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AIRCRAFT NOISE DEFINITION. PHASE I. ANALYSIS
OF EXISTING DATA FOR THE DC-8, DC-9 AND DC-10
AIRCRAFT

J. S. Goodman

Douglas Aircraft Company

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PHASE I

ANALYSIS OF EXISTING DATA FOR THE DC-8, DC-9 AND DC-10 AIRCRAFT

J.S. Goodman, et al

Douglas Aircraft Company

McDonnell Douglas Corporation

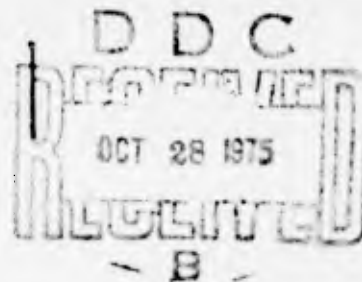
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16. Abstract The efforts in this phase of the "Aircraft Noise Definition" project was comprised of processing and analysis of existing acoustic and performance data and preparing acoustic and performance (based on average engine) graphical and computer presentations for two JT3D turbofan-powered DC-8s, one with short and one with long fan ducts; two DC-9s, one with JT8D-7 and one with JT8D-9 engines; and the DC-10-10 and DC-10-40 aircraft. The acoustic data included reference-day EPNL and peak A-weighted sound level curves with empirically developed curves for adjusting the noise levels to temperatures from 30°F to 100°F with the relative humidity held constant at 70 percent. The performance data include provisions for a temperature variation from 30°F to 100°F and runway altitude from sea level to 6000 feet. Data accuracy is described in terms of assignable confidence limits.					
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ABBREVIATIONS AND SYMBOLS

EPNL	Effective perceived noise level
EPNdB	Unit of effective perceived noise level
FAR	Federal Aviation Regulations
PNLTM	Maximum tone corrected perceived noise level
PNdB	Unit of perceived noise level or tone-corrected perceived noise level
P	Sound pressure
SPL	Sound pressure level, decibels or dB
EPR	Engine pressure ratio
rms	Root mean square
N_1	First fan stage rotational speed, rpm
$N_1/\sqrt{\theta_{T2}}$	First fan stage referred speed, rpm
θ_{T2}	Ratio of total temperature at fan stage face to standard sea level reference temperature of 518.7° Rankine
F_N	Net thrust, pounds
F_N/δ_{amb}	Referred net thrust, pounds
δ_{amb}	Ratio of ambient pressure to standard sea level reference pressure of 29.92 inches of mercury
I	Sound intensity
M	Mach number
V_S	Stall speed, knots
V_2	Second segment airspeed (defined by FAA), knots
°F	Degrees Fahrenheit
RH	Relative humidity, percent
c	Speed of sound, ft/sec
q	Dynamic pressure, lb/ft ²
ρ	Density, slugs/ft ³

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KEAS	Knots equivalent airspeed
KIAS	Knots indicated airspeed
KTAS	Knots true airspeed
C_D	Coefficient of drag
C_{DG}	Coefficient of drag for landing gear
C_{DO}	Coefficient of drag at zero lift
C_I	Induced drag coefficient
C_L	Coefficient of lift
W	Gross weight, pounds

SUMMARY

This report presents graphs and computer programs for utilizing acoustic and aerodynamic performance data of six operating Douglas aircraft. The acoustic data are presented as curves of EPNL and A-weighted sound level as function of slant range at closest point of approach (CPA) of the aircraft for various engine power settings. Combining the acoustic data with the aircraft height and power setting determined from the aerodynamic performance data provides the capability for determining flyover noise levels for each type of aircraft over a broad range of operating and ambient conditions and graphical locations. Noise exposure predictions for aircraft operations at a given airport can be made from these data if the operational procedures, prevailing ambient conditions, and number of flights in a given time period are known.

SECTION 1 INTRODUCTION

The rapid growth in commercial air traffic in recent years has resulted in an increase in human exposure to aircraft noise to the extent of becoming an environmental problem in airport communities. The enactment of Part 36 of the Federal Aviation Regulations placed noise constraints on new aircraft. However, the regulation requires noise measurements for an aircraft at three locations which do not adequately describe the noise impact of the aircraft on the surrounding airport community. To more accurately define the noise impact of each aircraft on a community, it is necessary that detailed information be available that relates the aircraft noise with engine power setting, distance from the aircraft and operational procedures used. To acquire this capability it was necessary for the Federal Aviation Administration to obtain these data from the airframe manufacturers on their respective aircraft.

The FAA Aircraft Noise Definition project requires that the Douglas Aircraft Company provide graphic and computerized acoustic and performance data on six aircraft that are representative of those currently operating. The project has three phases: Phase I, Analysis of Existing Data; Phase II, Minimum Data Acquisition Program, is designed to improve the existing data base as indicated by improved confidence limits; and Phase III, Expanded Data Program Plan is a plan to further improve the confidence limits. This document reports the results of Phase I, Analysis of Existing Data, for the DC-8, DC-9, and DC-10 aircraft. These data were obtained during various flight test programs conducted in prior years.

Section 2 presents data for the following configurations: (1) the DC-8-61 with short-fan-duct JT3D-3B engines, (2) the DC-8-63 with long-fan-duct JT3D-7 engines, (3) the DC-9-30 with JT8D-7 engines, (4) the DC-9-30 with JT8D-9 engines, (5) the DC-10-10 with CF6-6D engines, and (6) the DC-10-40 with JT9D-20 engines. Each configuration is treated in a separate section comprising specific aircraft and engine information with the noise and performance charts. Descriptions of the test programs from which these data were obtained are not within the scope of this report but are referenced in the text where available.

Section 3 presents correction curves for adjusting reference-day noise levels to temperatures ranging from 30° to 100°F with the relative humidity held constant at 70 percent. An airport altitude correction curve is also provided.

An analysis of the data accuracy is described, and appropriate confidence limits are established in Section 4.

SECTION 2

ACOUSTIC AND PERFORMANCE DATA

2.1 GENERAL DESCRIPTION

2.1.1 Acoustic Data

The noise levels presented in this report are based on the best data available to the Douglas Aircraft Company.

The acoustic data are presented as curves of reference-day (77°F, 70 percent humidity) effective perceived noise level (EPNL) and peak A-weighted sound level (maximum A-weighted sound level during flyover) versus slant range at closest point of approach for several power settings ranging from takeoff thrust to typical approach thrusts for a 3-degree glide slope. An additional power setting for a steep approach (2000 pounds) is included for the DC-9-30 with JT8D-9 engines based on measured data. The curves extend from 200 feet to levels of 80 EPNdB or 65 dB(A) or to 10,000 feet, using extrapolation where necessary. Ground attenuation is not included in the above curves and must be added where the sideline distance from the flight path is large compared to the aircraft distance above ground level.

Slant range at closest point of approach (CPA) is used in this report to identify the aircraft distance with the aircraft noise during flyover. The term denotes the minimum distance of the aircraft to the observer in contrast to the distance directly overhead, also called altitude or height about runway. The latter term is used in the takeoff performance charts to denote perpendicular distance above ground level. The terms geometric and pressure altitude denote the perpendicular distance above sea level. Figure F-1 in Appendix F provides a chart for determining the slant range distance to the aircraft when it does not pass directly overhead, using height above ground level and sideline distance.

Power settings for the DC-8 and DC-9 aircraft are identified by referred thrust (F_N / δ_{amb}); approach power settings are also identified by referred fan speed ($N_1 / \sqrt{\theta T_2}$), to be compatible with the approach performance charts. Power settings for the DC-10 acoustic data are in terms of referred fan speed only. Linear interpolation may be used for determining noise levels at intermediate power settings.

Computer programs were used to process the flyover noise data in terms of reference-day, EPNLs and peak A-weighted sound levels. The EPNL data were adjusted to reference airspeeds appropriate for the power setting and aircraft, as noted for each set of curves. The correction applied to each data point was determined using the relation $\Delta\text{EPNL} = 10 \log_{10} (V_{\text{TEST}}/V_{\text{REF}})$. Reference airspeed, V_{REF} , is discussed in a later section. Power setting adjustments were made to both EPNLs and A-weighted levels to normalize each data point of a group of points, at approximately the same thrust, to the average thrust of the group. The adjusted acoustic data were plotted as noise level versus distance in groups comprising data of one power setting, and a least-squares curve was faired through the data points. Cross-plots were made at selected slant ranges to provide the means for plotting at the desired thrust settings, for curve smoothing and extrapolation. Details of this procedure are described in Appendix A.

2.1.2 Performance Data

2.1.2.1 All Engine Flight-Path Charts - Charts are presented that depict aircraft height above runway (to 3000 feet) versus distance from brake release as a function of takeoff gross weight. Corrections are included for headwinds up to 30 knots, temperatures from 30° to 100°F , and air conditioning packs on or off. Separate charts are presented for airport altitudes of sea level, 3000 feet, and 6000 feet. The climb speed is $V_2 + 10$ knots for all aircraft. Separate charts are presented for each of two flap settings for the DC-8 and DC-9 aircraft. Flap position is shown on a correction grid for the DC-10 aircraft. Another set of flight-path charts is presented for the DC-9 aircraft with a pitch limit of 15 degrees.

2.1.2.2 Thrust Required at Cutback - Charts are presented that show the thrust required at cutback during takeoff as a function of gross weight, climb gradient, geometric altitude, and airspeed. All thrusts are based on performance of an average engine. Separate charts are presented for each of two flap settings for the DC-8 and DC-9 aircraft. A correction grid for flap position is included on the DC-10 charts. An additional cutback chart for a clean airplane configuration is provided for the six aircraft models using a constant indicated airspeed of 250 knots. The thrust required is shown in terms of referred thrust ($F_N/\epsilon_{\text{amb}}$) for the DC-8 and DC-9 aircraft and in terms of percent referred fan speed ($N_1/\sqrt{\theta T_2}$) for the DC-10 aircraft.

2.1.2.3 Approach Glide Slope Charts - Charts are presented that show referred fan speed versus glide slope from 2.5 to 6 degrees for various gross weights, airspeeds, and airplane pressure altitudes for certified flap settings. Included on each chart is the variation of geometric height with pressure height for temperatures from -40 to +40 F. The plot at the upper right of each chart shows the equivalent airspeeds as a function of gross weight at $1.3 V_S$, $1.3 V_S + 10$, $1.3 V_S + 20$, and $1.3 V_S + 30$ knots. Separate charts are presented for flaps full down at 50 degrees for each airplane. For the DC-10 airplanes, an alternate landing flap of 35 degrees is also included. All data are for the landing gear extended. A warning horn is activated if the gear is retracted when the airplane is in a landing configuration.

Provision is made in Appendix B for determining the power setting required for a 0-degree glide slope. Drag polars are given for each model which relate lift to drag along with other data which, used with the calculation procedure provided, permit calculation of the thrust required. A term for gear drag is also included for determining the thrust required with gear up or down.

2.1.3 Reference Airspeeds

The reference airspeeds used for each aircraft are representative of those that would be used for Part 36 noise certification which associates them with maximum takeoff or landing gross weights and a specific flap setting. Based on reference-day conditions, the DC-8 and DC-10 reference takeoff airspeeds are about 0.27 M and for the DC-9 about 0.25 M. The takeoff Mach number for the heavier DC-10-40 is 0.3. Reference approach airspeeds are 0.22 to 0.24 M for the DC-8 and DC-10 aircraft and 0.2 M for the DC-9 aircraft. Table 1 shows the reference airspeeds used and the difference between the takeoff and approach airspeeds in terms of $\Delta EPNL$.

For most operations the takeoff or approach gross weight of the aircraft will be less than the maximum certified weight and the resulting airspeed will be less than shown in Table 1. The airspeed correction is: $\Delta EPNL = -10 \log_{10} (V_{ANY}/V_{REF})$, where V_{ANY} is the operational airspeed. This correction is applied to the value of the EPNL obtained from the EPNL map. Should the thrust level fall in the transition range between takeoff and approach thrusts, appropriate adjustment to the noise curve is required before the interpolation

TABLE 1
REFERENCE AIRSPEEDS

Aircraft	Airspeed		$\Delta \text{EPNL} = (10 \text{ Log}_{10} \frac{V_{\text{T.O.}}}{V_{\text{APP}}})$ (EPNdB)
	Takeoff KTAS	Approach KTAS	
DC-8-61	180	155	0.6
DC-8-63	190	155	0.9
DC-9-30/JT8D-7	170	140	0.8
DC-9-30/JT8D-9	165	140	0.7
DC-10-10	180	150	0.8
DC-10-40	200	160	1.0

is performed. The transition range for the DC-8 and DC-9 aircraft is between 6000 and 8000 pounds and for the DC-10 aircraft, between 2600 and 3000 rpm. If, for example, the DC-8-61 were in a climb at 7500 pounds thrust, the value of the 6000-pound thrust curve would be decreased by 0.6 EPNdB before interpolation is performed. If the airplane were in an approach, the 0.6 EPNdB would be added to the 8000-pound curve before interpolation is performed.

The power setting will usually fall within the takeoff or approach airspeed range, and the airspeed correction applied to the curve value of EPNL is calculated as indicated above if the true airspeed is known, otherwise it is obtained from Figure F-2 in Appendix F. This chart provides a correction, in EPNdB, that is based on inputs of aircraft speed, pressure altitude, and reference airspeed. The aircraft speed must be indicated or equivalent airspeed (IAS or EAS). The difference between these airspeeds is the sum of (1) the position error (due to location of the sensing device on the aircraft), (2) the instrument error, and (3) the compressibility factor. At low Mach numbers and altitudes the total difference between indicated and equivalent airspeed is rarely more than 5 knots which translates to about 0.1 EPNdB. The airspeed for takeoff may be found in the appropriate FAA manual for each aircraft. The approach airspeeds are noted on the approach-glide slope charts.

2.1.4 Engine Parameters

Charts relating referred thrust, fan speed, and engine pressure ratio (EPR) for various Mach numbers follow the aerodynamic performance data. (EPR is not shown for the CF6-6D engine since $N_1/\sqrt{\theta_{T2}}$ was established as the parameter best relating to thrust and to the noise output). These are generalized curves applicable for altitudes within the flight envelope of each aircraft. The charts showing $N_1/\sqrt{\theta_{T2}}$ are provided with a notation to indicate flight idle, the lower thrust limit. To assist in the use of these curves, curves of ϕ_{amb} (Figure F-3) versus geometric altitude and total air temperature versus $\sqrt{\theta_{T2}}$ (Figure F-4) are provided in Appendix F.

2.2 COMPUTER PROGRAMS

2.2.1 Acoustics

A computer program D3AA, was developed to provide EPNL and A-weighted sound level for an input of slant range and thrust setting. Where the observer or measuring point is located on a sideline position relative to the flight path and the aircraft height above ground level is known, the slant range must first be determined from Figure F-1 in Appendix F. A description of the program is found in Appendix C.

2.2.2 Performance

Computer programs F2SA and A8RA, which were developed by Douglas to provide performance data. F2SA, described in Appendix D, provide the altitude for all-engine takeoff and the required thrust, where cutback is used, for various operating and ambient conditions. Program A8RA provides altitude and thrust data for various landing-approach guideslopes and is described in Appendix E.

2.3 DC-8-55/61

2.3.1 Aircraft Description

The DC-8-61, shown in Figure 1, is one of the stretched versions of the DC-8 fan-jets powered by four Pratt and Whitney Aircraft JT3D-3B engines in the short fan-duct configuration. Figure 2 presents a dimensioned three-view drawing of the aircraft. The maximum gross weights are 325,000 pounds for takeoff and 240,000 pounds for landing. The seating capacity (high density) is 252.

The JT3D-3B engine is rated at 18,000 pounds, flat rated to 84⁰F and has a bypass ratio of 1.3.

2.3.2 Acoustic Data

The EPNL and peak A-weighted sound levels are presented in Figures 3 and 4, respectively for seven power settings. Power settings are defined in terms of referred net thrust and also in terms of referred fan speed for the approach thrusts of 4000, 5000, and 6000 pounds. Takeoff EPR is approximately 1.86, decreasing slightly as forward speed increases. The takeoff thrust varies slightly with altitude and airspeed, but 15,000 pounds is representative of takeoff power.

The data base for deriving these curves was the production-nacelle test data taken during the NASA-funded program for reduction of DC-8 flyover noise. The test program utilized a DC-8-55 with JT3D-8B engines. The results of the tests are given in Reference 1.

2.3.3 Performance Data

Figures 5 through 10 present the all-engine takeoff flight paths for 15 and 25-deg flaps for airport pressure altitudes of sea level, 3000 and 6000 feet. Figures 11 and 12 are charts for determining F_N/δ_{amb} at cutback for 15 and 25-deg flaps, respectively, for a range of gross weights, climb gradients, altitudes, and airspeeds for the aircraft in a takeoff configuration. Figure 13 is a cutback chart for the airplane in a clean configuration (0-deg flaps) at an indicated airspeed of 250 knots. The DC-8-55 has the same drag characteristics during takeoff as the DC-8-61 so that these charts are also applicable to the -55.

