AIRCRAFT RETROFIT WITH LINED NACELLES - 707 AND DC-8 AIRCRAFT WITH JT3D SERIES ENGINES

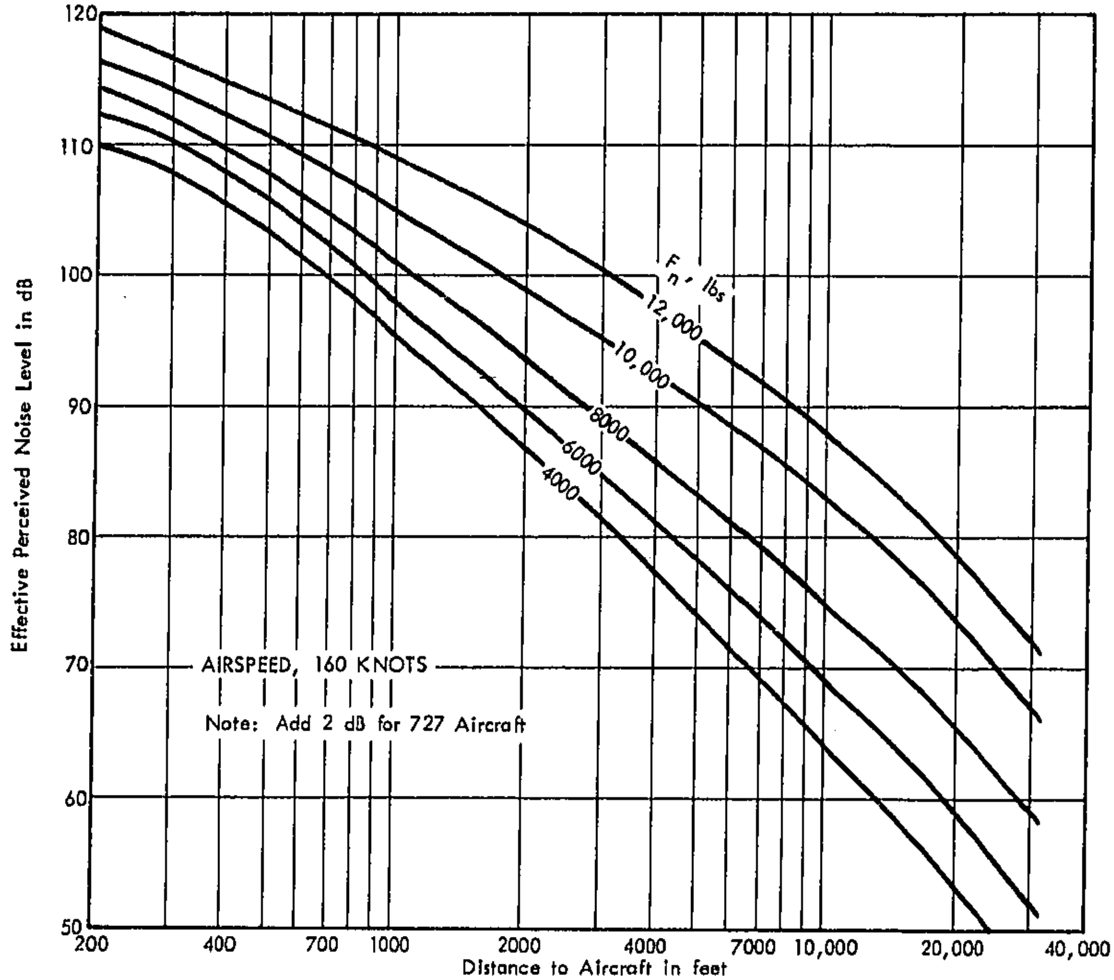


FIGURE A-3 VARIATION IN EFFECTIVE PERCEIVED NOISE LEVELS WITH DISTANCE - TWO AND THREE ENGINE LBPR TURBOFAN TRANSPORT AIRCRAFT - 737, DC-9 AND 727 AIRCRAFT WITH JT8D SERIES ENGINES

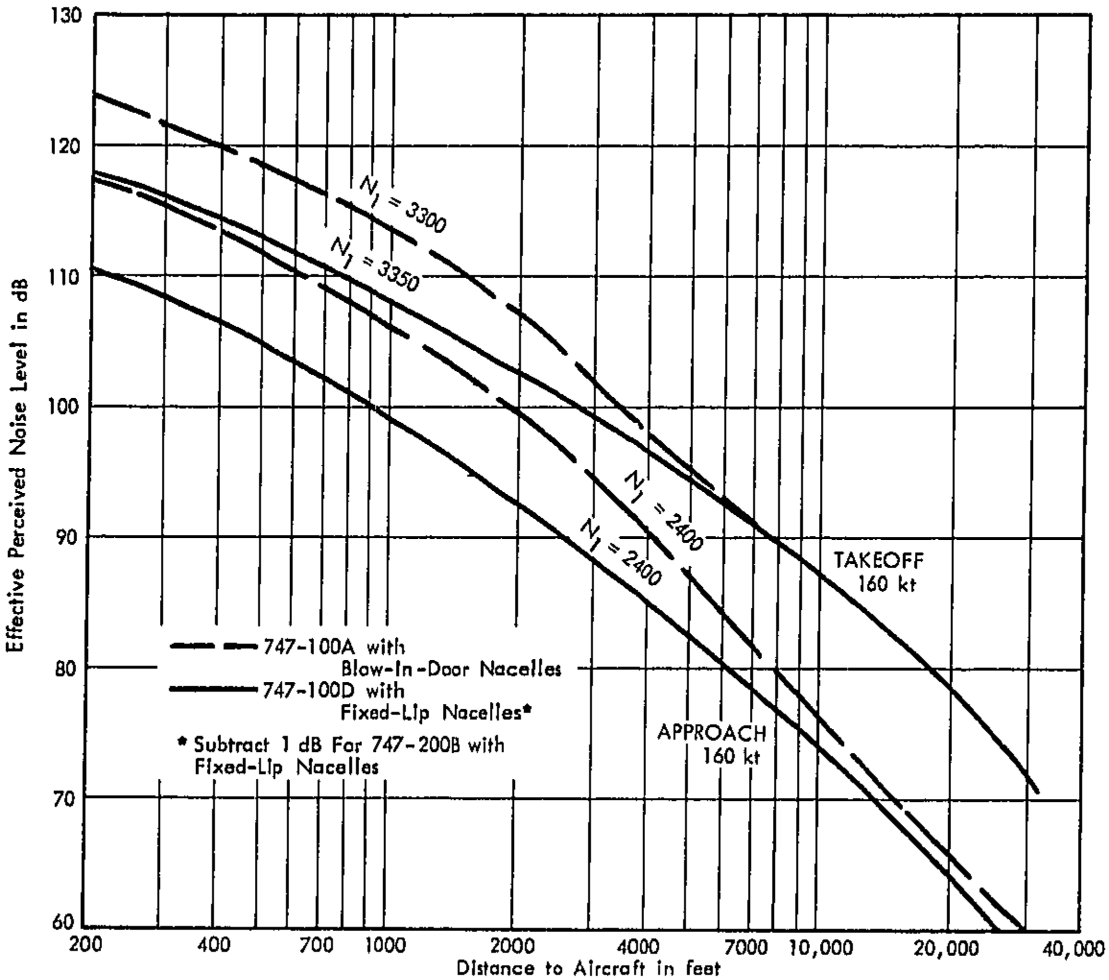


FIGURE A-4 VARIATION IN EFFECTIVE PERCEIVED NOISE LEVELS WITH DISTANCE - FOUR ENGINE HBPR TURBOFAN TRANSPORT AIRCRAFT - 747 AIRCRAFT WITH JT9D SERIES ENGINES

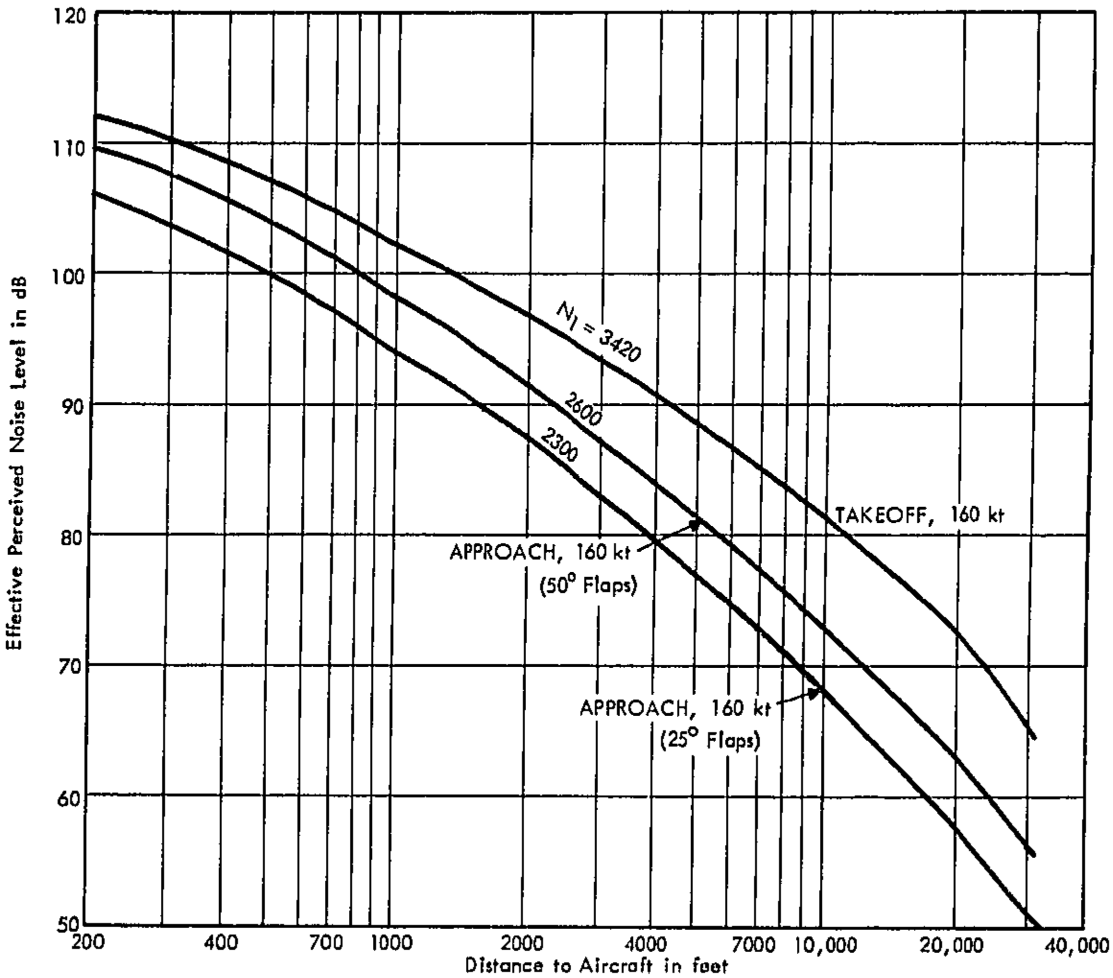


FIGURE A-5 VARIATION IN EFFECTIVE PERCEIVED NOISE LEVELS WITH DISTANCE - THREE ENGINE HBPR TURBOFAN TRANSPORT AIRCRAFT - DC-10 AIRCRAFT WITH CF-6 SERIES ENGINES

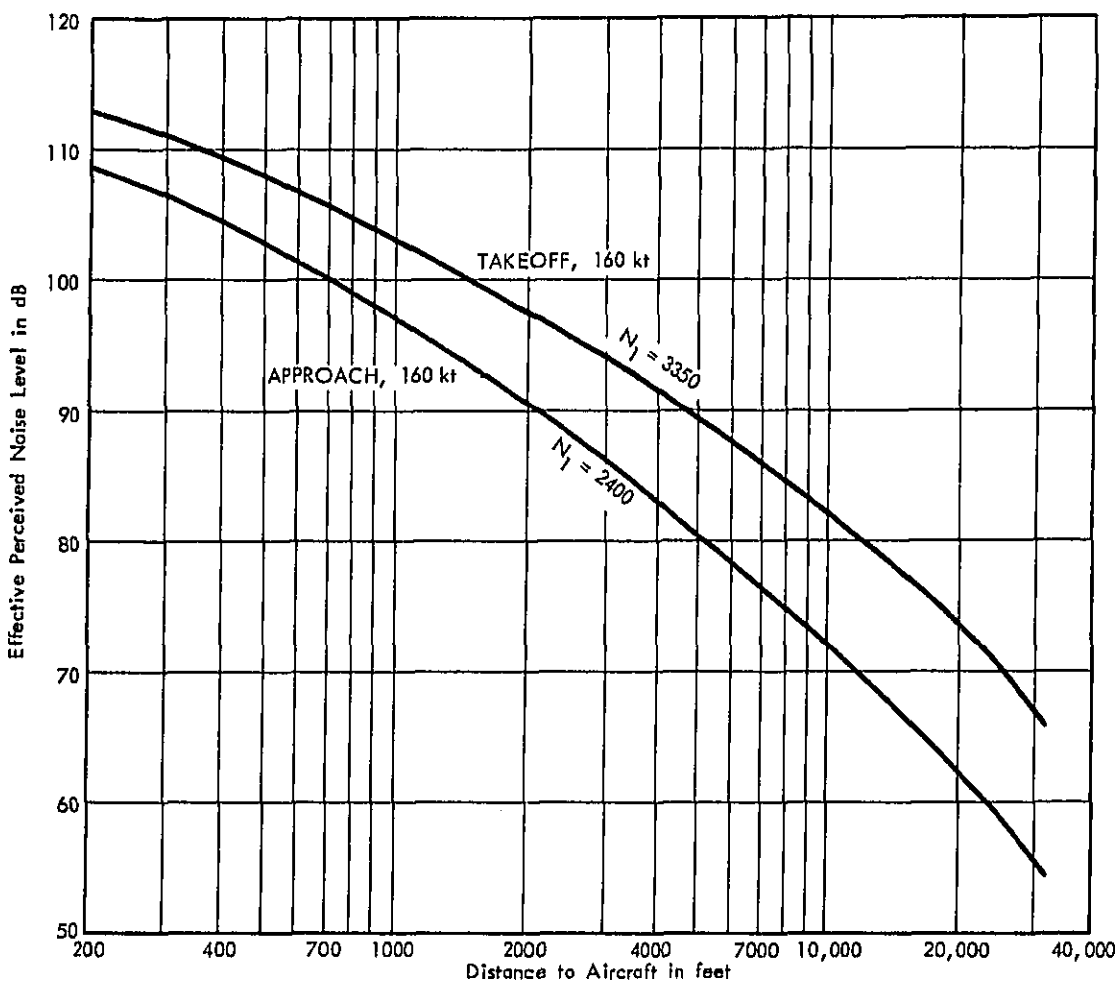


FIGURE A-6 VARIATION IN EFFECTIVE PERCEIVED NOISE LEVELS WITH DISTANCE - THREE ENGINE HBPR TURBOFAN TRANSPORT AIRCRAFT - DC-10 AIRCRAFT WITH JT8D SERIES ENGINES