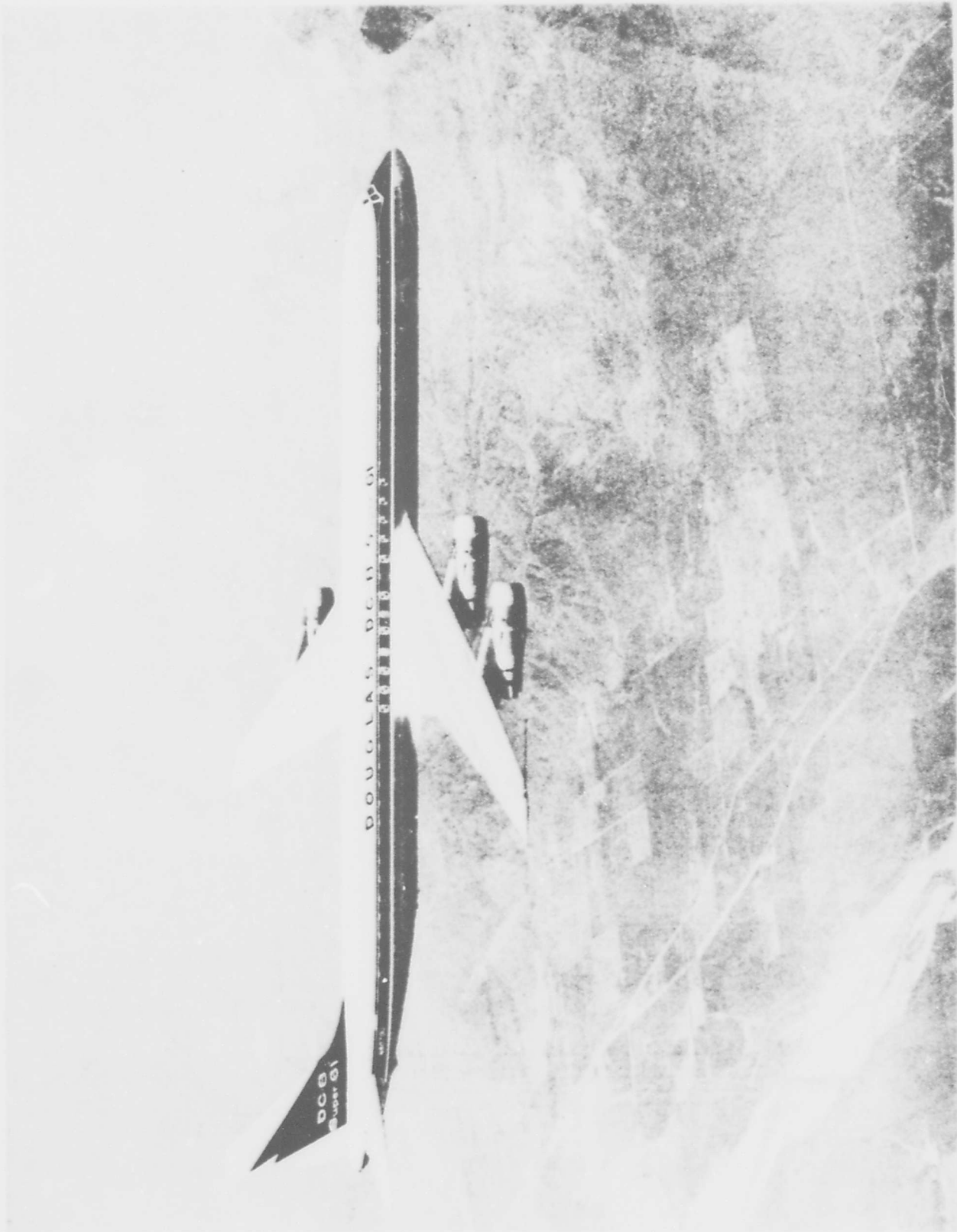


FIGURE 1.

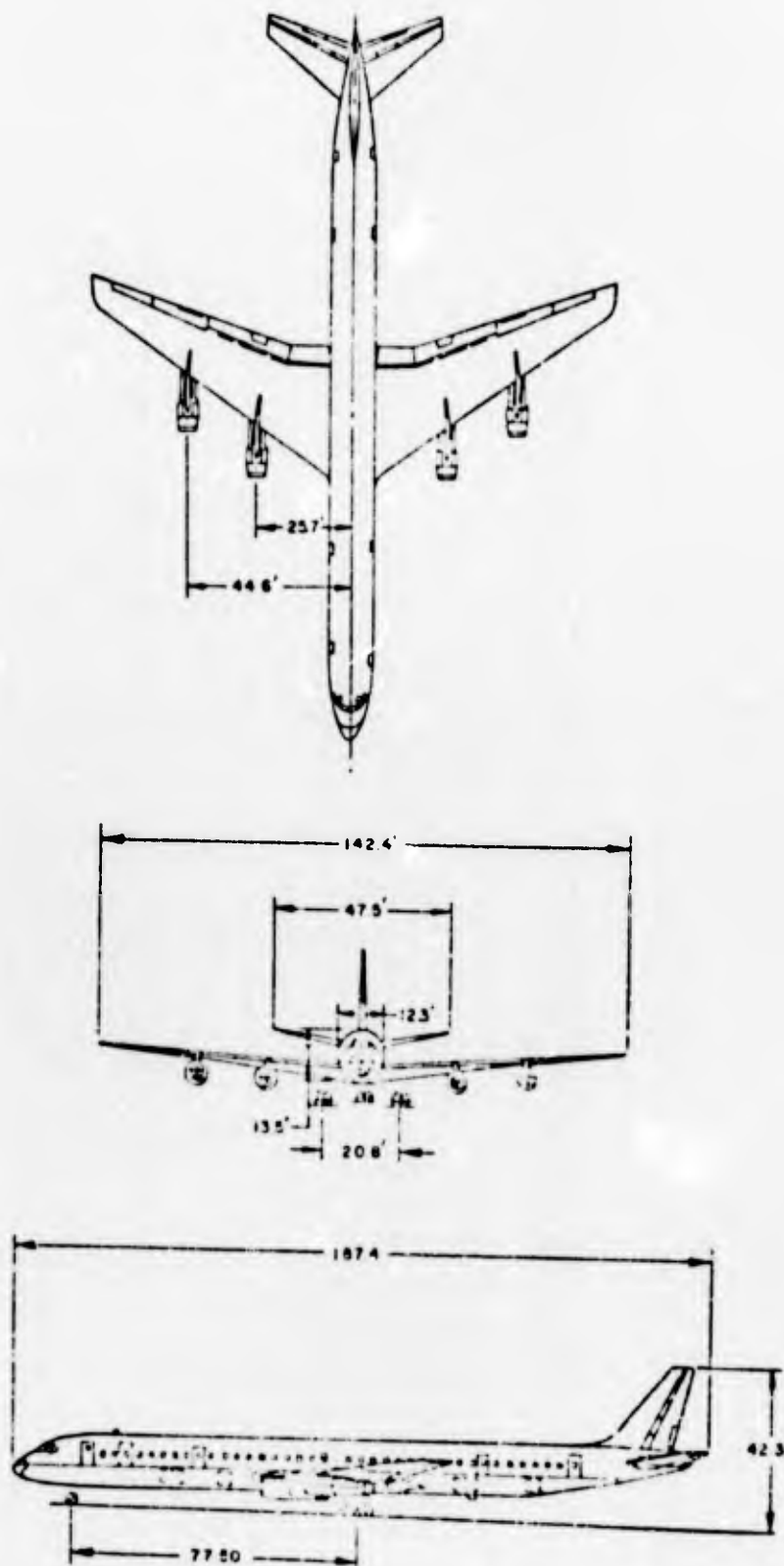


FIGURE 2. DC-8-61

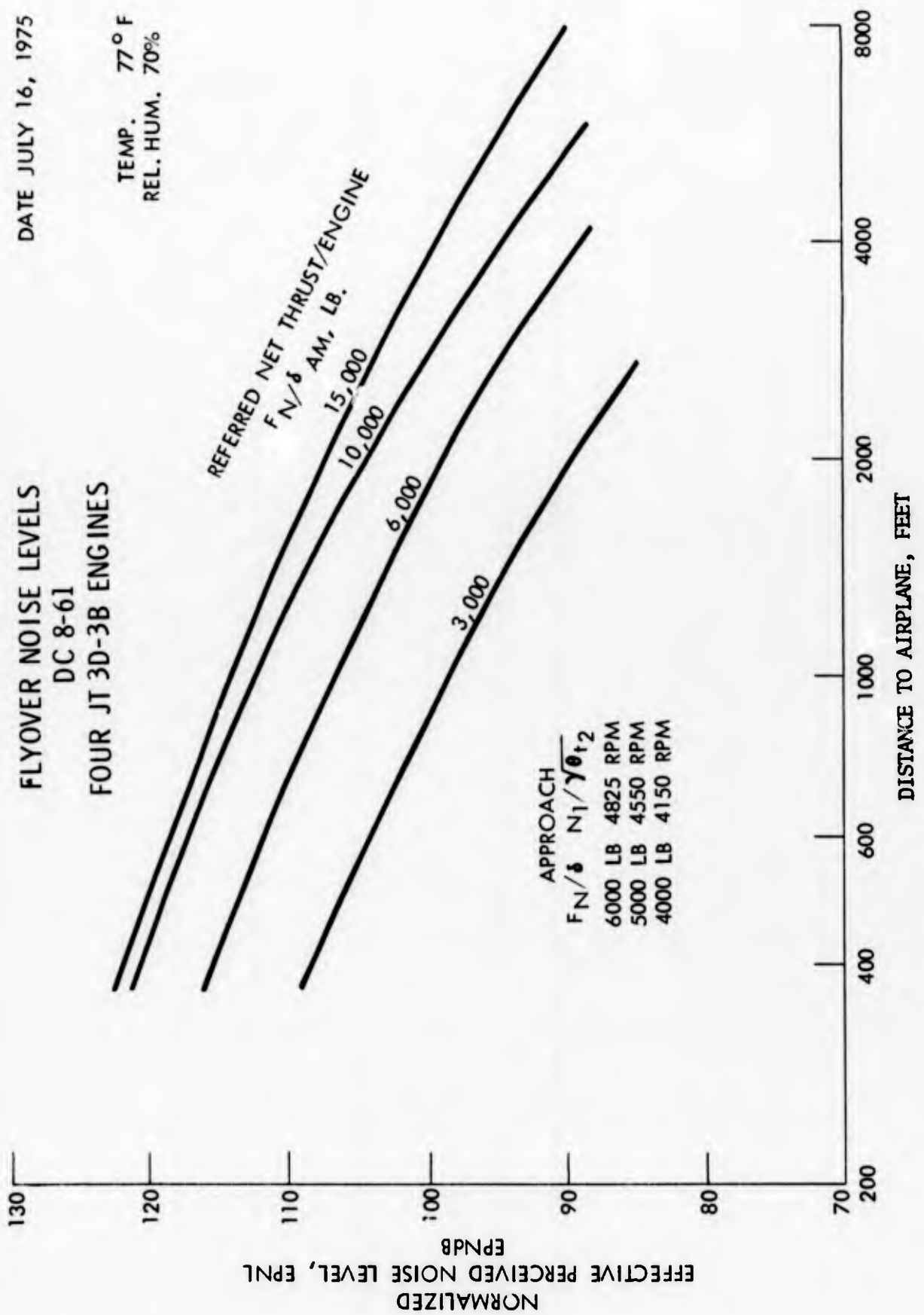


Figure 3

The EPNL and dB(A) data for the DC-8-61 (pages 11 and 12) were developed from FAA field measurements conducted in October 1974.

FLYOVER NOISE LEVELS
DC-8-61
FOUR JT3D-3B ENGINES

DATED: JULY 16, 1975

TEMP. 77°F
REL HUM. 70%

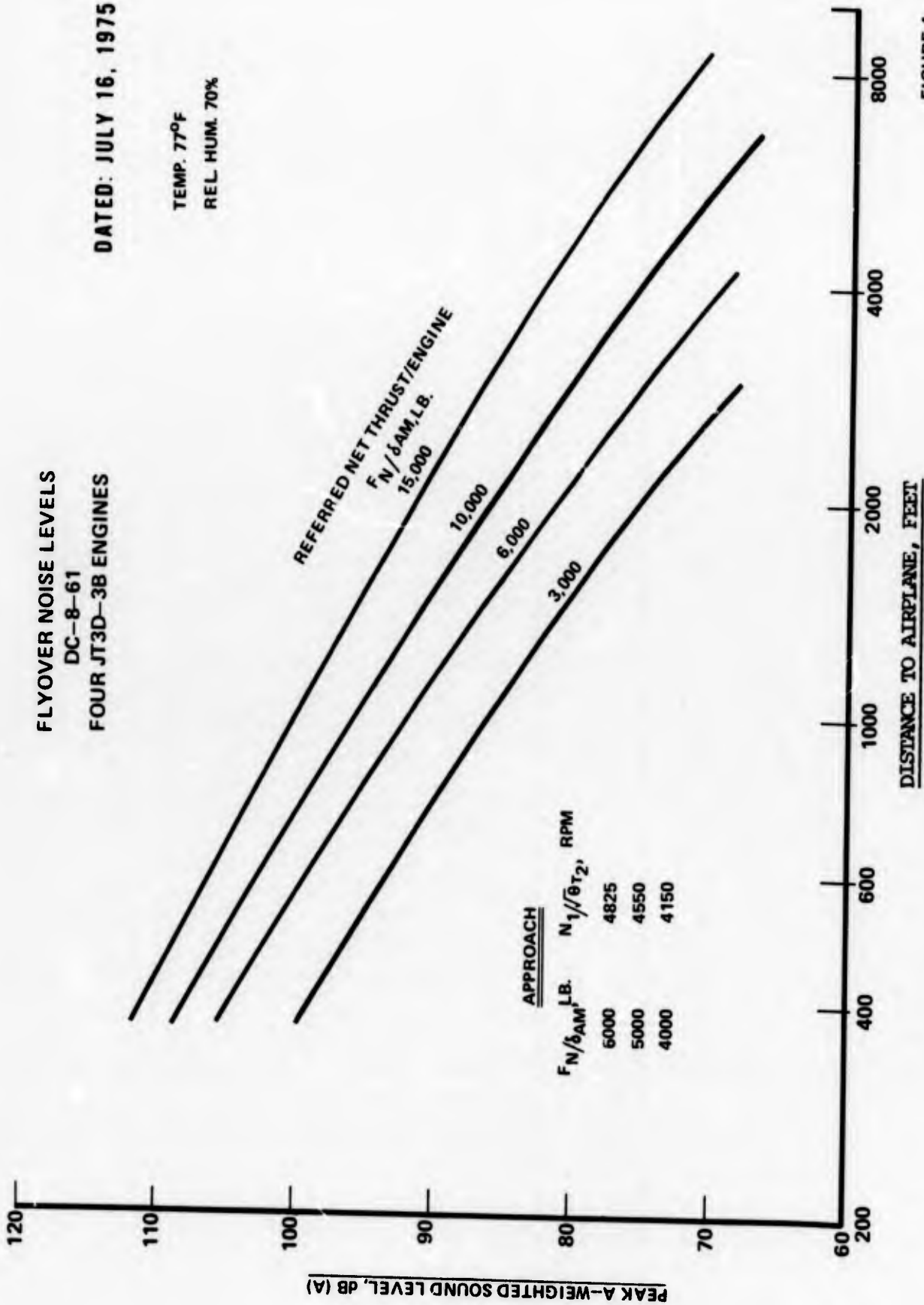


FIGURE 4

The EPNL and dB(A) data for the DC-8-61 (pages 11 and 12) were developed from FAA field measurements conducted in October 1974.

DC-6 SERIES 25/61
 ALL ENGINE FLIGHT PATH
 8.7 LEVEL AIRPORT ALTITUDE
 1000-2000 ENGINE
 15° FLAPS
 CLIMB AT $V_2 + 10$

HEIGHT ABOVE RUNWAY (FT)

3000
2500
2000
1500
1000
500
0

ON GIP
A/C PACKS

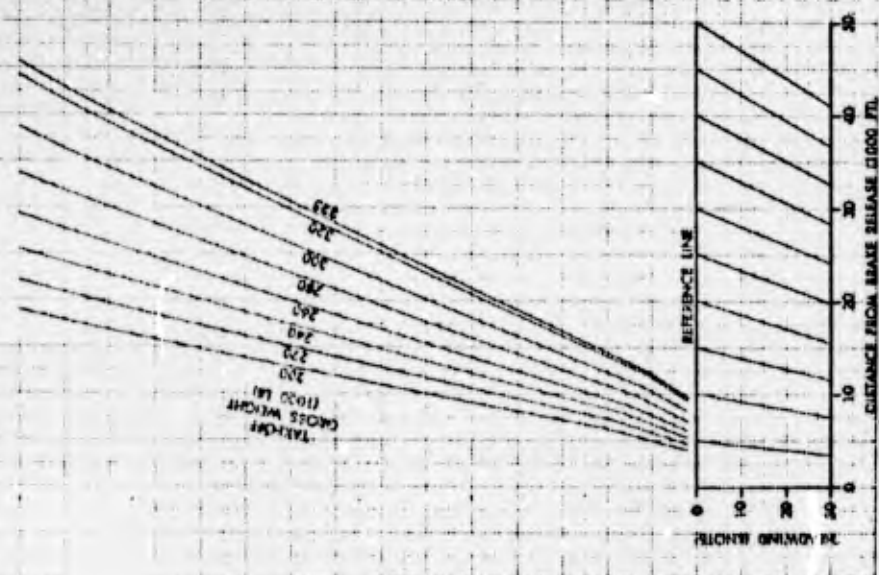
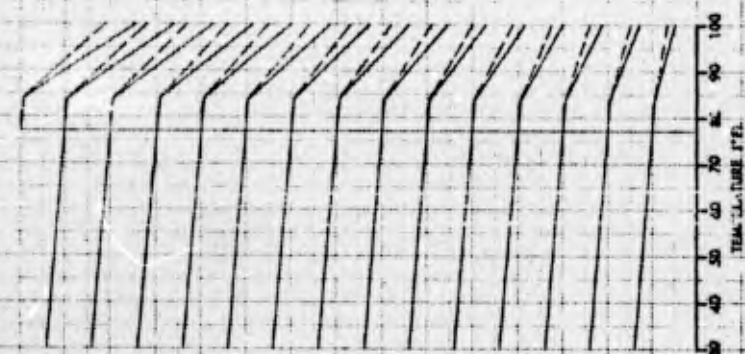
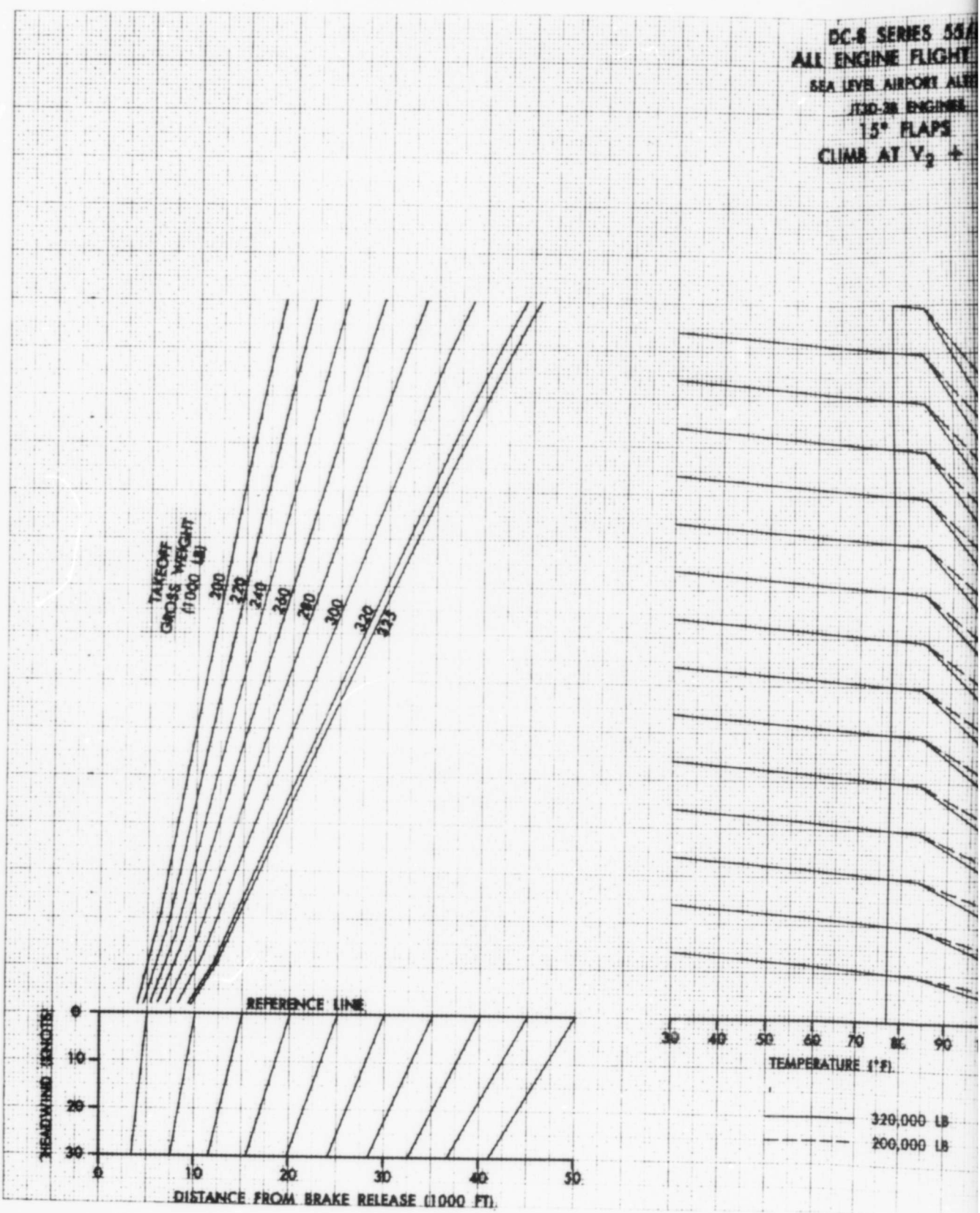


FIGURE 5

DC-8 SERIES 55A
 ALL ENGINE FLIGHT
 SEA LEVEL AIRPORT ALTD
 JT3D-28 ENGINE
 15° FLAPS
 CLIMB AT $V_2 +$



A

DC-8 SERIES 55/61
 ALL ENGINE FLIGHT PATH
 SEA LEVEL AIRPORT ALTITUDE
 JT3D-3B ENGINES
 15° FLAPS
 CLIMB AT $V_2 + 10$

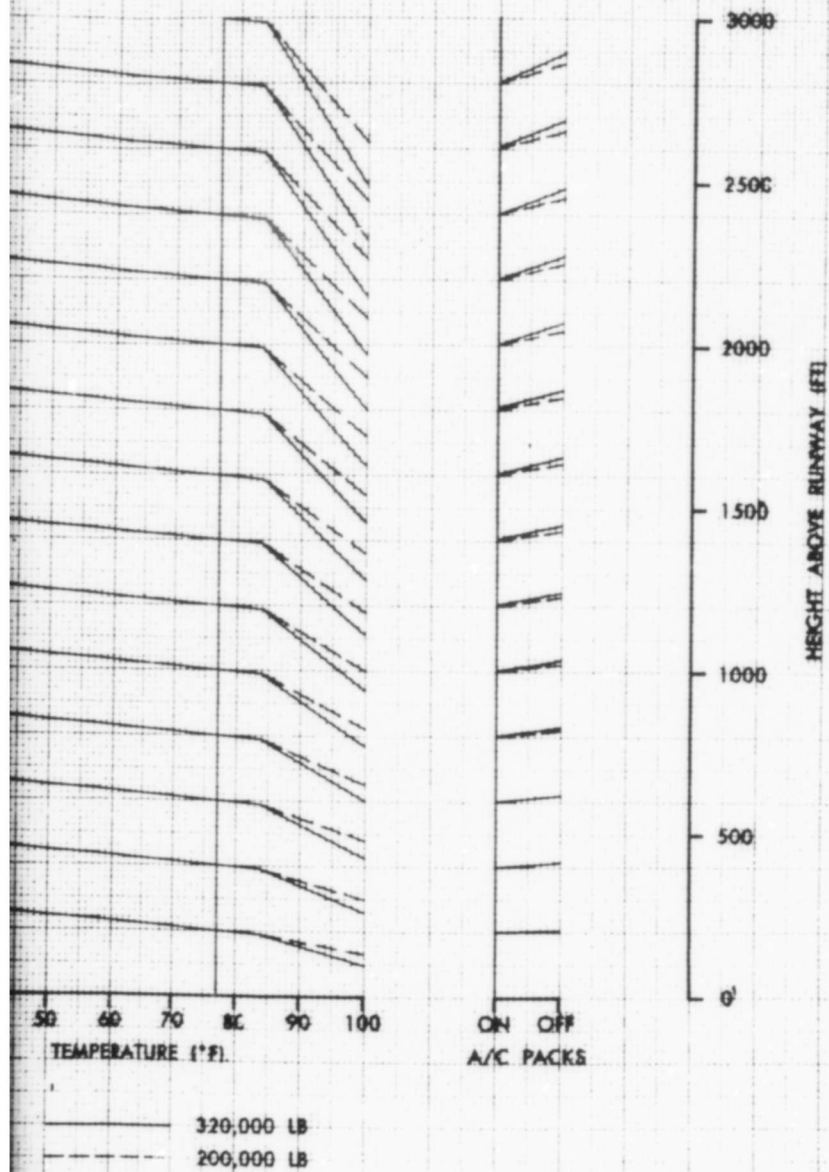


FIGURE 5.

B

DC-8 SERIES 55/61
 ALL ENGINE FLIGHT PATH
 3000 FT AIRPORT ALTITUDE
 J130 31 ENGINES
 15° FLAPS
 CLIMB AT $V_2 \pm 10$

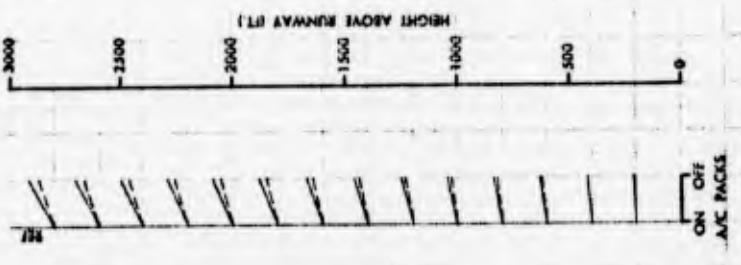
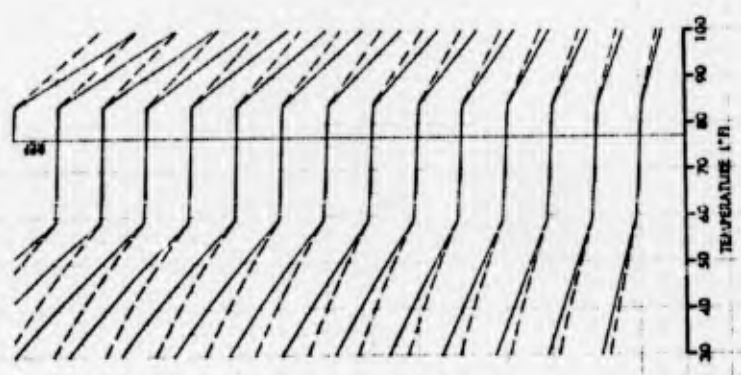
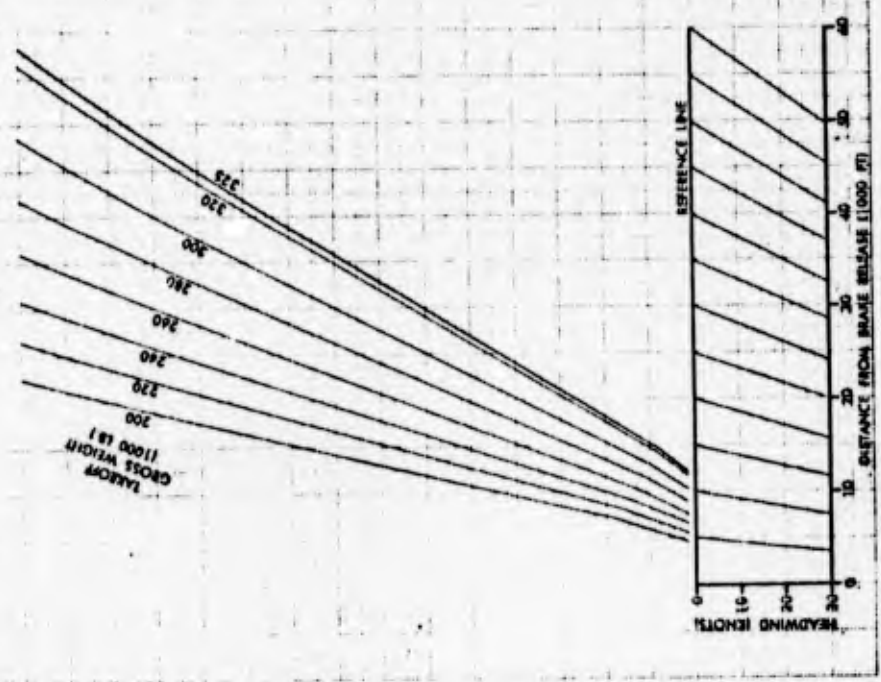


FIGURE 6

DC-8 SERIES 55/61
 ALL ENGINE FLIGHT PATH
 3000 FT ALL POST ALTITUDE
 J100 J1 ENGINES
 15° FLAPS
 CLIMB AT $V_2 + 10$

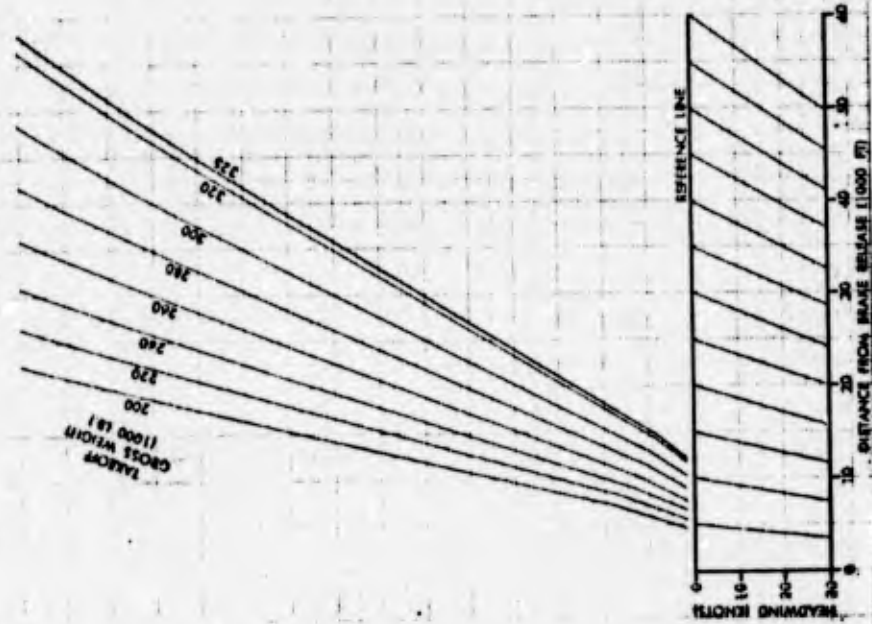
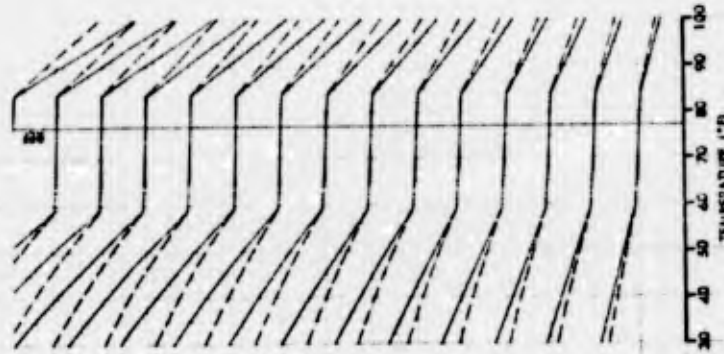
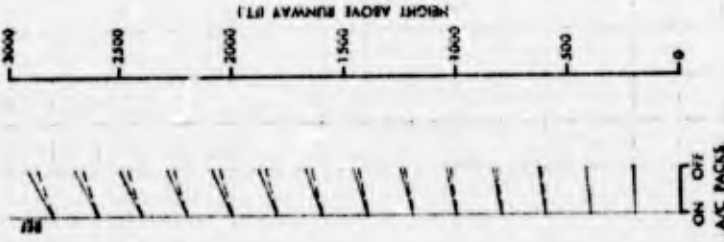