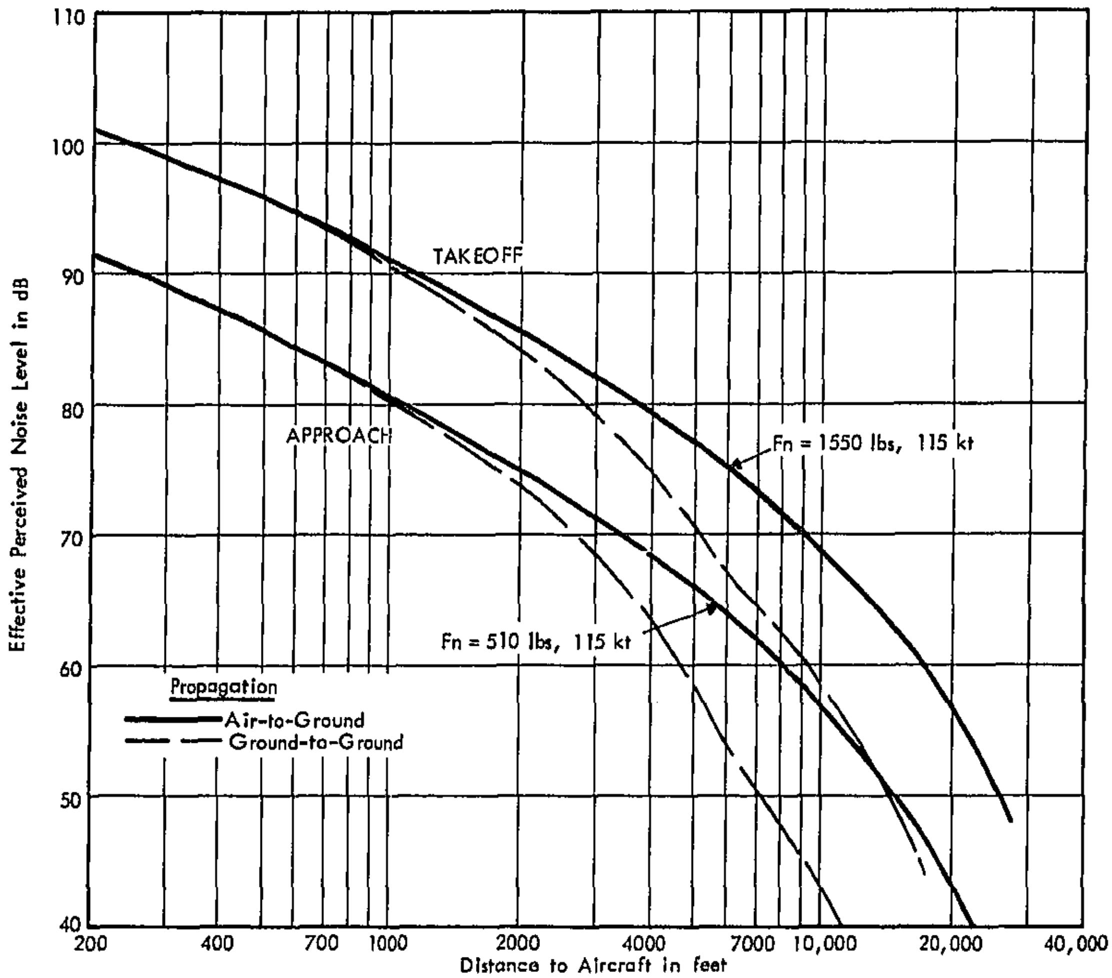


FIGURE A-7 VARIATION IN EFFECTIVE PERCEIVED NOISE LEVELS WITH DISTANCE - BUSINESS JET AIRCRAFT - CESSNA CITATION WITH TWO JT15D-1 TURBOFAN ENGINES

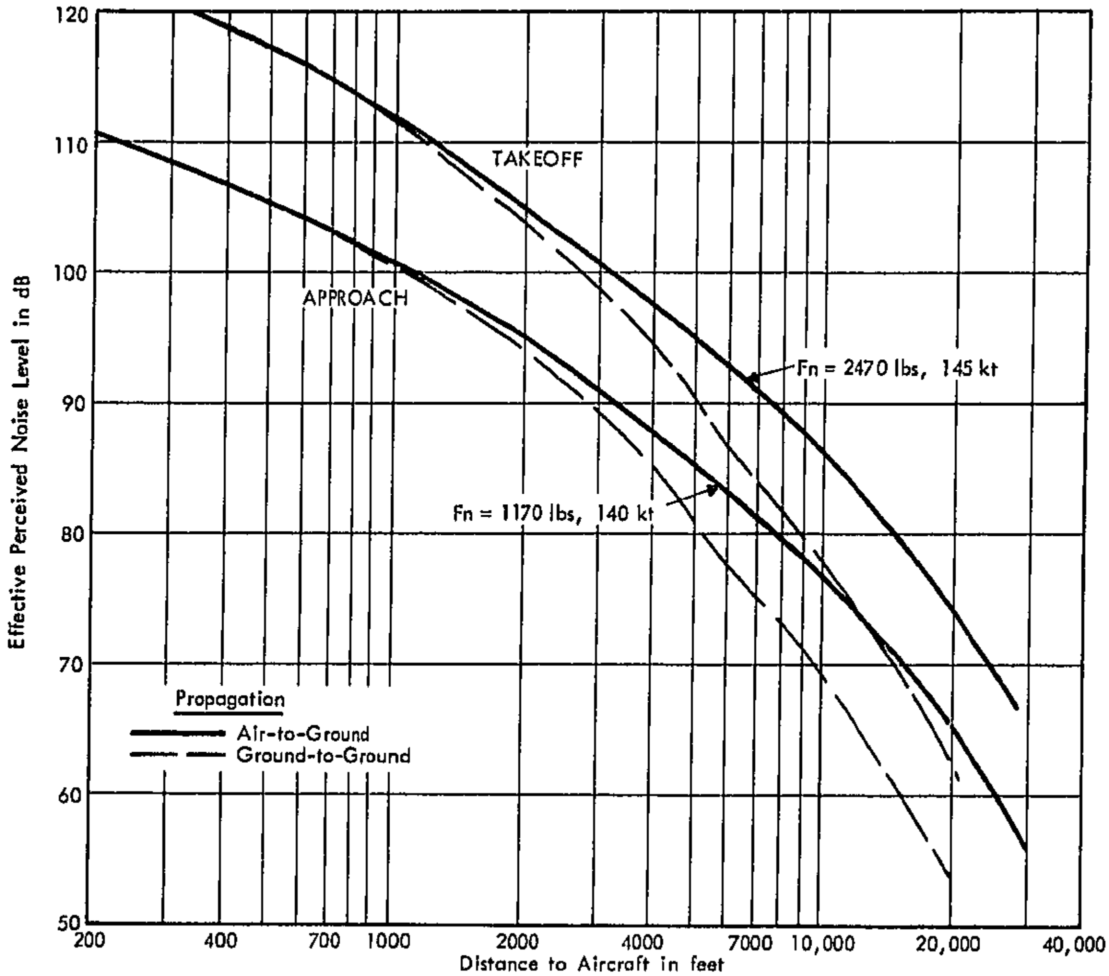


FIGURE A-8 VARIATION IN EFFECTIVE PERCEIVED NOISE LEVELS WITH DISTANCE - BUSINESS JET AIRCRAFT - COMMODORE JET COMMANDER 1121 WITH TWO CJ610-5 TURBOJET ENGINES

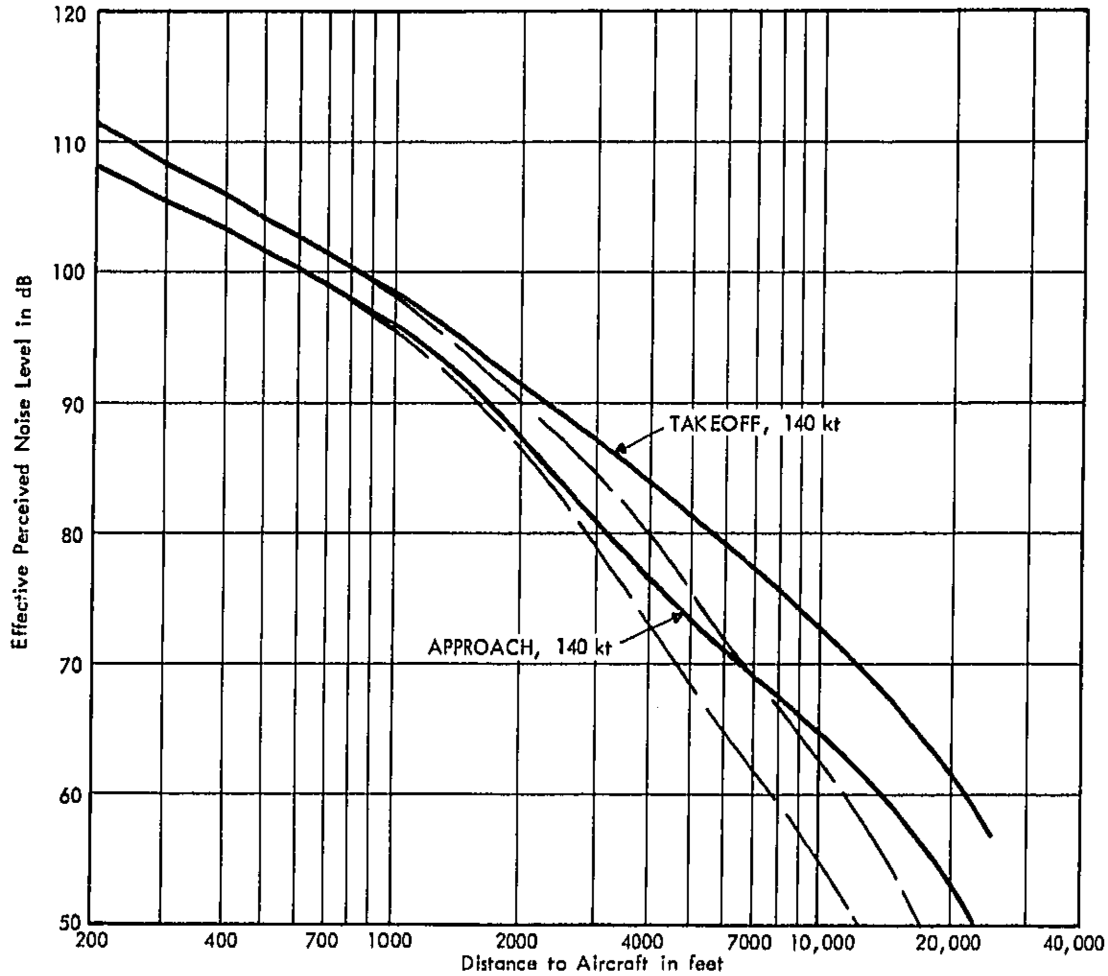


FIGURE A-9 VARIATION IN EFFECTIVE PERCEIVED NOISE LEVELS WITH DISTANCE - DASSAULT FANJET FALCON WITH TWO CJ700-2B TURBOFAN ENGINES

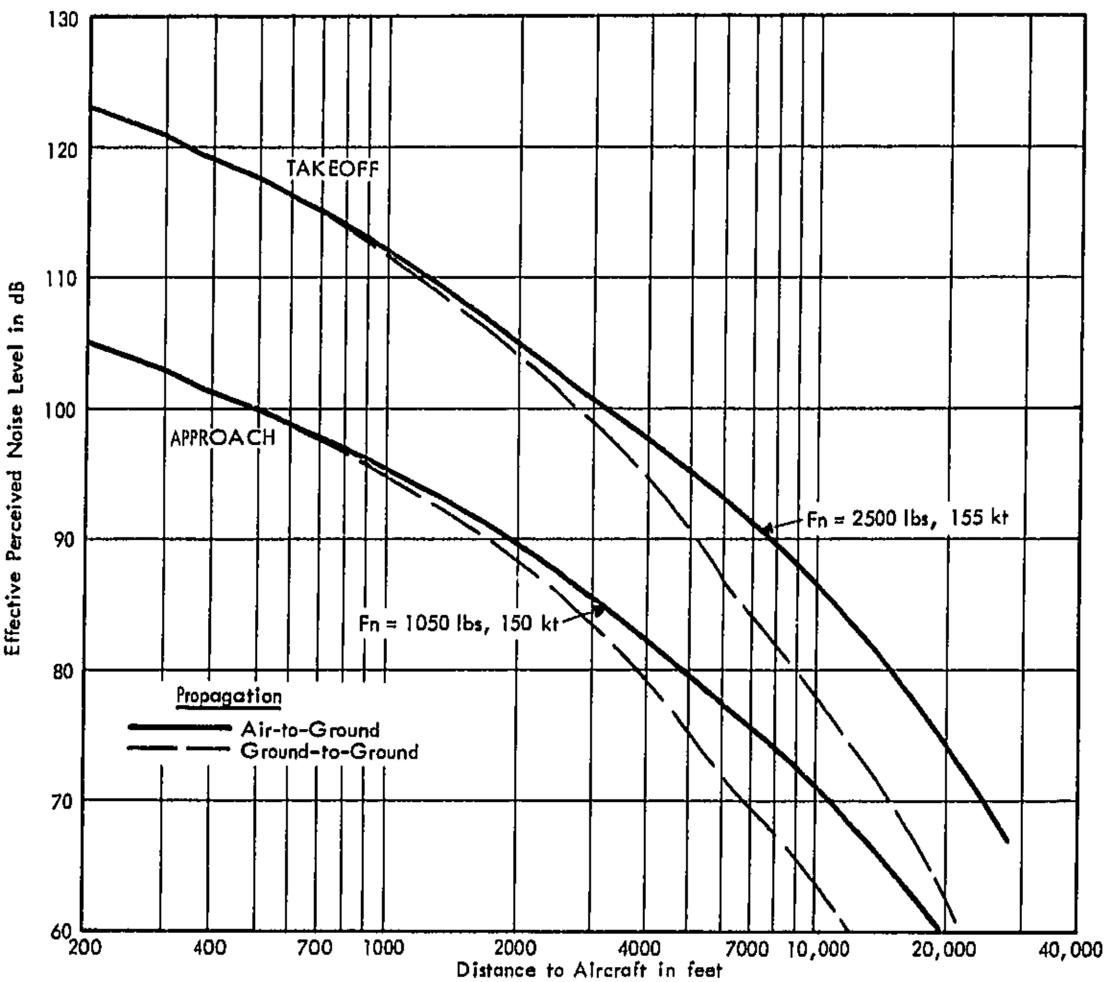


FIGURE A-10 VARIATION IN EFFECTIVE PERCEIVED NOISE - BUSINESS JET AIRCRAFT - GATES LEARJET 24 AND 25 WITH TWO CJ610-6 TURBOJET ENGINES