FIGURE 6

DC8 SERIES 55/61
 ALL ENGINE FLIGHT PATH
 800 FT AIRPORT ALTITUDE
 1700 35 ENGINES
 15° FLAPS
 CLIMB AT $V_2 + 10$

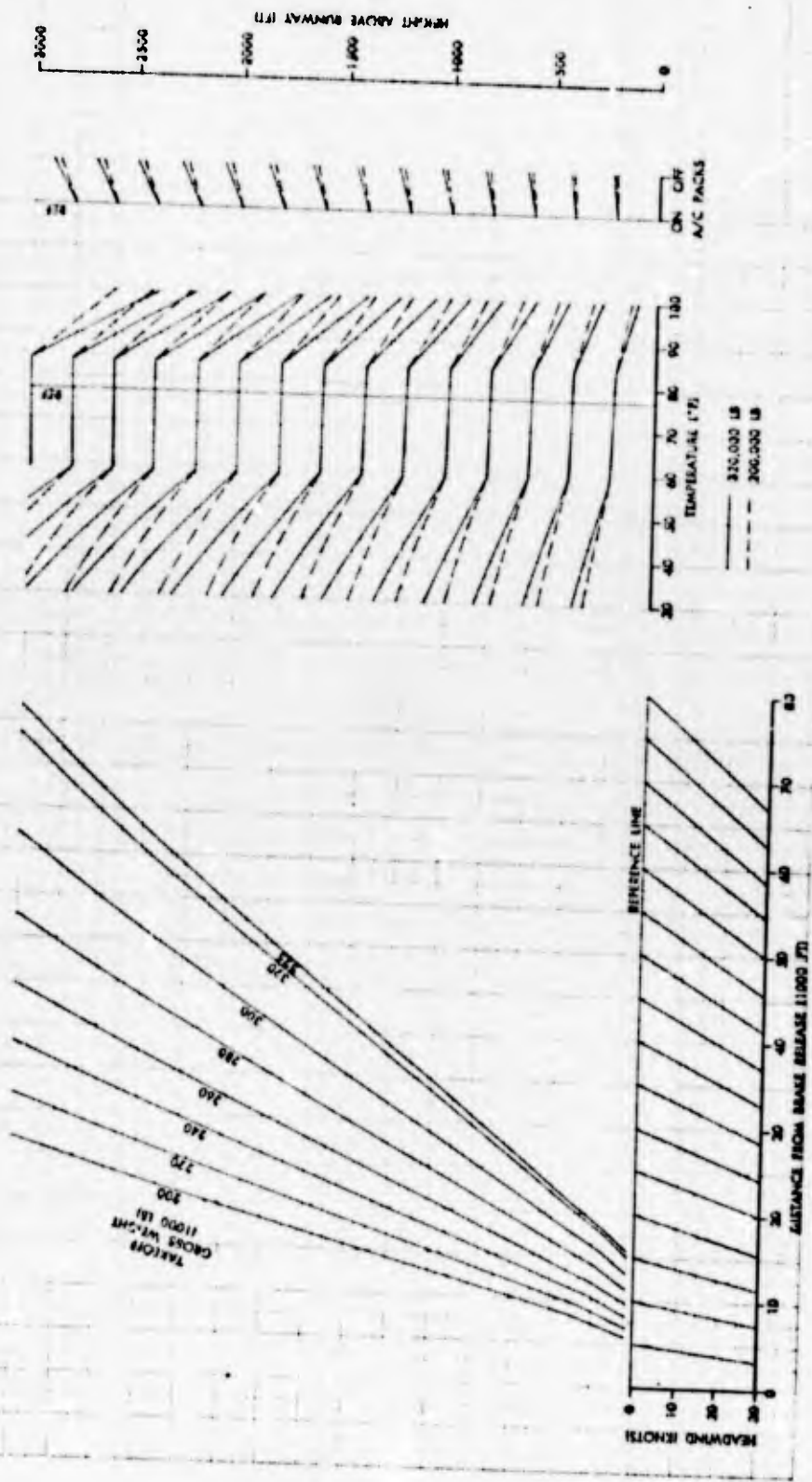
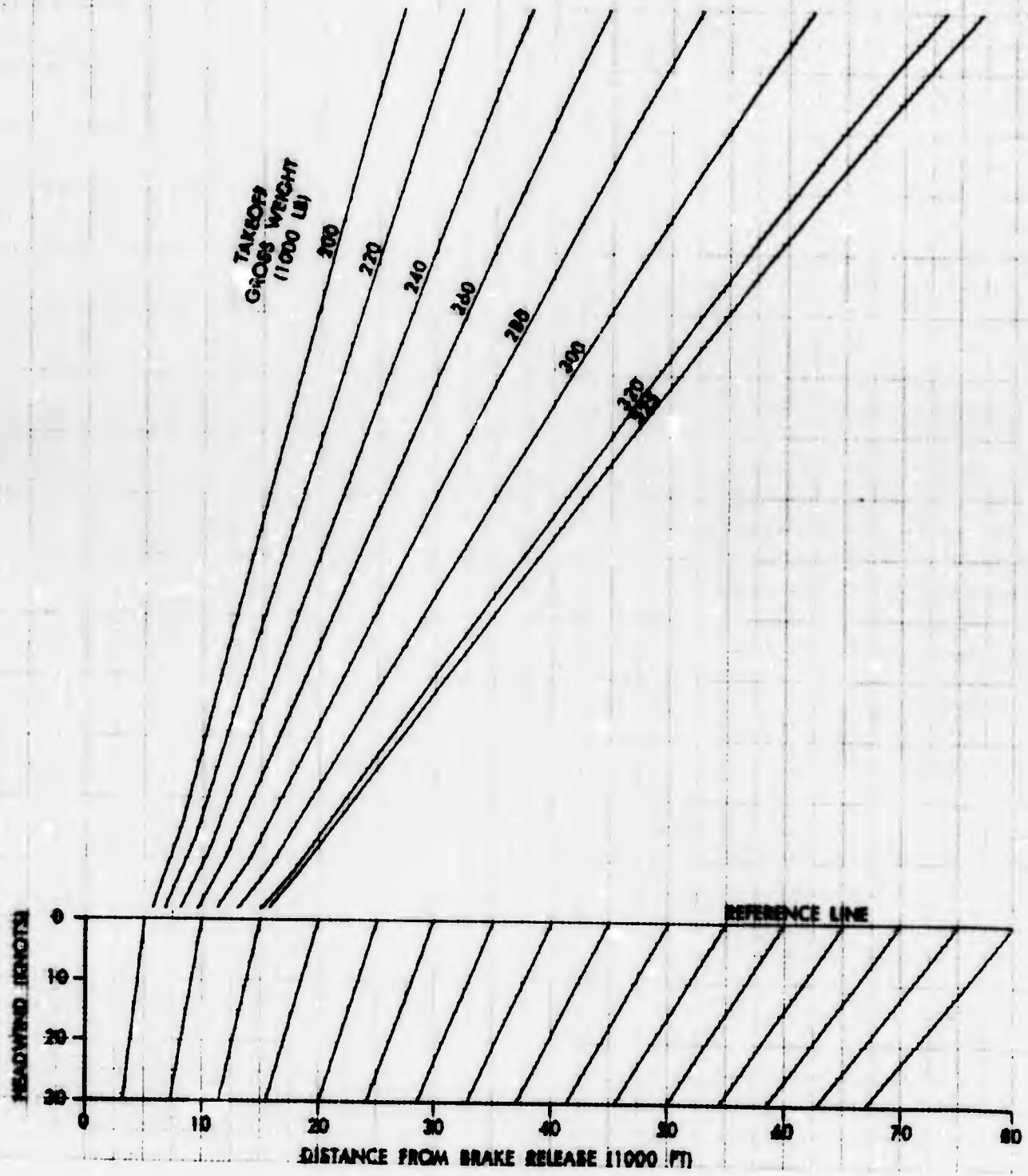


FIGURE 7.

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DC-8 SERIES 55/60
ALL ENGINE FLIGHT
6000 FT AIRPORT ALTITUDE
JT3D-2B ENGINES
15° FLAPS
CLIMB AT $V_2 + 10$



8

DC-8 SERIES 55/61
ALL ENGINE FLIGHT PATH
 4000 FT AIRPORT ALTITUDE
 JT3D-36 ENGINES
 15° FLAPS
 CLIMB AT $V_2 + 10$

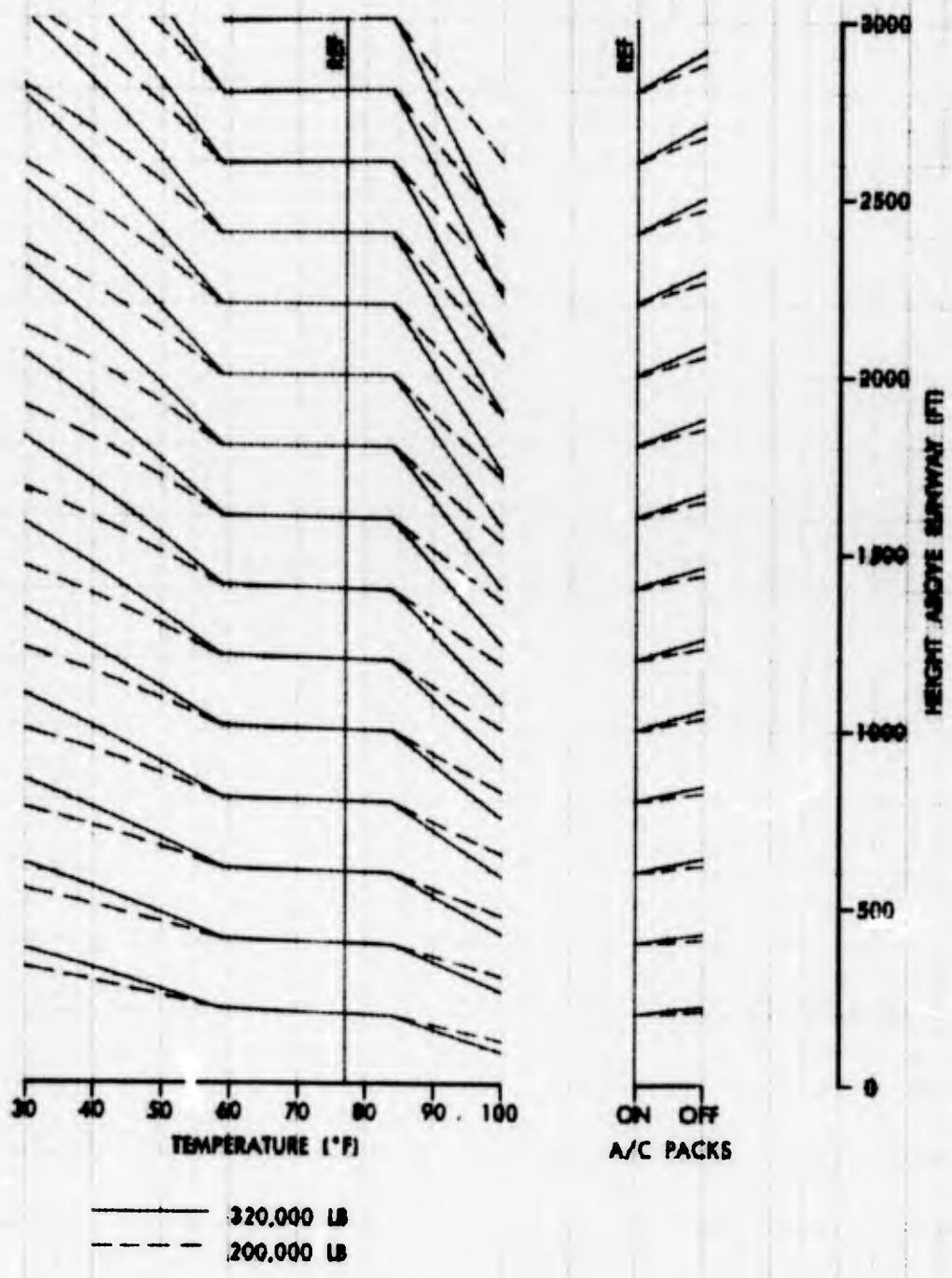


FIGURE 7.

DC-8 SERIES 55/51
 ALL ENGINE FLIGHT PATH
 SEA LEVEL AIRPORT ALTITUDE
 J22-D8 ENGINE
 25° FLAPS
 CLIMB AT V_{Y+10}

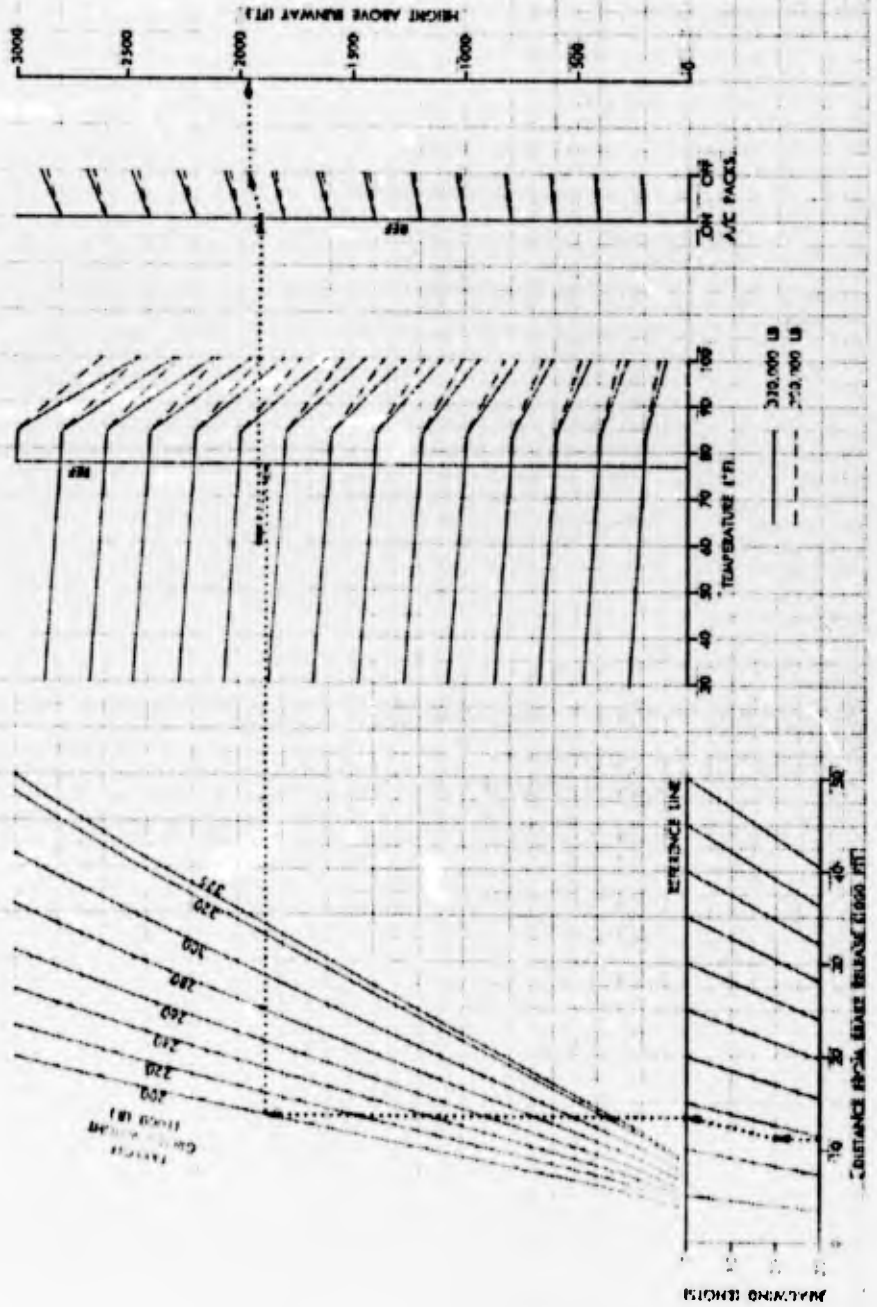


FIGURE 8

DC-8 SERIES 55/51
 ALL ENGINE FLIGHT PATH
 3000 FT AIRPORT ALTITUDE
 JTD-8 ENGINES
 25° FLAPS
 CLIMB AT $V_3 + 10$

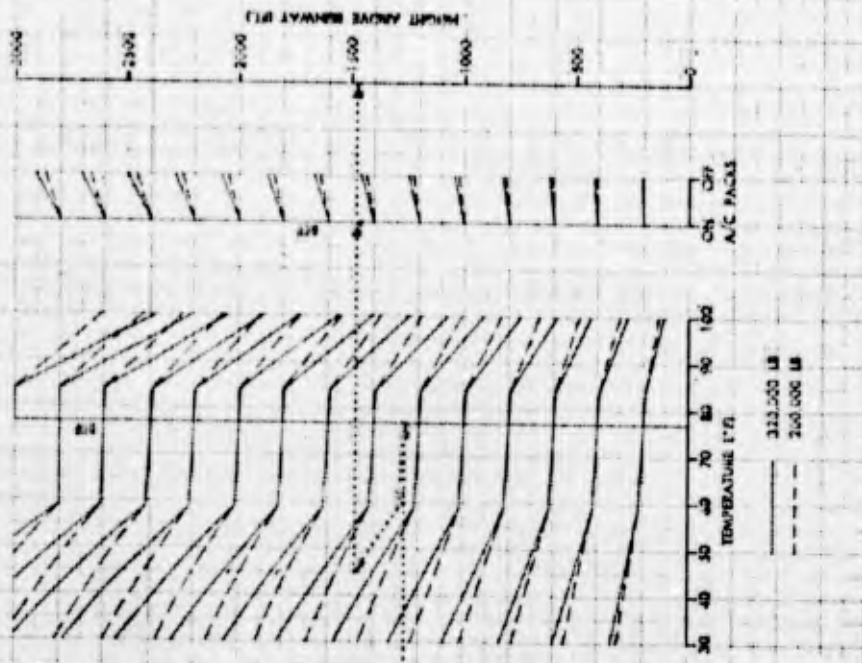
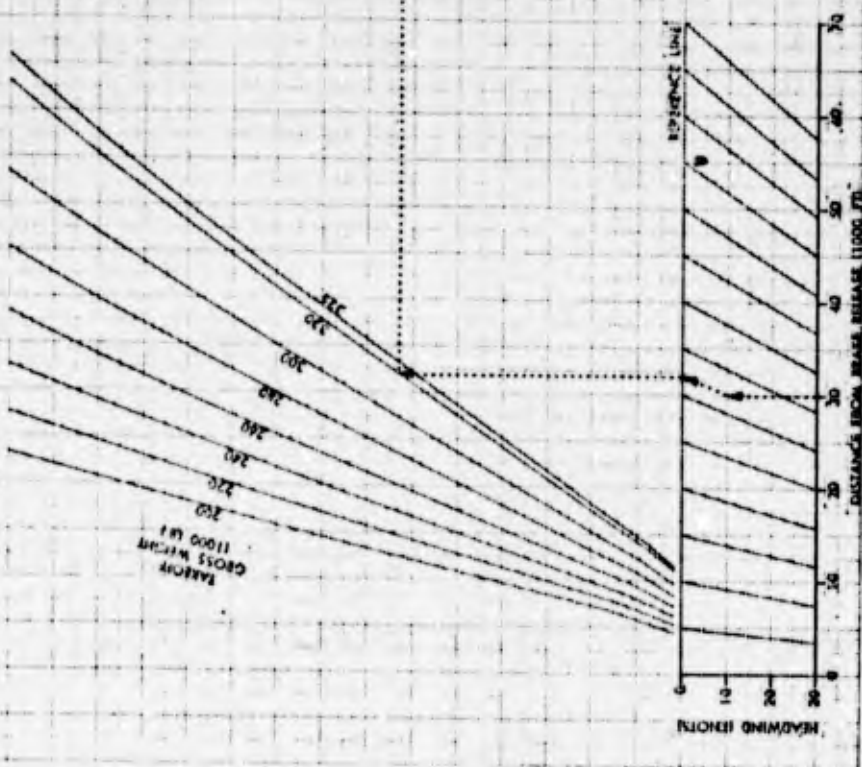
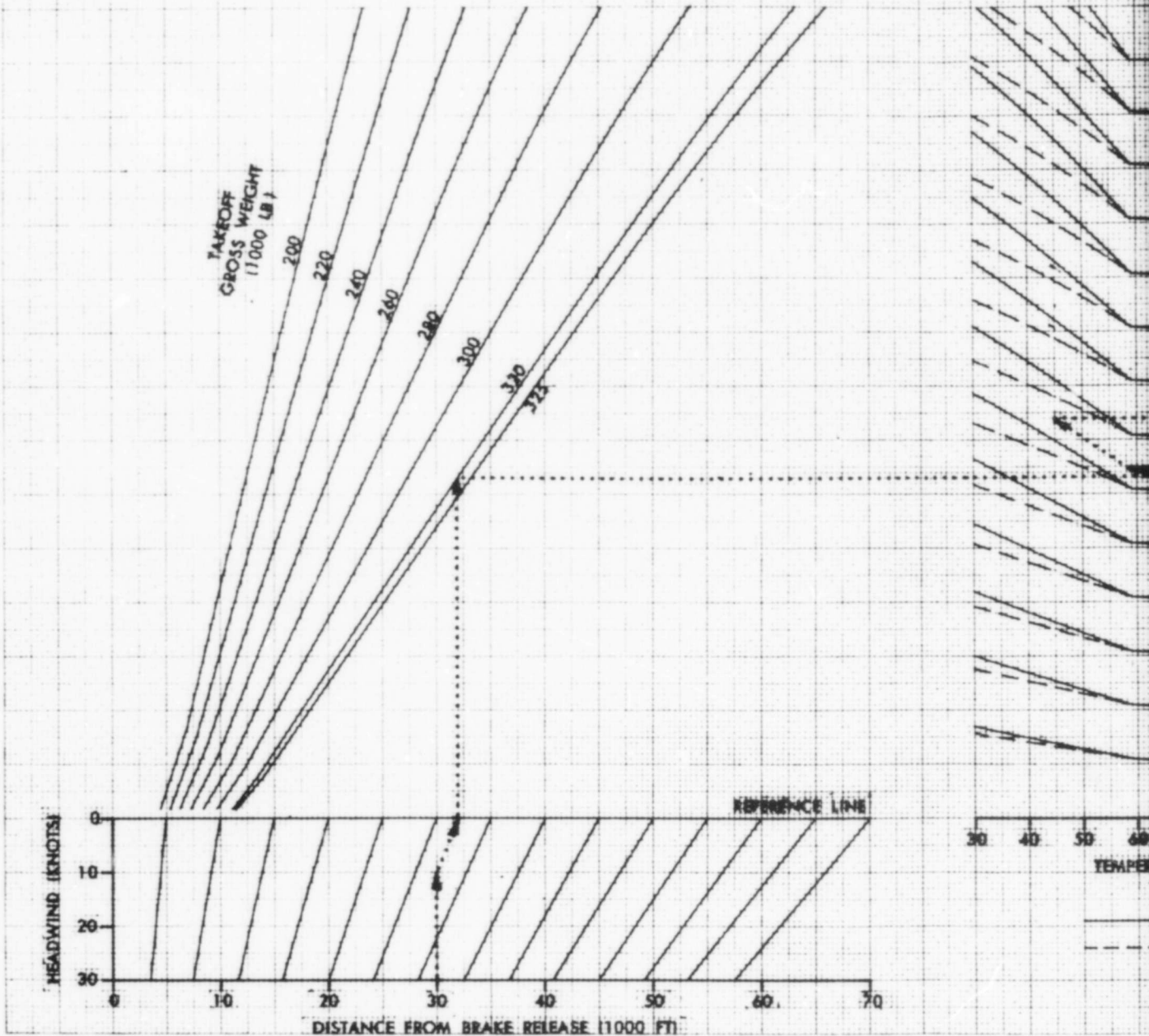