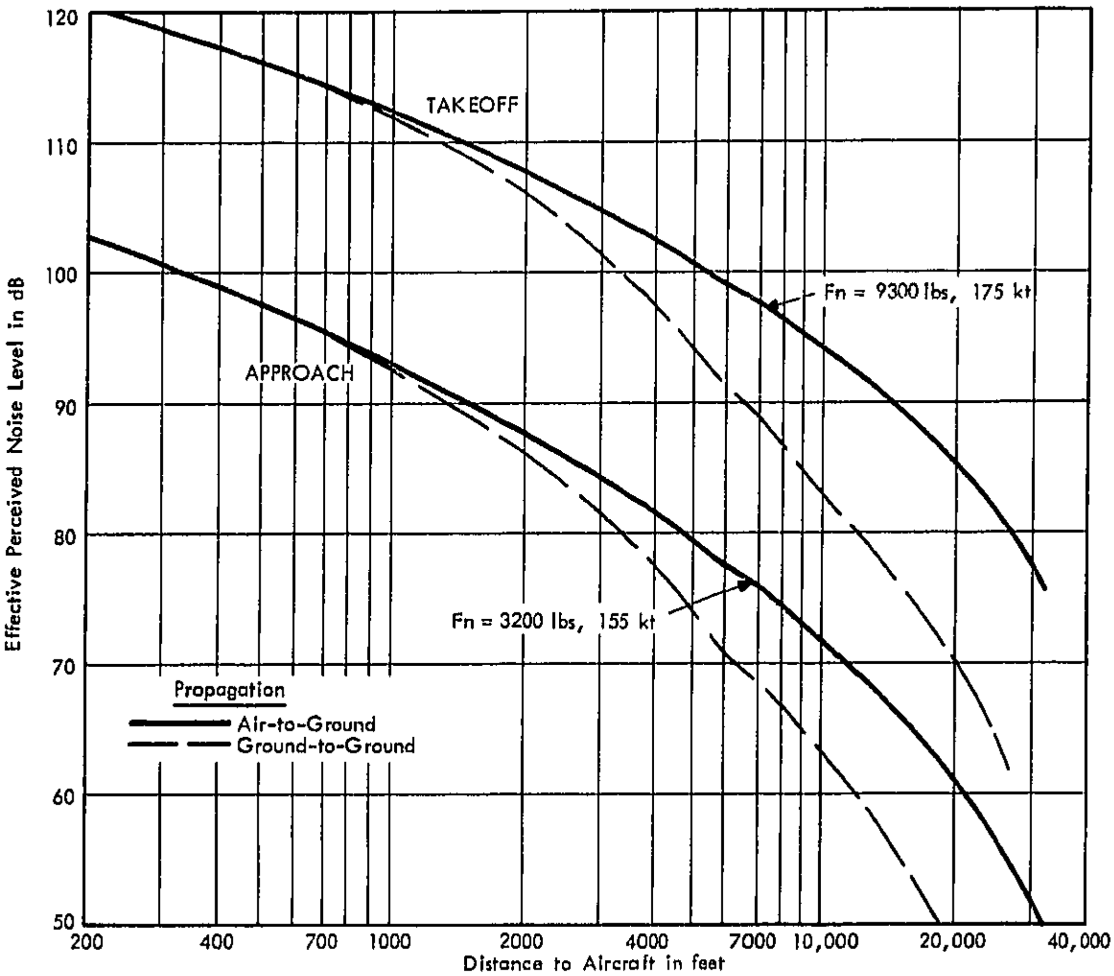


FIGURE A-11 VARIATION IN EFFECTIVE PERCEIVED NOISE LEVELS WITH DISTANCE - BUSINESS JET AIRCRAFT - GRUMMAN GULFSTREAM II WITH TWO SPEY 511-8 TURBOJET ENGINES

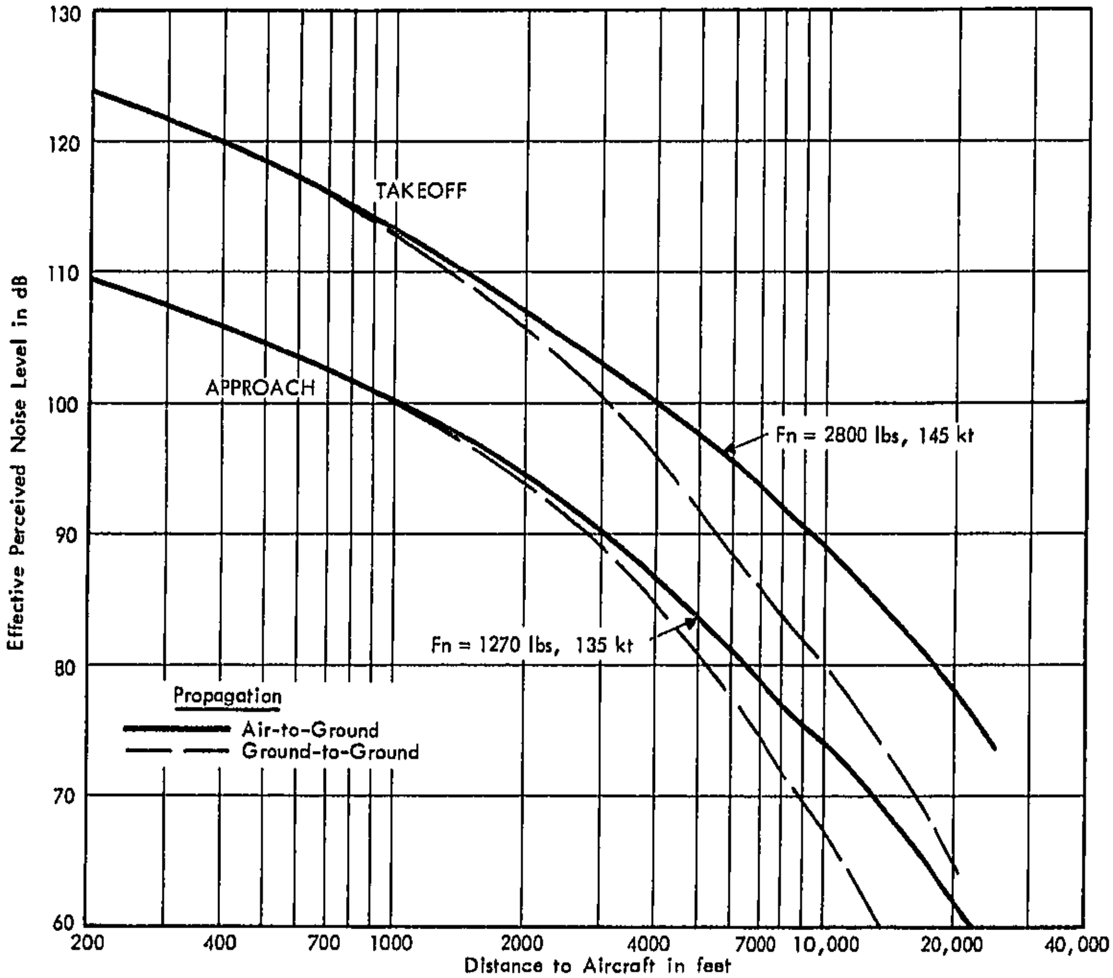


FIGURE A-12 VARIATION IN EFFECTIVE PERCEIVED NOISE LEVELS WITH DISTANCE - BUSINESS JET AIRCRAFT - LOCKHEED JETSTAR I/C-140 WITH FOUR PT 12A-6A TURBOJET ENGINES