FIGURE 9

DC-8 SERIES 55/61
 ALL ENGINE FLIGHT PA
 3000 FT AIRPORT ALTITUDE
 JT3D-3B ENGINES
 25° FLAPS
 CLIMB AT $V_2 + 1.0$



8

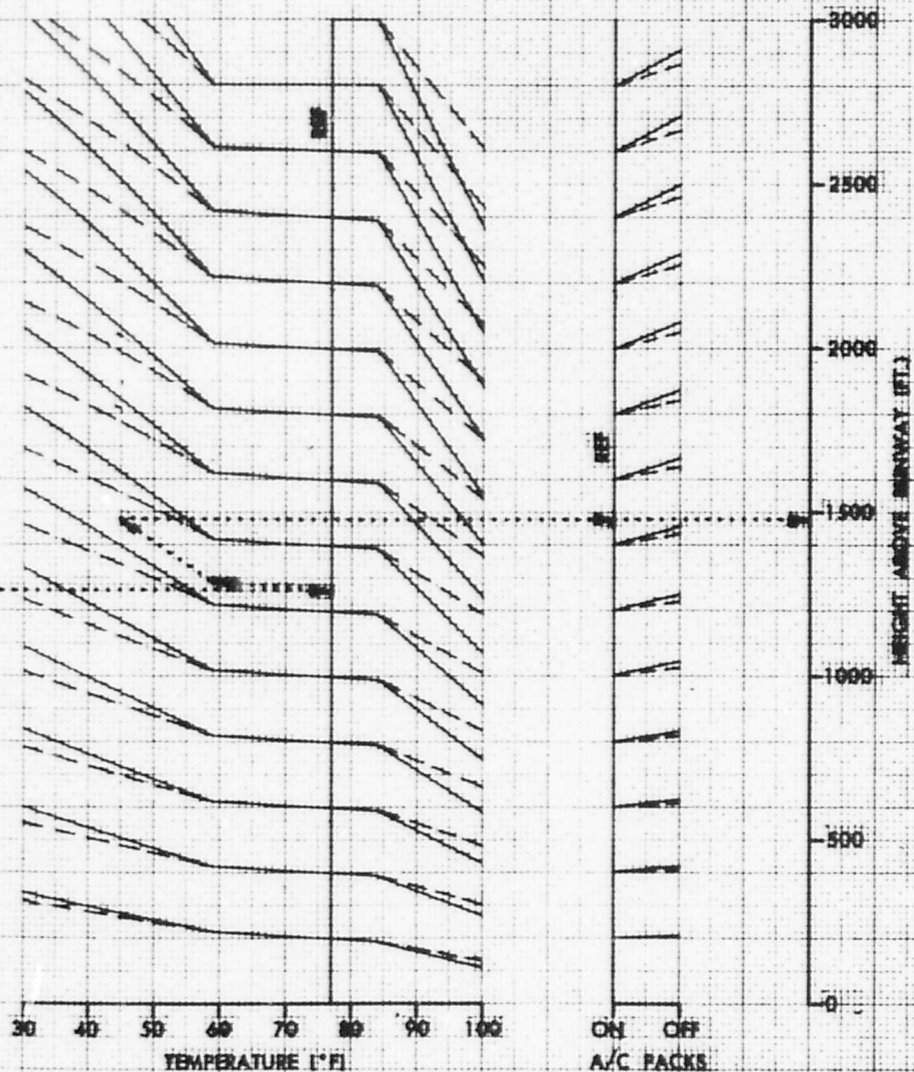
DC-8 SERIES 55/61
ALL ENGINE FLIGHT PATH

3000 FT AIRPORT ALTITUDE

JT3D-3B ENGINES

25° FLAPS

CLIMB AT $V_2 \pm 10$

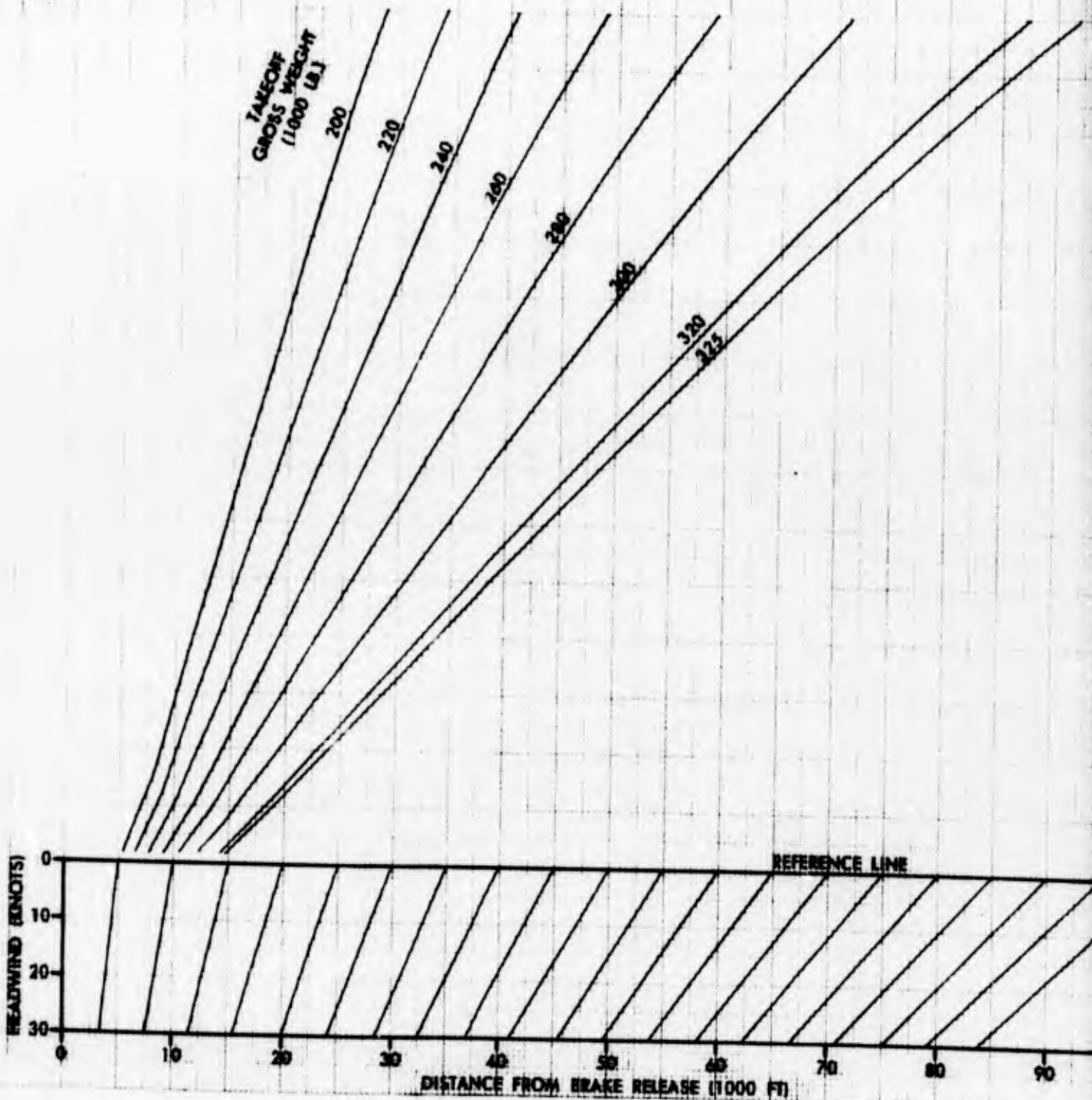


— 320,000 LB
- - - 200,000 LB

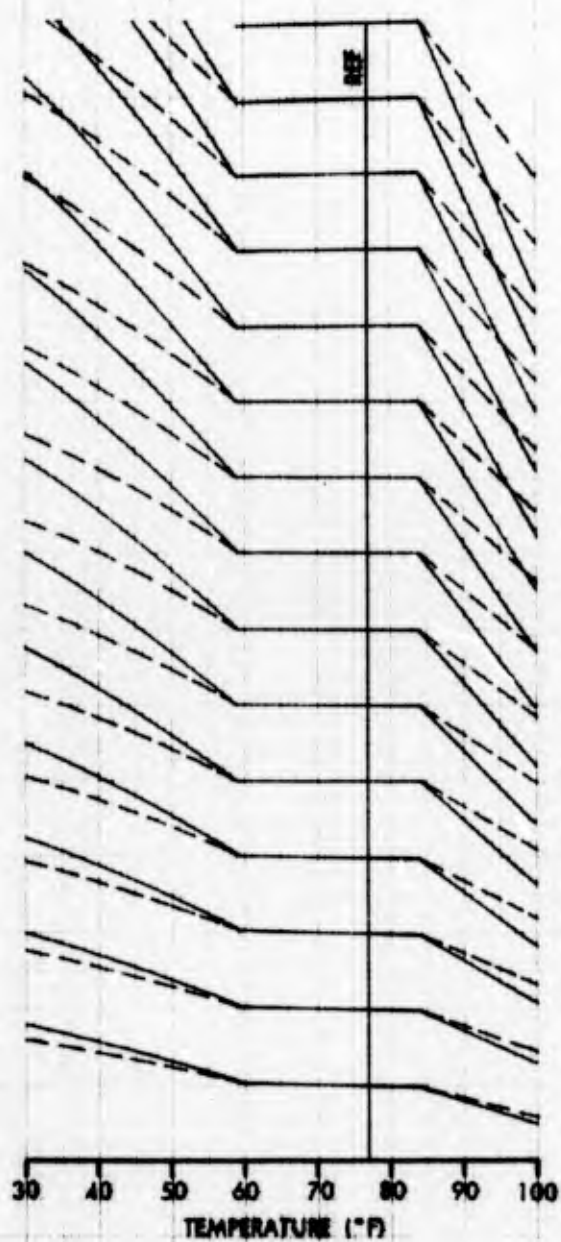
FIGURE 9.

B

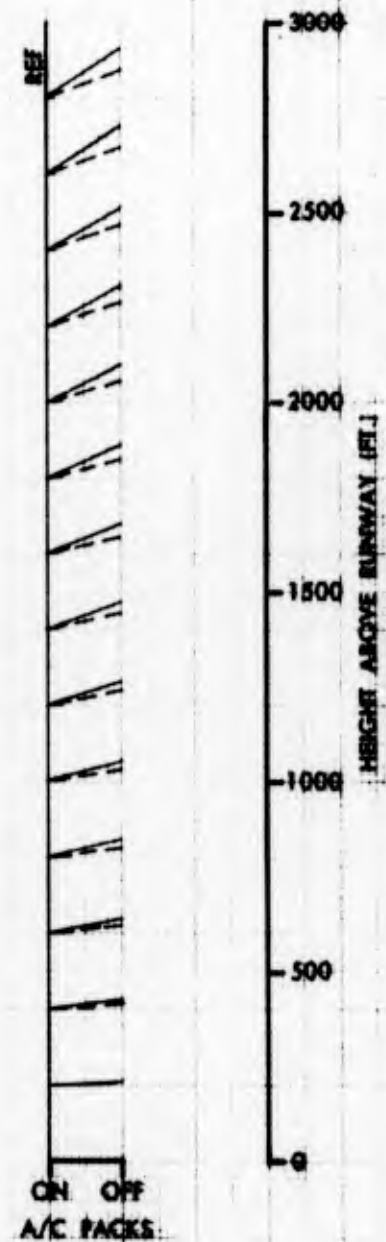
DC-8 SERIES 55A
ALL ENGINE FLIGHT
6000 FT RUNWAY ALTITUDE
JT3D-3B ENGINES
25° FLAPS
CLIMB AT $V_2 +$



DC-8 SERIES 55/61
 L ENGINE FLIGHT PATH
 6000 FT RUNWAY ALTITUDE
 JT3D-3B ENGINES
 25° FLAPS
 CLIMB AT $V_2 + 10$



320,000 LB
 200,000 LB



ON OFF
 A/C PACKS

FIGURE 10.

DC-8 SERIES 55/61
 ALL ENGINE FLIGHT PATH
 6000 FT RUNWAY ALTITUDE
 JT1D-3B ENGINES
 25° FLAPS
 CLIMB AT $V_2 + 10$

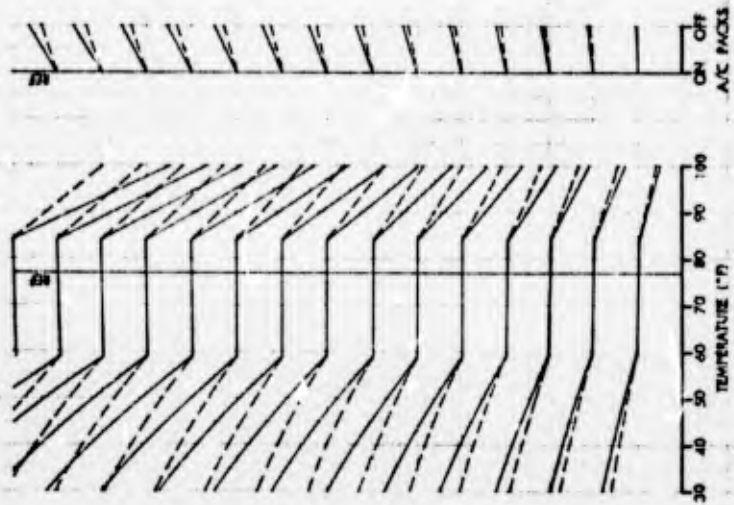
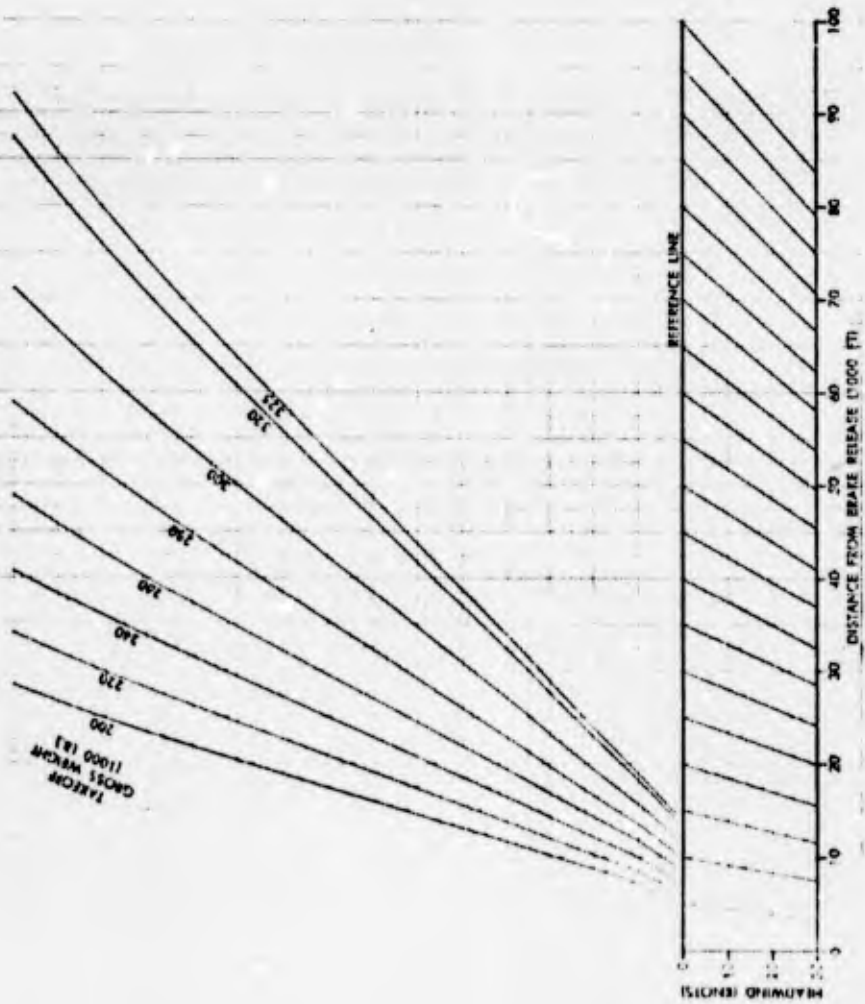


FIGURE 10.