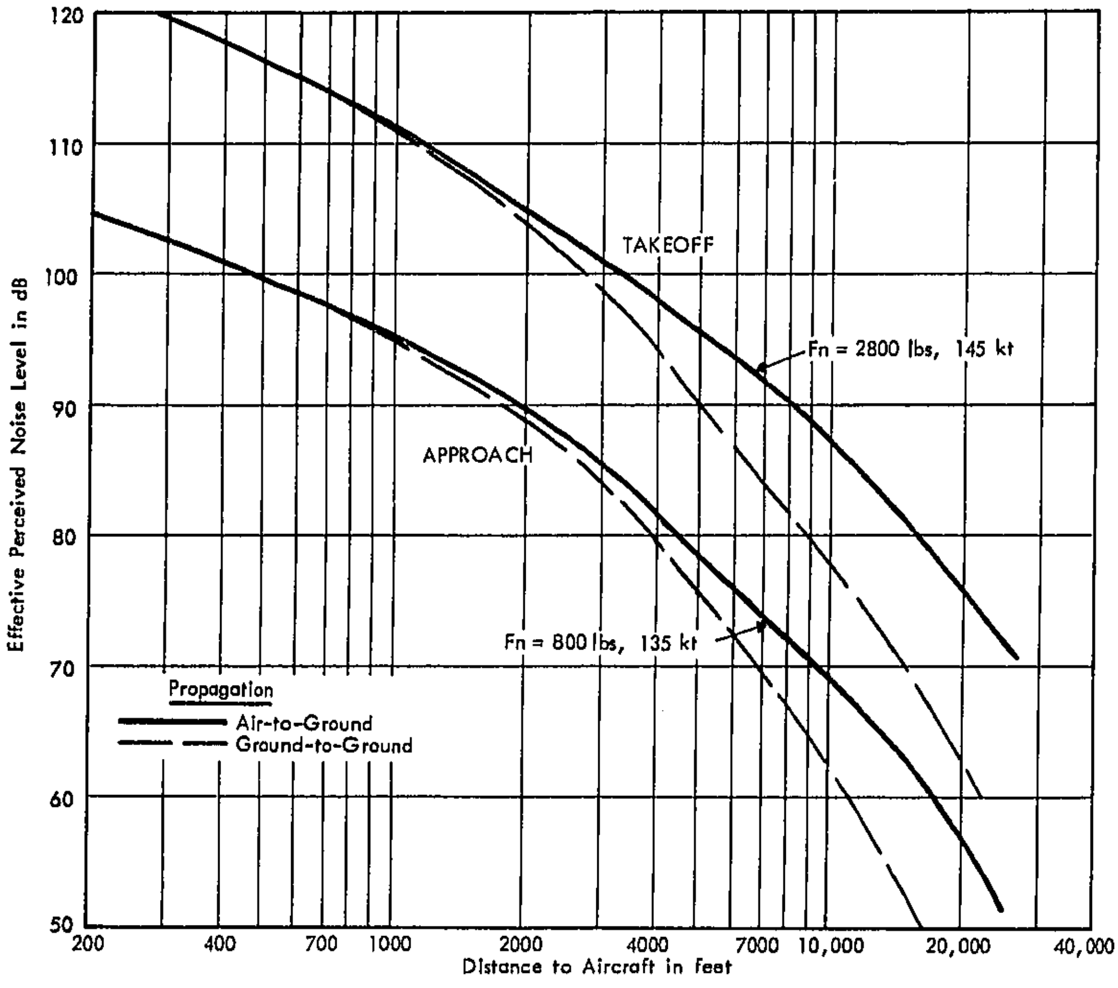


FIGURE A-13 VARIATION IN EFFECTIVE PERCEIVED NOISE LEVELS WITH DISTANCE - BUSINESS JET AIRCRAFT - NORTH AMERICAN SABRE 60 WITH TWO PT12A-8 TURBOJET ENGINES

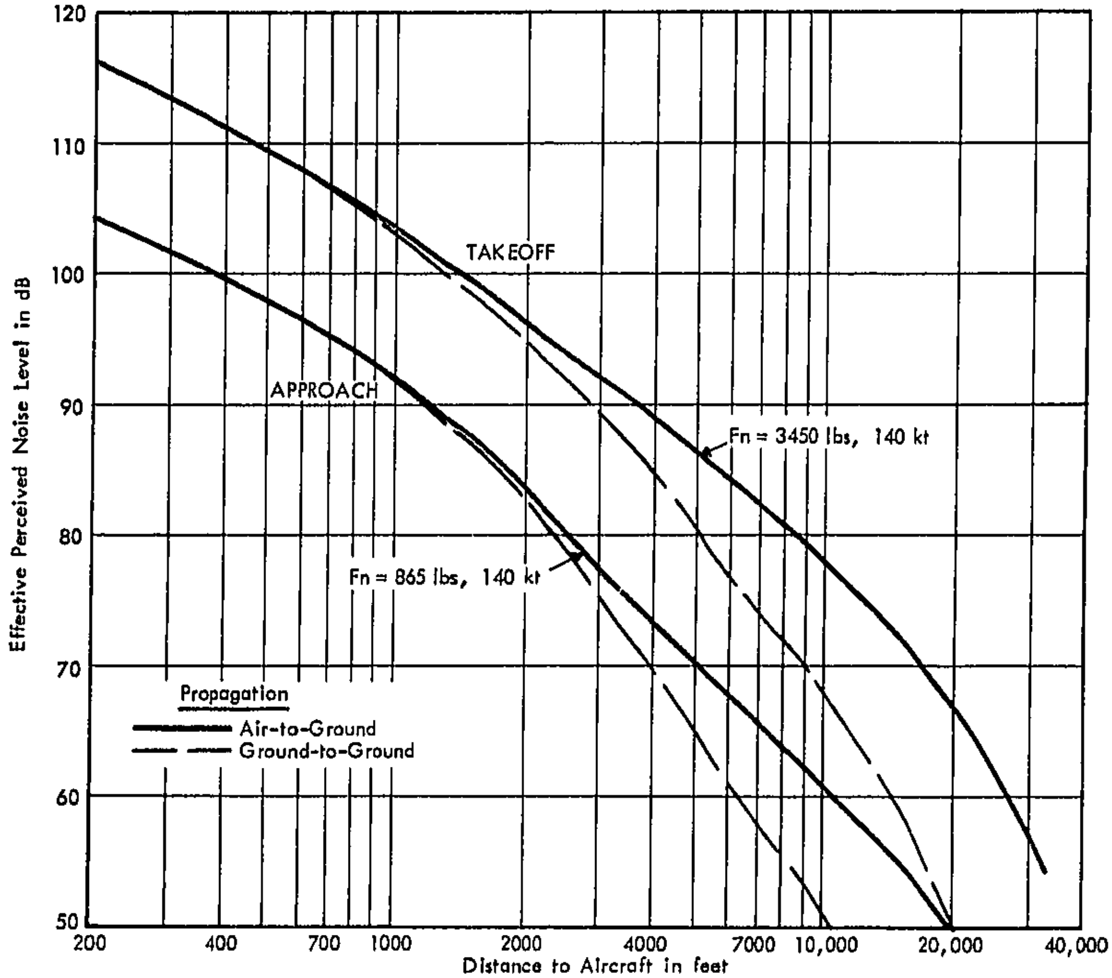


FIGURE A-14 VARIATION IN EFFECTIVE PERCEIVED NOISE LEVELS WITH DISTANCE - BUSINESS JET AIRCRAFT - NORTH AMERICAN SABRE 80 WITH TWO CJ 700-2D-2 TURBOFAN ENGINES

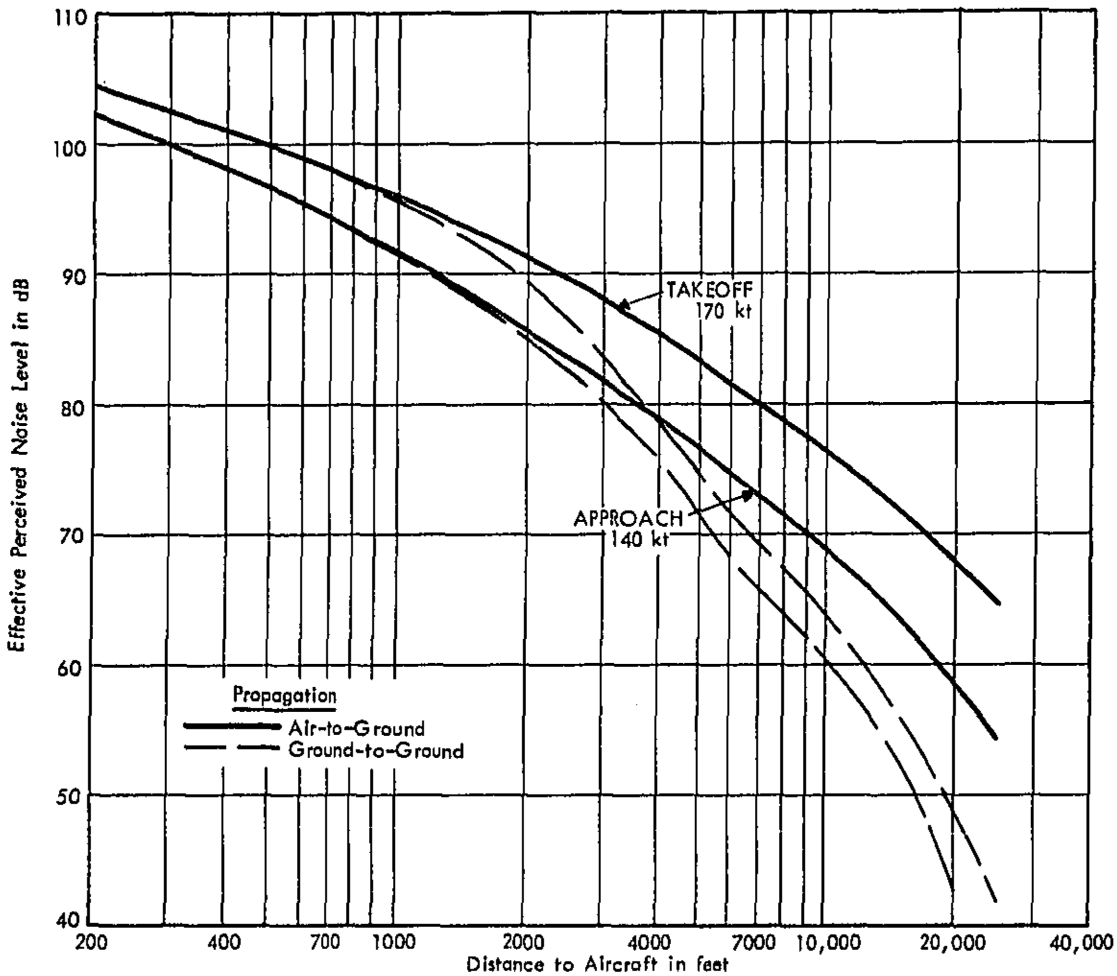


FIGURE A-15 VARIATION IN EFFECTIVE PERCEIVED NOISE LEVELS WITH DISTANCE - FOUR ENGINE TURBOPROP TRANSPORT AIRCRAFT - LOCKHEED ELECTRA, C 130 HERCULES