If the aircraft operates at maximum thrust during the takeoff, the applicable chart of Figures 5 to 10 is used. If a thrust reduction is used, the appropriate selection of Figures 11, 12, or 13 is made to use in combination with the full thrust portion of the flight path.

Figures 14 and 15 present curves of referred fan speed versus glideslope angle for 2.5 to 6 degrees for the DC-8-61 and -55, respectively for a range of gross weights, airspeeds from $1.3 V_S$ to $1.3 V_S + 30$ knots, and airplane pressure altitudes from sea level to 6000 feet. Curves relating geometric height above airport to pressure height above airport are presented for deviations from standard-day temperature of $+40^{\circ}\text{F}$ to -40°F . A plot is also shown that relates airspeed to aircraft gross weight for $1.3 V_S$ to $1.3 V_S + 30$ knots. A provision for determining the thrust required for a 0-degree glideslope is given in Appendix B.

To illustrate the use of the takeoff charts, Figure 8 is provided with a trace-around. The conditions given are: sea level airport, 25-deg flaps, 200,000-pound takeoff gross weight, AC packs off, an ambient temperature of 60°F , a 20-knot headwind, and a distance of 11,100 feet from brake release.

Starting in the lower left corner on the bottom line (also the line for 30-knot headwind), proceed vertically to the line for a 20-knot headwind; from this point proceed along a line parallel to the headwind guidelines to the reference line, then vertically to the gross weight line for 200,000 pounds. Proceeding horizontally through the temperature and A/C PACKS ON-OFF adjustment curves the height above the runway is determined to be 1960 feet. Entering Figure 3 at the slant range of 1960 feet on the full takeoff thrust line, the EPNL is 108.9 EPNdB. Assuming an airspeed of 175 KIAS, from Figure F-2 the airspeed correction is 0.1 EPNdB resulting in an EPNL of 109.0 EPNdB. From Figure 4 the peak A-weight sound level is 96.1 dB(A).

Figure 12 illustrates a cutback case using a trace-around for the following conditions: sea level airport, 25-deg flaps, 220,000-pound takeoff gross weight, a 6-percent climb gradient, and an airspeed of $V_2 + 20$ knots. The chart shows that an altitude (slant range) of 1500 feet was reached at the point of observation, the first segment of which was achieved at full thrust

DC-8 SERIES 55/61
 $F_N/8$ AMB AT CUTBACK
 JT3D-3B ENGINES
 FLAPS - 15°

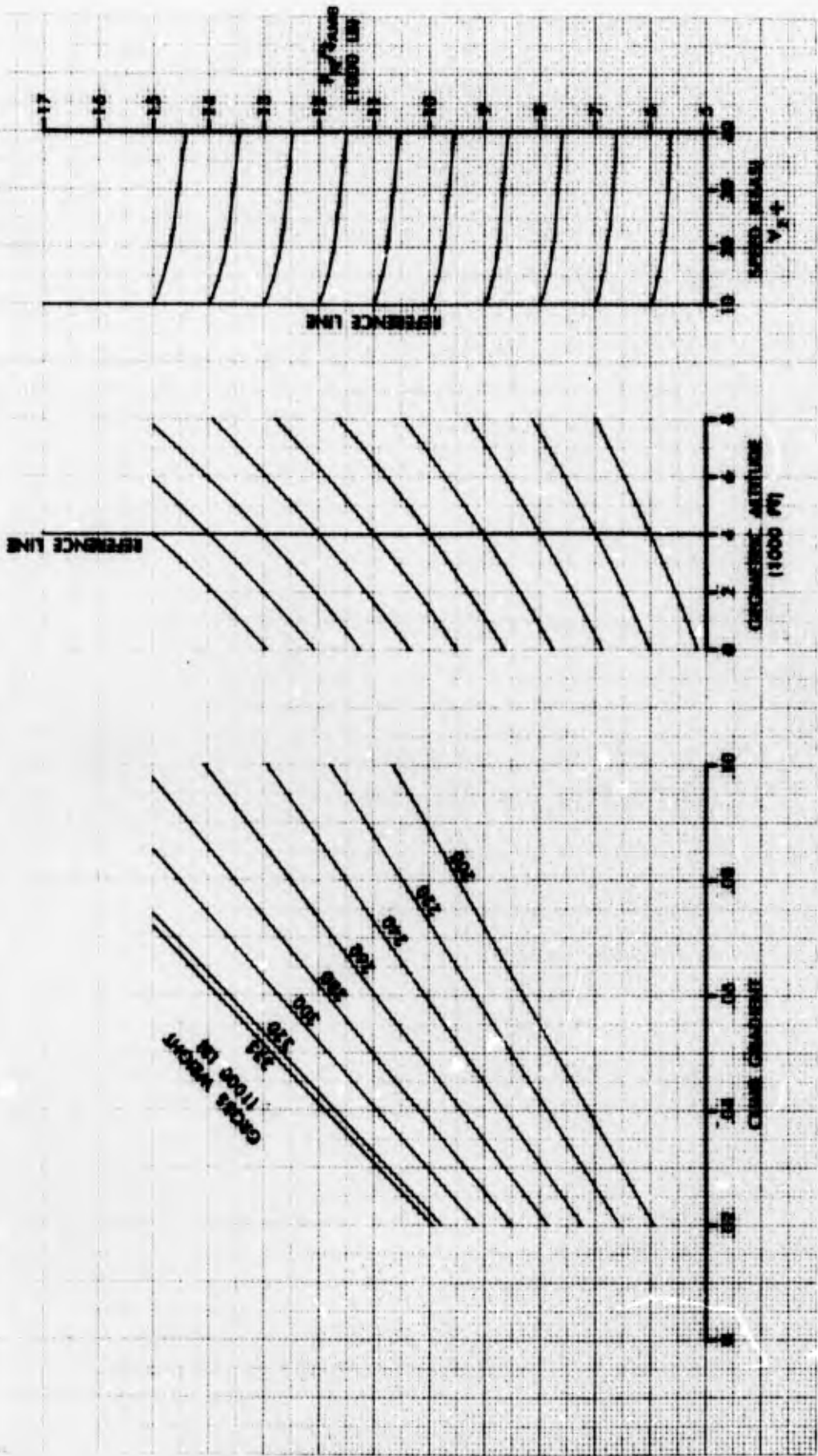


FIGURE 11.

DC-8 SERIES 61
 F_N / δ_{AMB} AT CUTBACK
 JT3D-3B ENGINES
 CLEAN CONFIGURATION
 250 KNOTS, IAS

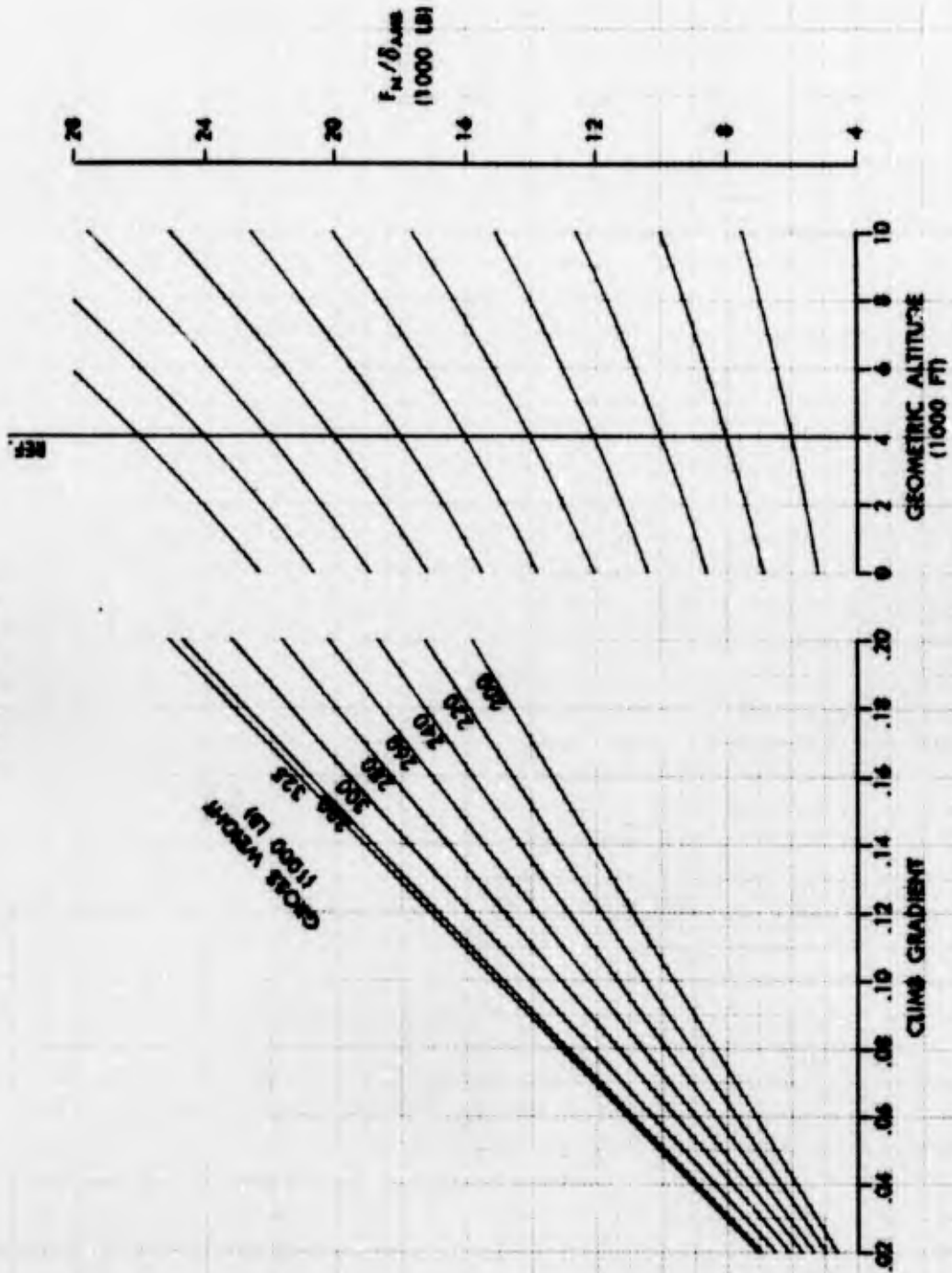


FIGURE 13.

along the flight path shown in Figure 8, and the second segment of which was at 6-percent climb gradient. The total flight path must be constructed using the two charts and designed to reach a desired aircraft height at the observation point.

A typical example using the trace-around might utilize a thrust reduction at a height of 1000 feet. From Figure 8 the distance from brake release for a height of 1000 feet would be 10,500 feet for a gross weight of 220,000 pounds, a 77°F day and AC packs on, assuming no headwind. To achieve the additional 500 feet in height to reach 1500 feet, a horizontal distance of 8333 feet is traveled using a 6-percent climb gradient resulting in a total distance from brake release of 18,833 feet as the point of observation. Completing the trace-around, at an altitude of 1500 feet and an airspeed of $V_2 + 20$ knots, F_N/δ_{amb} is 8900 pounds. Entering Figure 3 at this slant range and thrust, the EPNL is 107.0 EPNdB. From Figure 4 the peak A-weighted sound level is 92.2 dB(A). Cutback thrust may be determined from Figure 13 for the clean aircraft configuration in a similar manner.

Figure 14 shows a trace-around for determination of power setting required during approach at a 5.25-degree glideslope using an airspeed of $1.3 V_S + 20$ knots and at a pressure altitude of 2500 feet. Following the trace-around results in a $N_1/\sqrt{\theta_2}$ of 3800 rpm. Assume for this example that the airport pressure altitude is 1500 feet and that the deviation from the standard-day reference temperature is +20°F. Using the upper left-hand plot, for an aircraft pressure height above the runway of 1000 feet, the geometric altitude is approximately 1040 feet. From Figure 3 at 1040 feet and 3800 rpm, the EPNL is approximately 103.3 EPNdB and from Figure 4 the peak A-weighted sound level is 90.0 dB(A).

Charts relating engine parameters are provided in Figures 16 and 17 that show F_N/δ and $N_1/\sqrt{\theta_2}$ for a range of engine pressure ratios and Mach numbers with all four turbocompressors operating. The turbocompressors, which provide for cabin pressurization and air conditioning, normally operate during all phases of the flight envelope.

Reproduced from
best available copy.

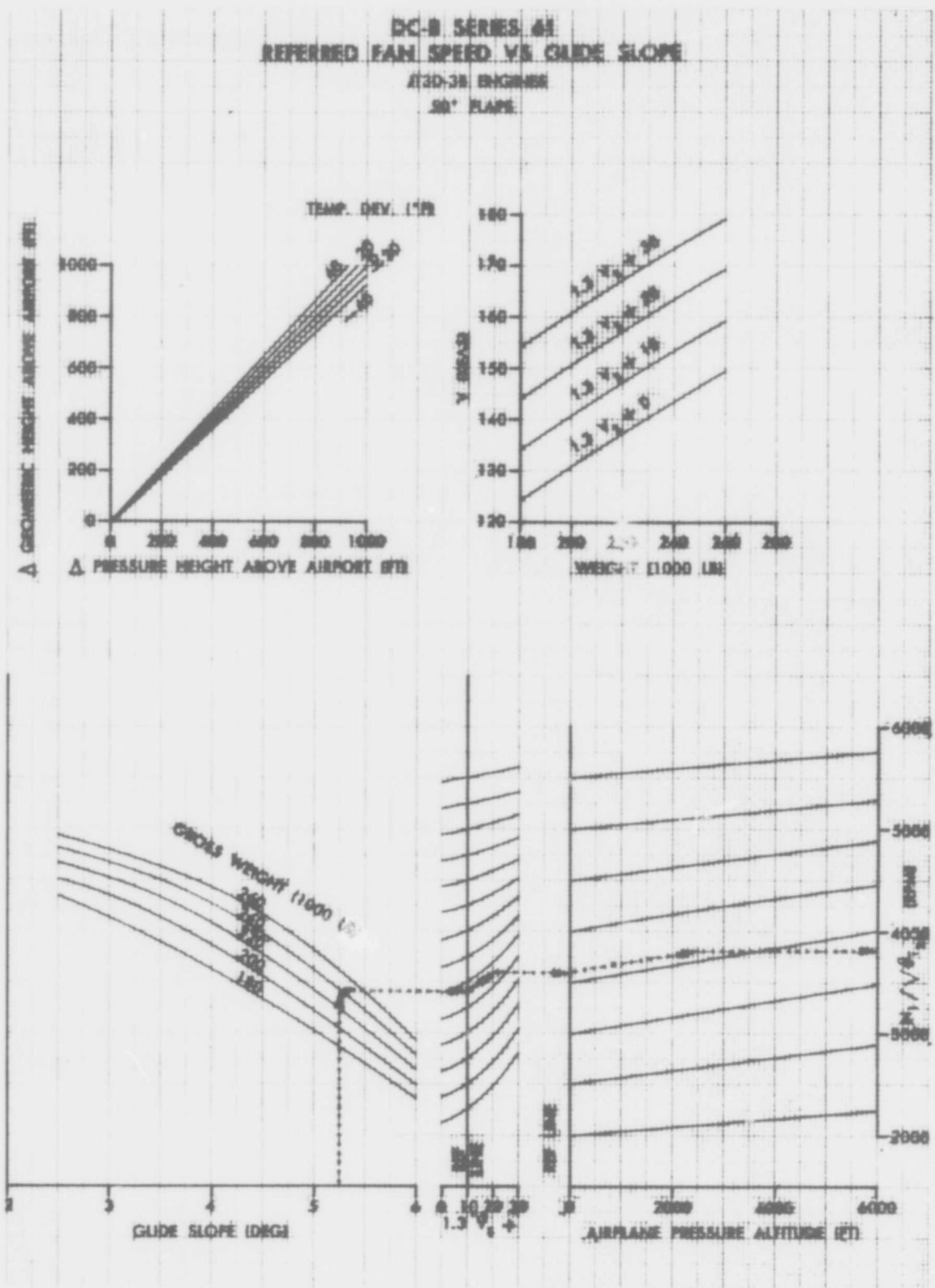


FIGURE 14.

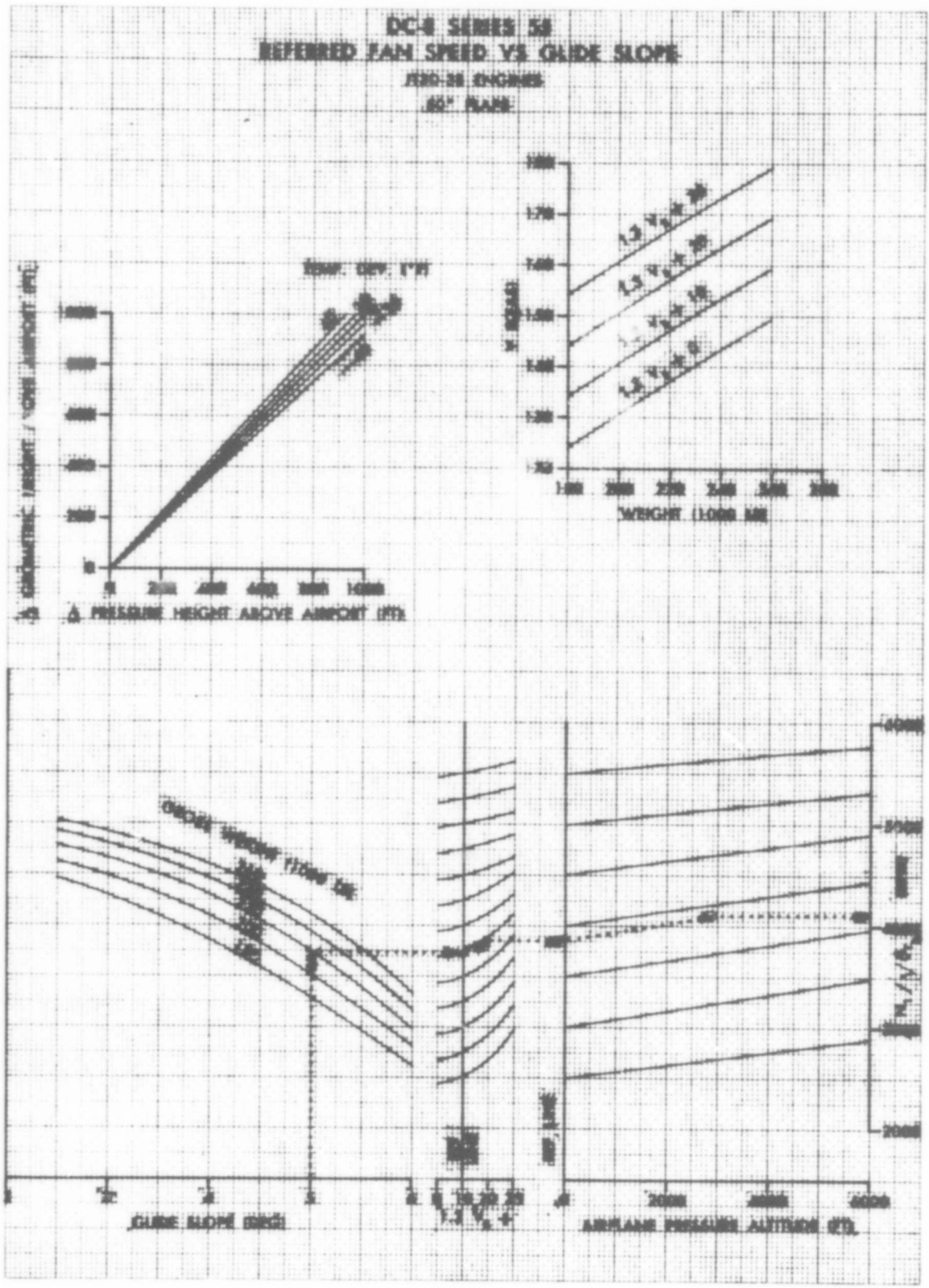


FIGURE 15.

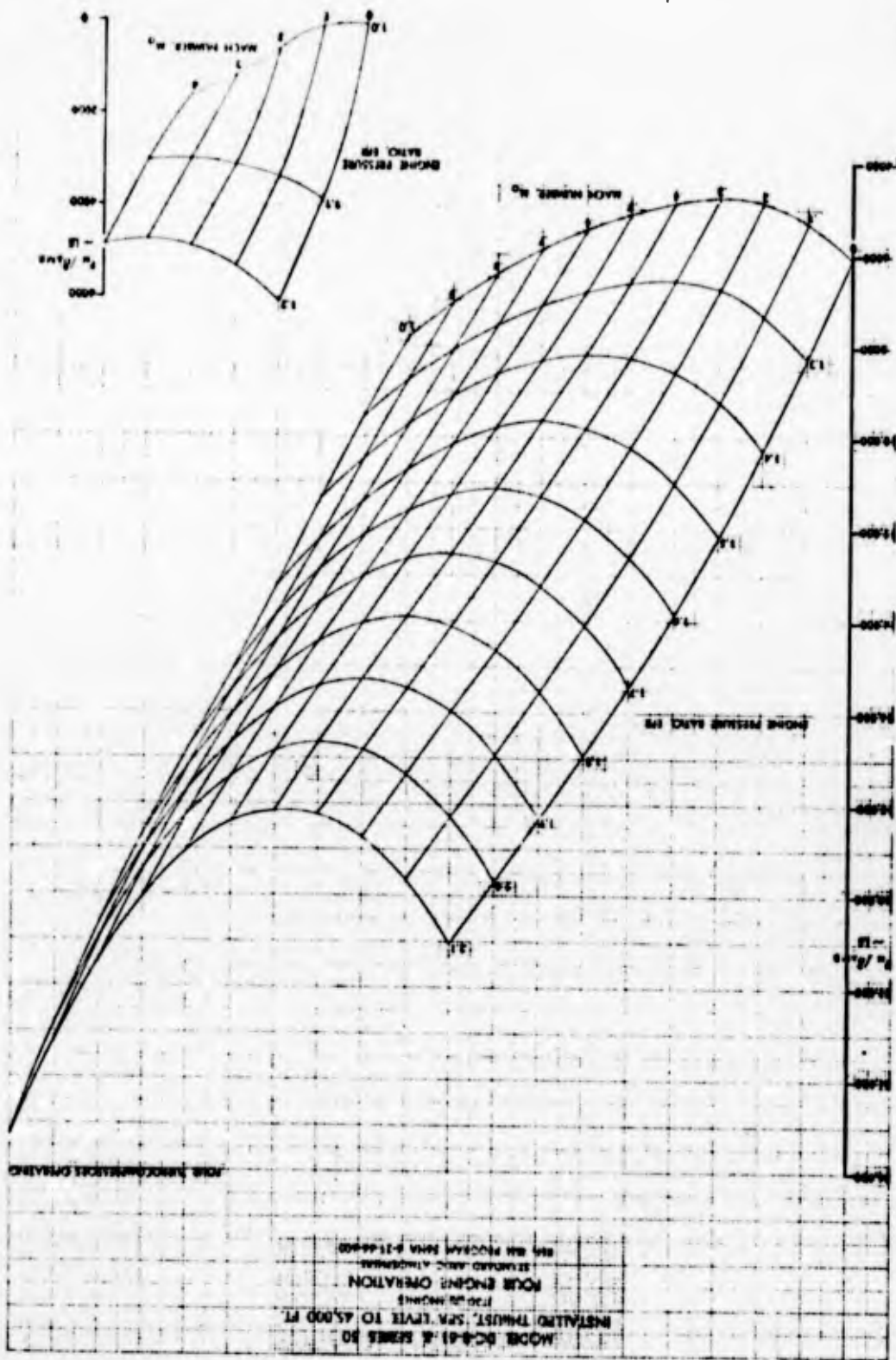
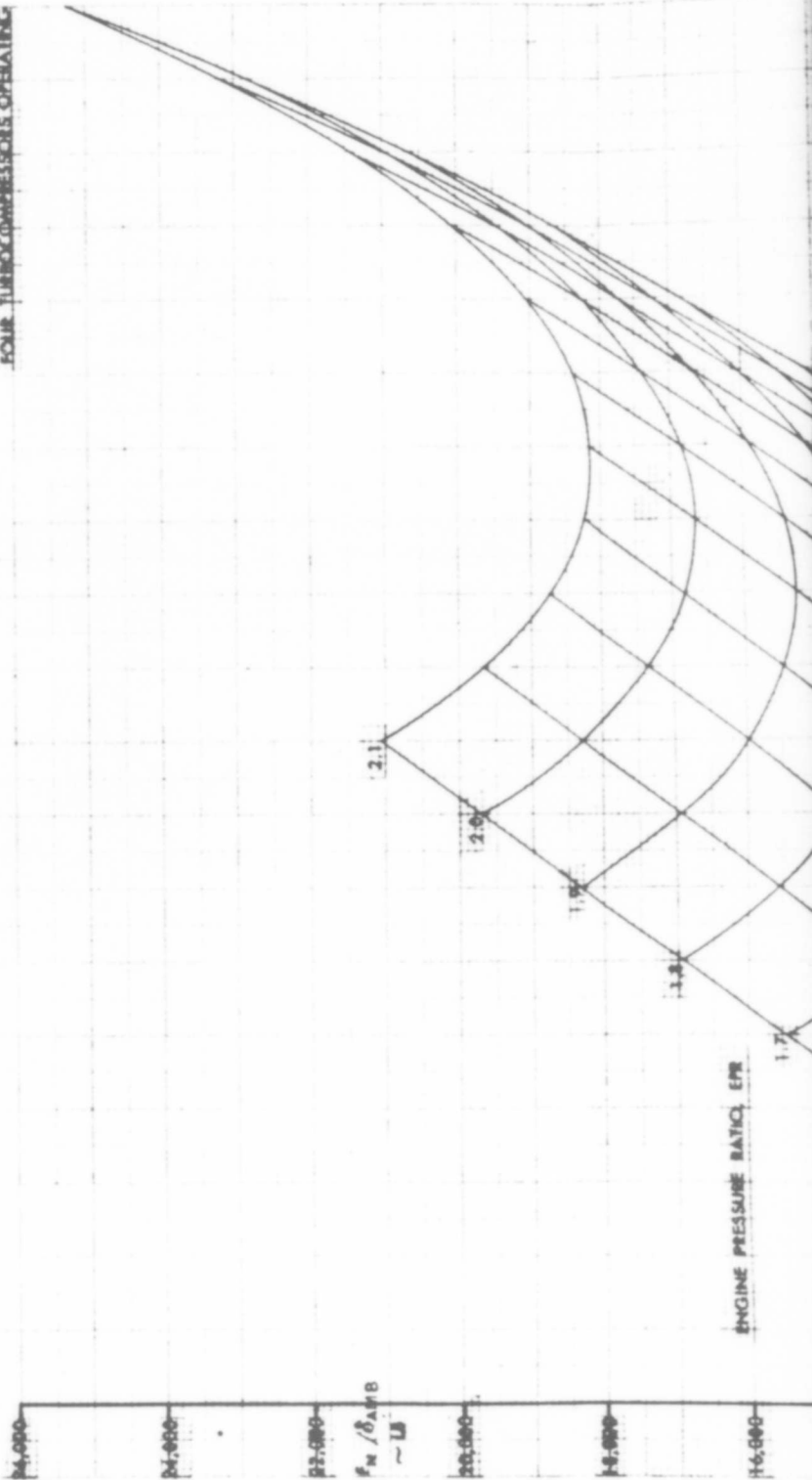


FIGURE 16.

MODEL BC-3-01-A SERIES 50
INSTALLED THRUST, SEA LEVEL TO 45,000 FT.
F30-50 ENGINES

FOUR ENGINE OPERATION
STANDARD AEDC-4 TURBOCOMPRESSORS
REF 344 PROGRAM 54NA 6-21-66-600

FOUR TURBOCOMPRESSORS OPERATING



ENGINE PRESSURE RATIO, EPR

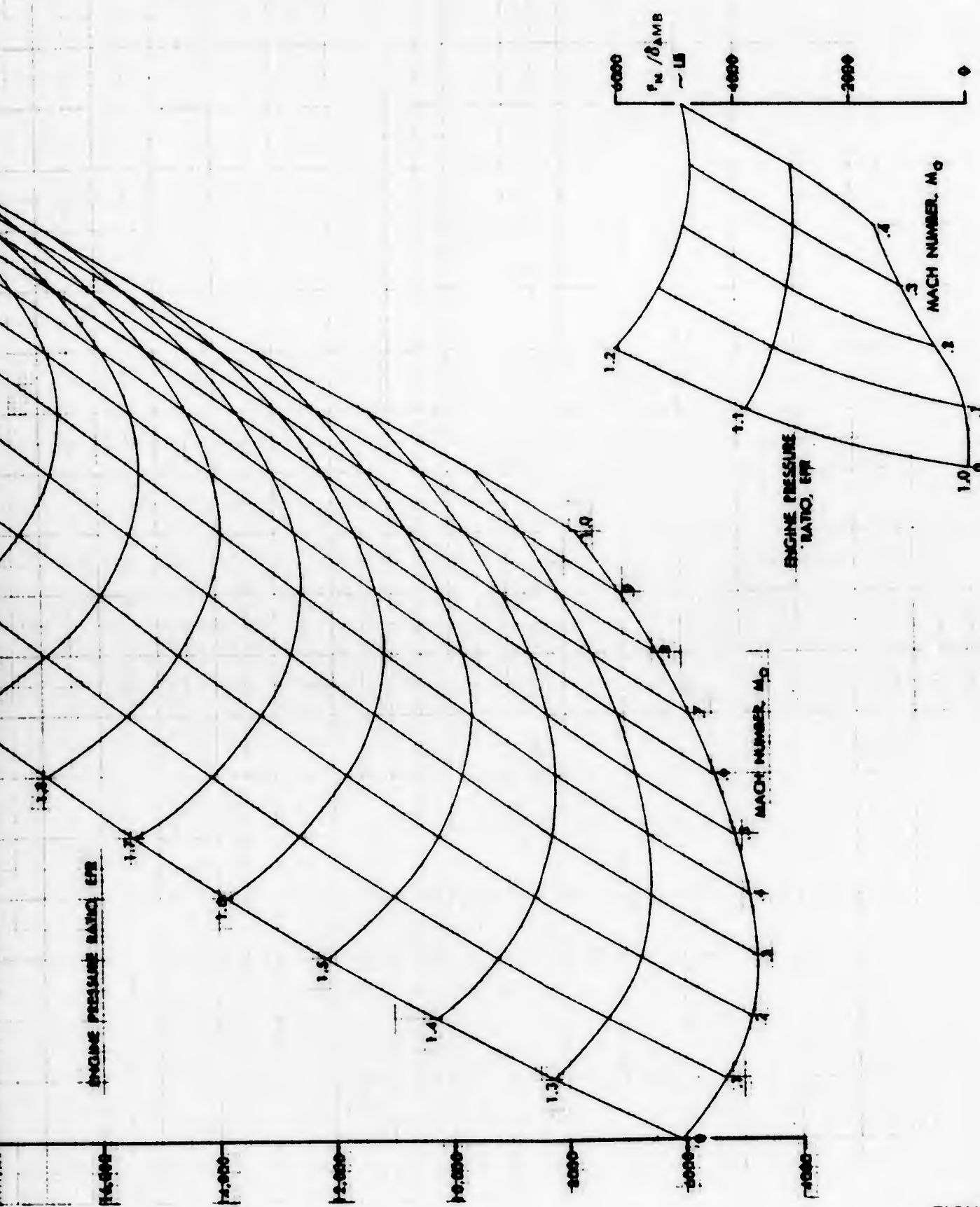
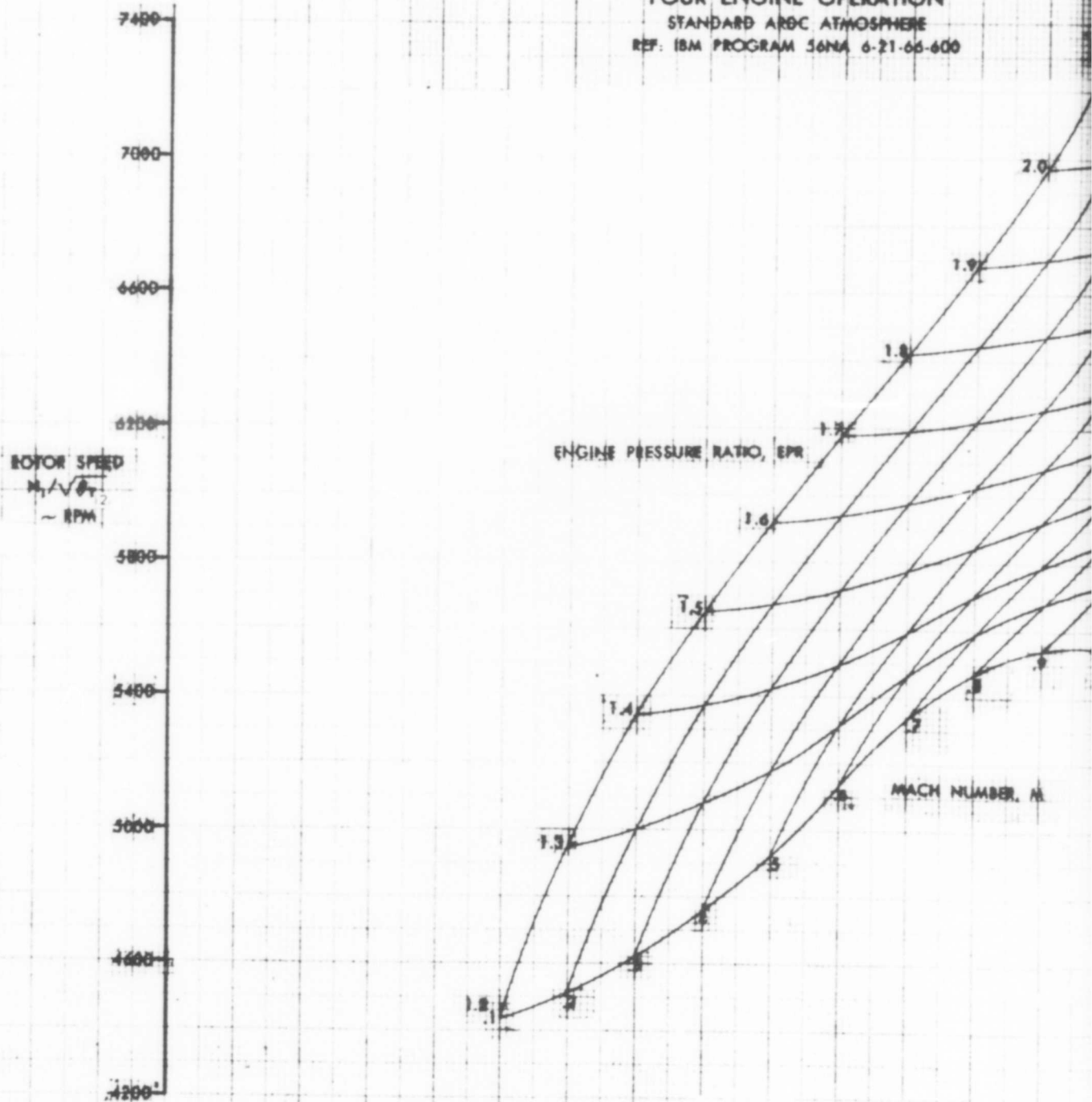


FIGURE 16.