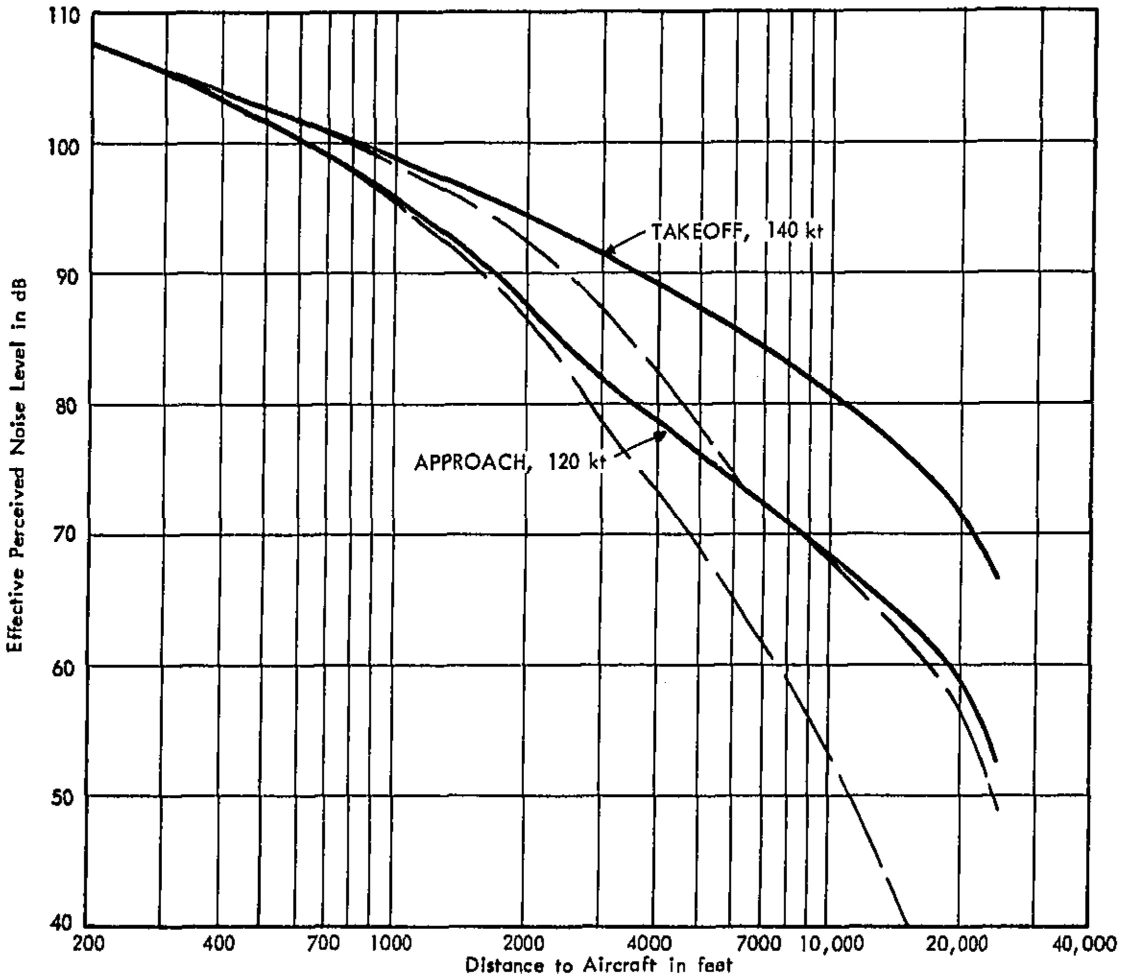


FIGURE A-16 VARIATION IN EFFECTIVE PERCEIVED NOISE LEVELS WITH DISTANCE - TWO ENGINE TURBOPROP AIRCRAFT WITH DART ENGINES (F27, HS 748)

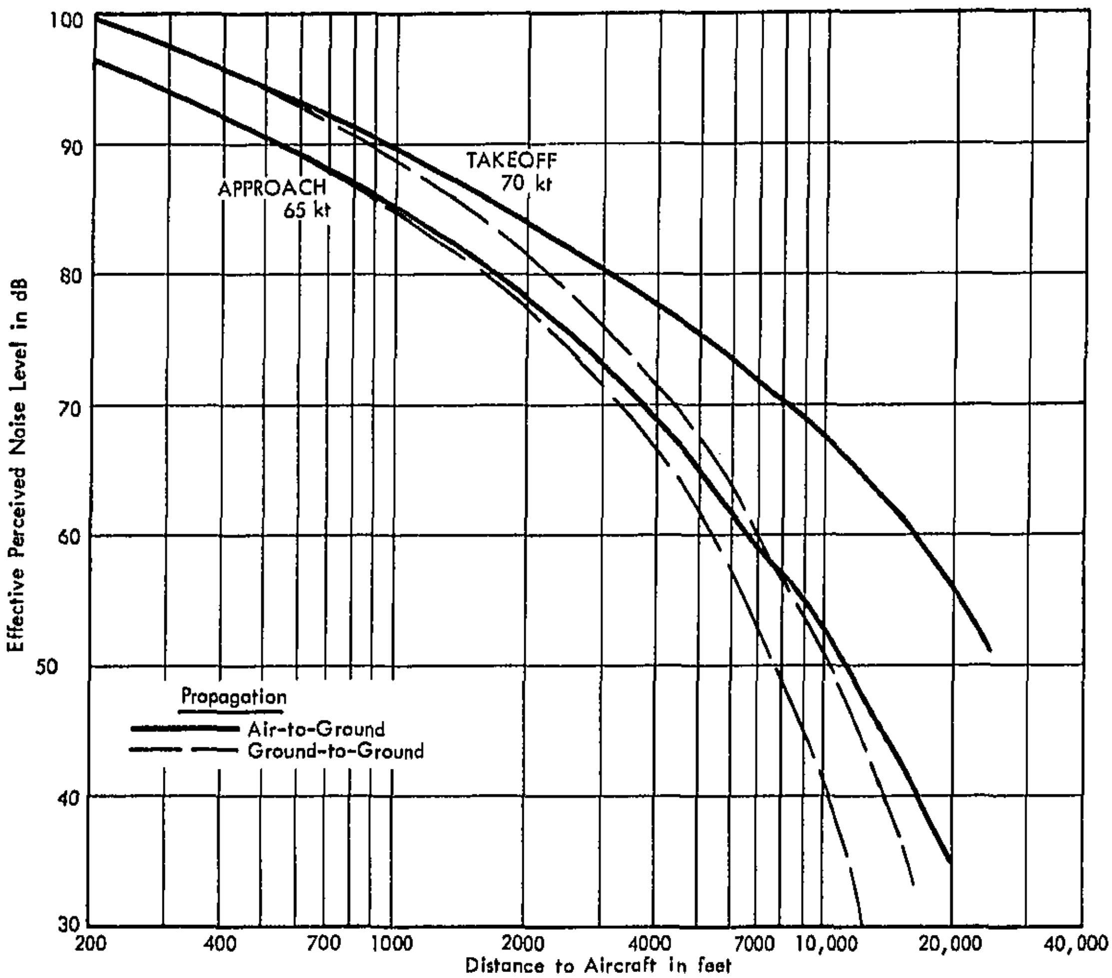


FIGURE A-17 VARIATION IN EFFECTIVE PERCEIVED NOISE LEVELS WITH DISTANCE - TWO ENGINE TURBOPROP AIRCRAFT - DCH-6 TWIN OTTER

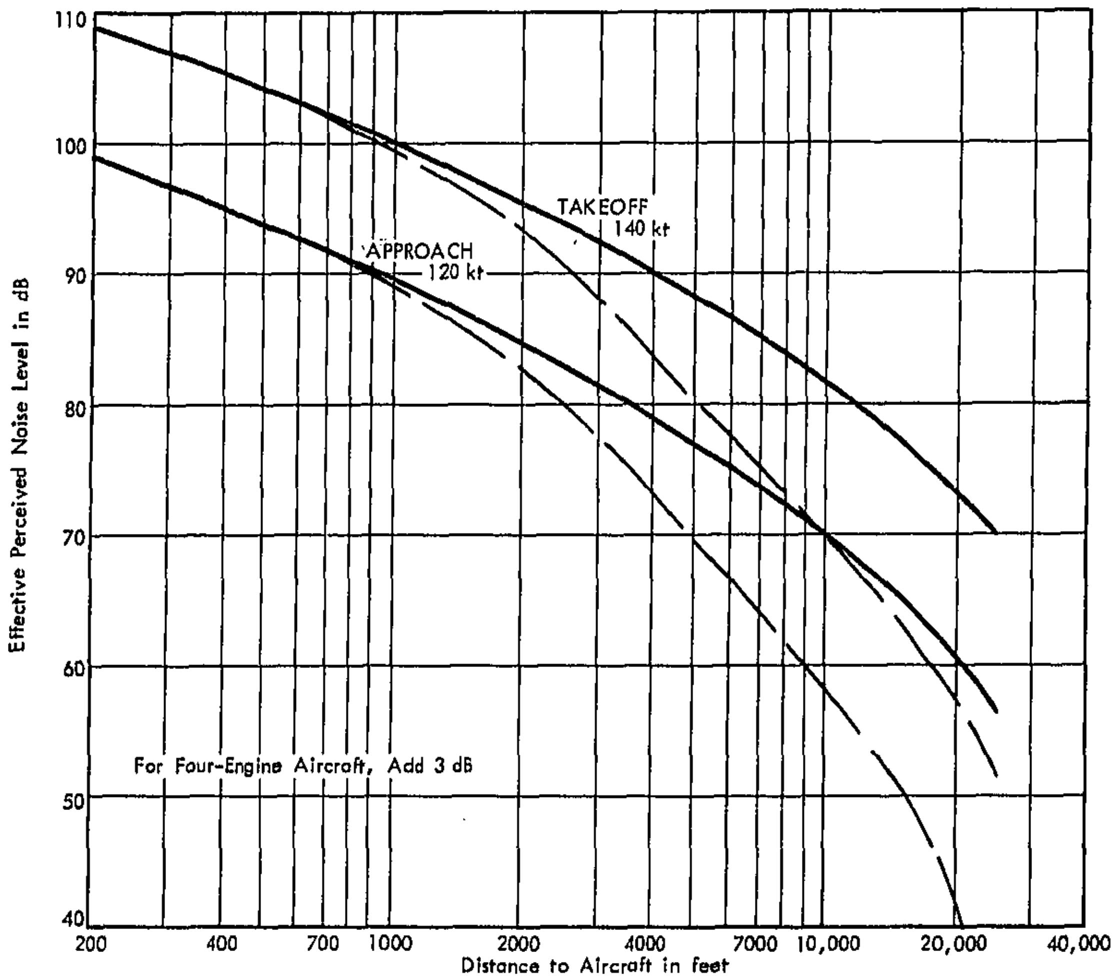


FIGURE A-18 VARIATION IN EFFECTIVE PERCEIVED NOISE LEVELS WITH DISTANCE - TWO ENGINE PISTON TRANSPORT AIRCRAFT (MORE THAT 12,000 LBS MAX GROSS WEIGHT)

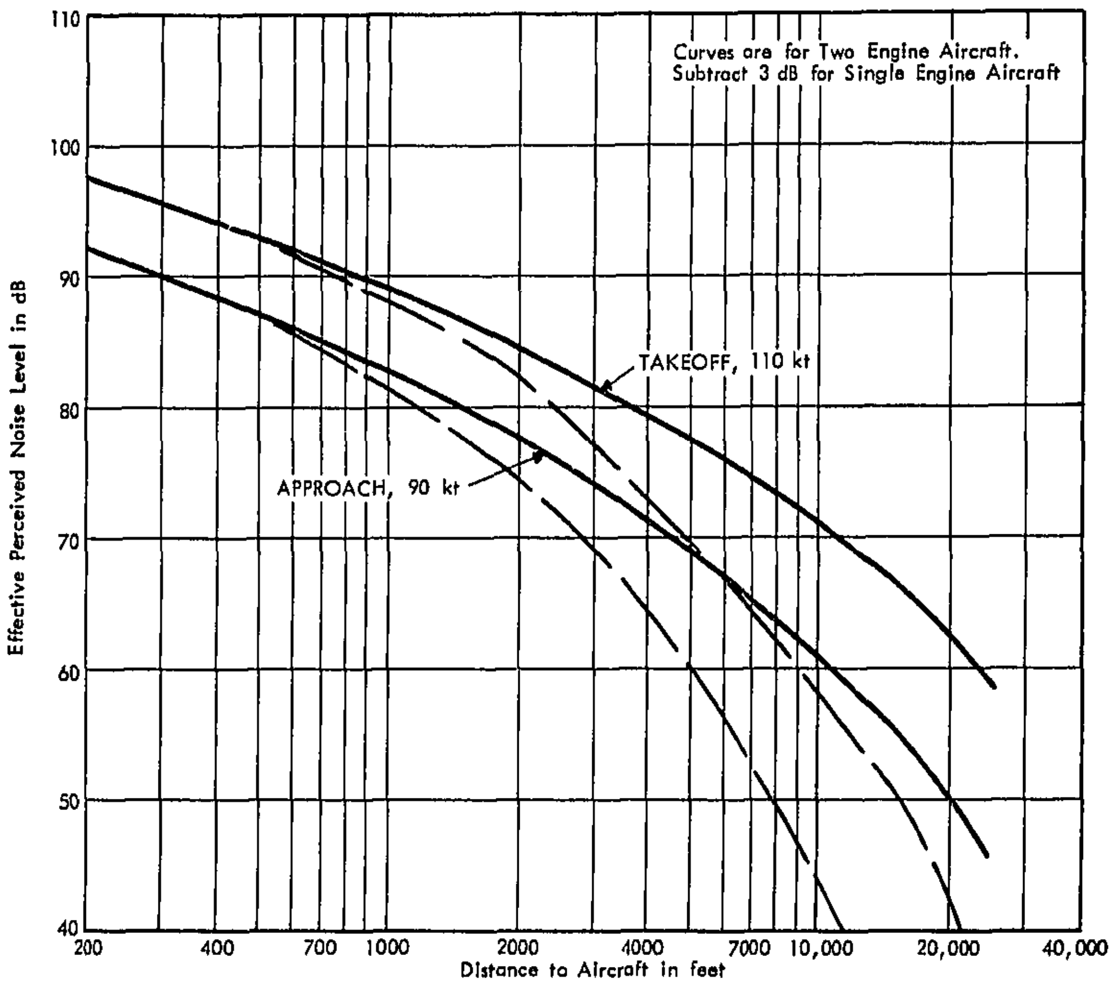


FIGURE A-19 VARIATION IN EFFECTIVE PERCEIVED NOISE LEVELS WITH DISTANCE - ONE AND TWO PISTON ENGINE PROPELLER AIRCRAFT (LESS THAN 12,500 LBS MAX. GROSS WEIGHT)