6

MODEL DC-8-61 & SERIES 50
 INSTALLED LOW PRESSURE ROTOR SPEED, SEA LEVEL TO 45,000 FT
 JT3D-3B ENGINES
 FOUR ENGINE OPERATION
 STANDARD ARDC ATMOSPHERE
 REF. IBM PROGRAM 56NA 6-21-66-600



X

SERIES 50
 FROM SEA LEVEL TO 45,000 FT.
 STANDARD ATMOSPHERE
 16-21-66-600

FOUR TURBOCOMPRESSORS OPERATING

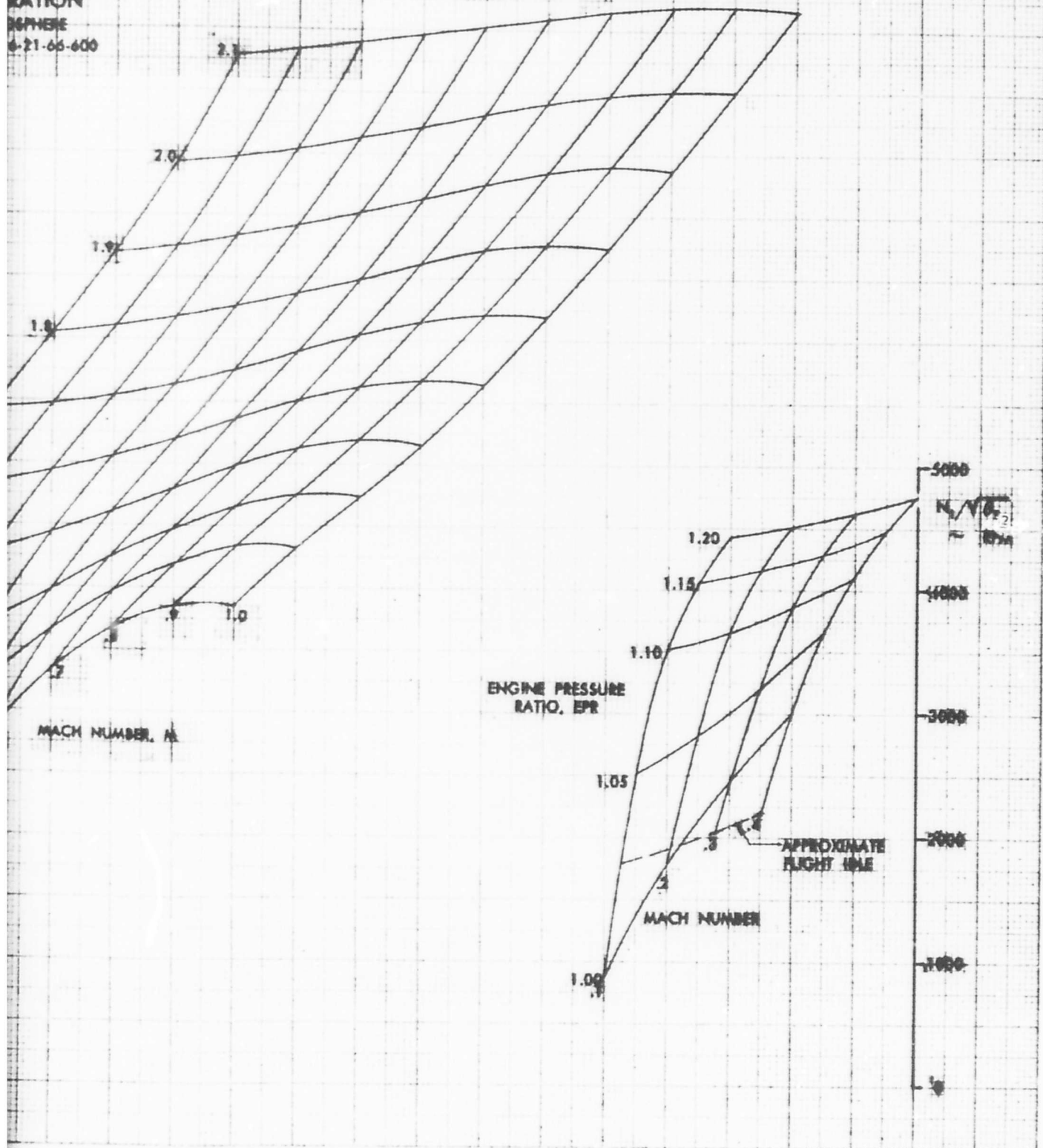


FIGURE 17.

B

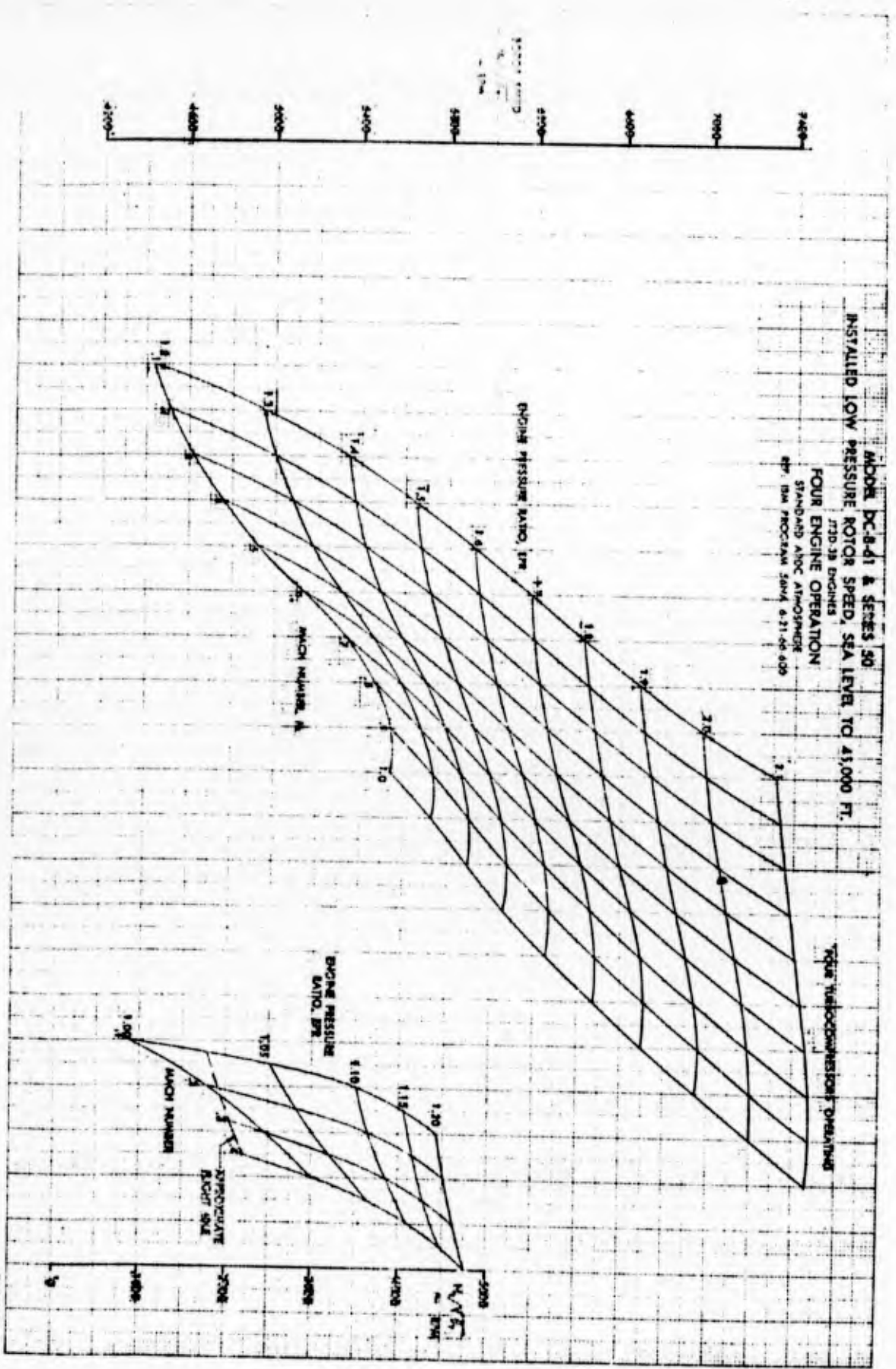


FIGURE 17.

2.4 DC-8-63

2.4.1 Aircraft Description

The DC-8-63, shown in Figure 18, is a long-range stretched version of the DC-8 fan-jets powered by four Pratt and Whitney Aircraft JT3D-7 engines in the long fan-duct configuration. Figure 19 is a dimensioned three-view drawing of the aircraft. The maximum gross weights are 355,000 pounds for takeoff and 258,000 pounds for landing. The seating capacity (high density) is 252.

The engine rating is 19,000 pounds flat rated to 84°F and the bypass ratio is approximately 1.4.

2.4.2 Acoustic Data

Figures 20 and 21 present the EPNL and A-weighted sound level versus distance curves. The curves developed from data acquired during a Douglas-funded test of a DC-8-63F with JT3D-7 engines. The data were originally recorded on analog magnetic tape and were reprocessed using simulated flight paths to transfer the data to the digitized form. This reprocessing is described in Appendix G. The power settings range from 4000 pounds to the takeoff thrust of 15,800 pounds.

The noise levels of the DC-8-63, in general, are somewhat lower than the DC-8-61 for reasons that are not fully understood. The change is due, in part, to the altered directivity pattern of the noise caused by the differences in the engine inlets and the use of the long versus short fan-duct nacelles.

2.4.3 Performance Data

Takeoff flight paths are presented in Figures 22 through 24 for 12-deg flaps and in Figures 25 through 27 for 23-deg flaps for various runway altitudes. These data combined with the cutback data in Figures 28, 29, and 30 provide aircraft height and thrust level for determining the noise levels from Figures 20 or 21. Figure 31 shows the power required during approach in terms of referred fan speed.

Curves relating the engine parameters are presented in Figures 32 and 33.

The $N_1 / \sqrt{\theta_{T_2}}$ correction for change in altitude is applied for aircraft operation at pressure altitudes above sea level. The increase in fan speed with altitude is required to overcome engine losses that increase with altitude. It is seen that for the altitude range used in this report, the correction is small and may be neglected.

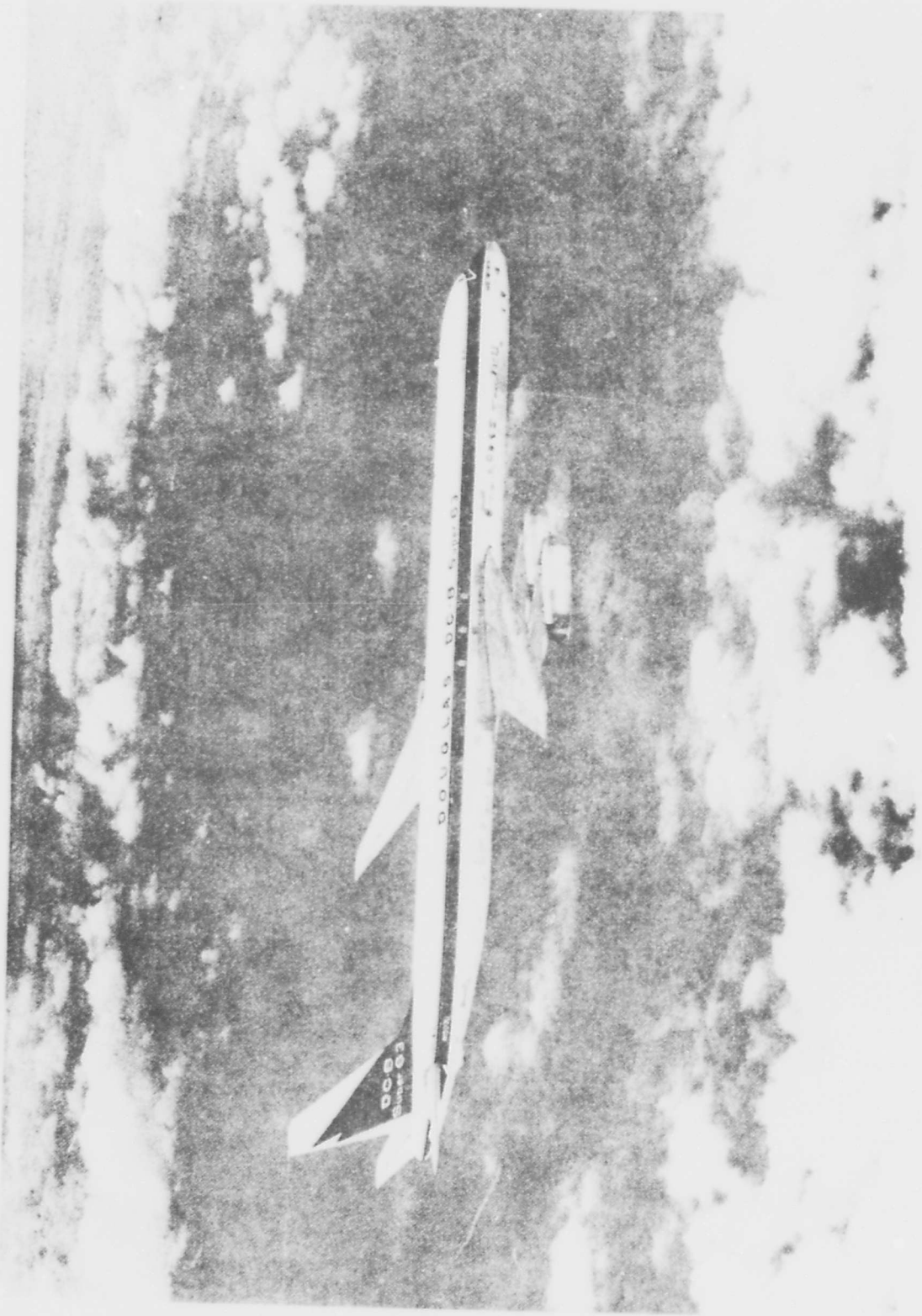
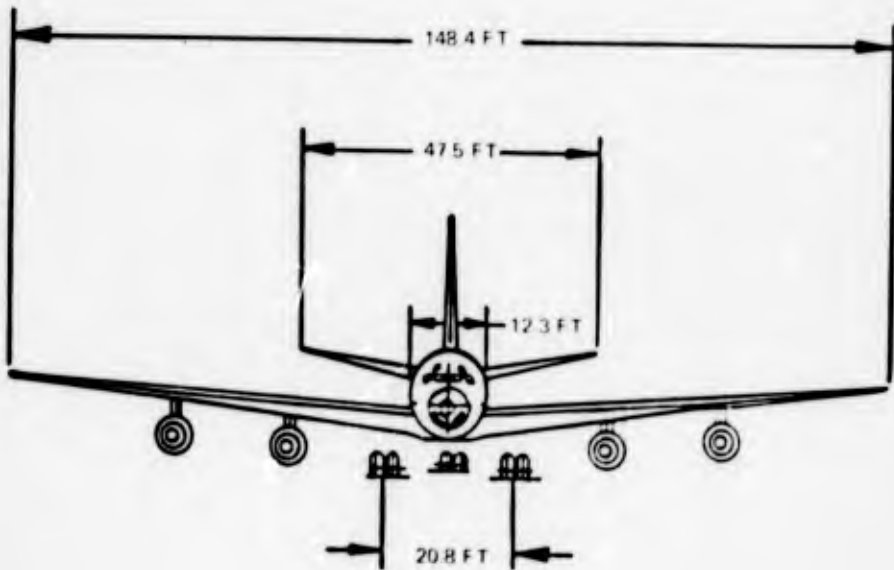


FIGURE 18.



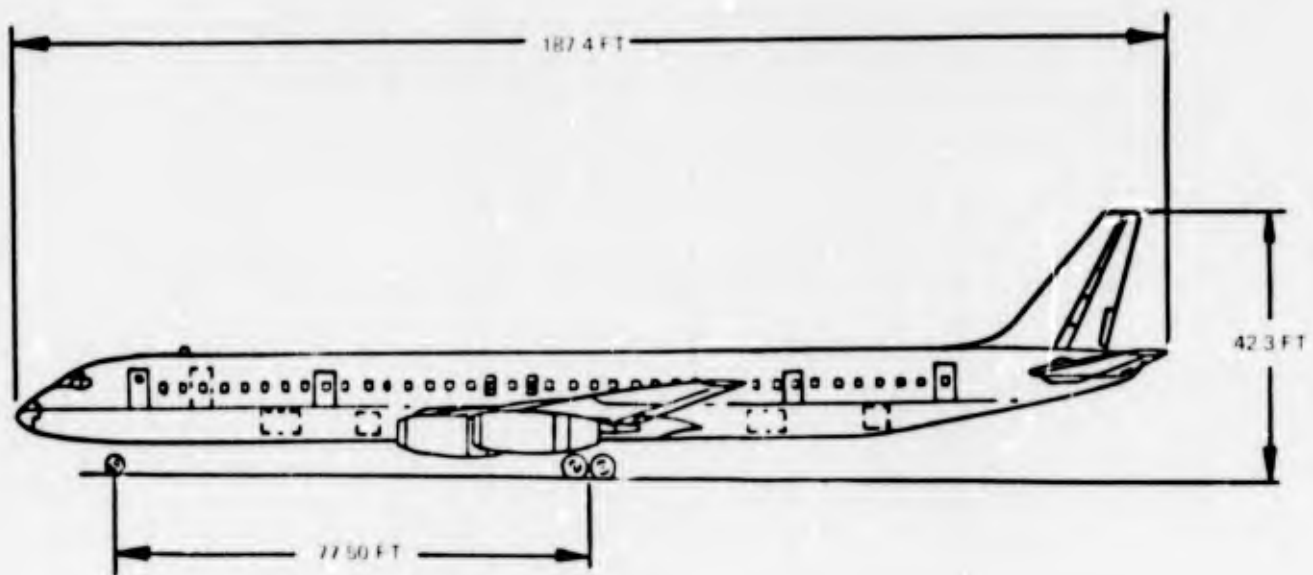
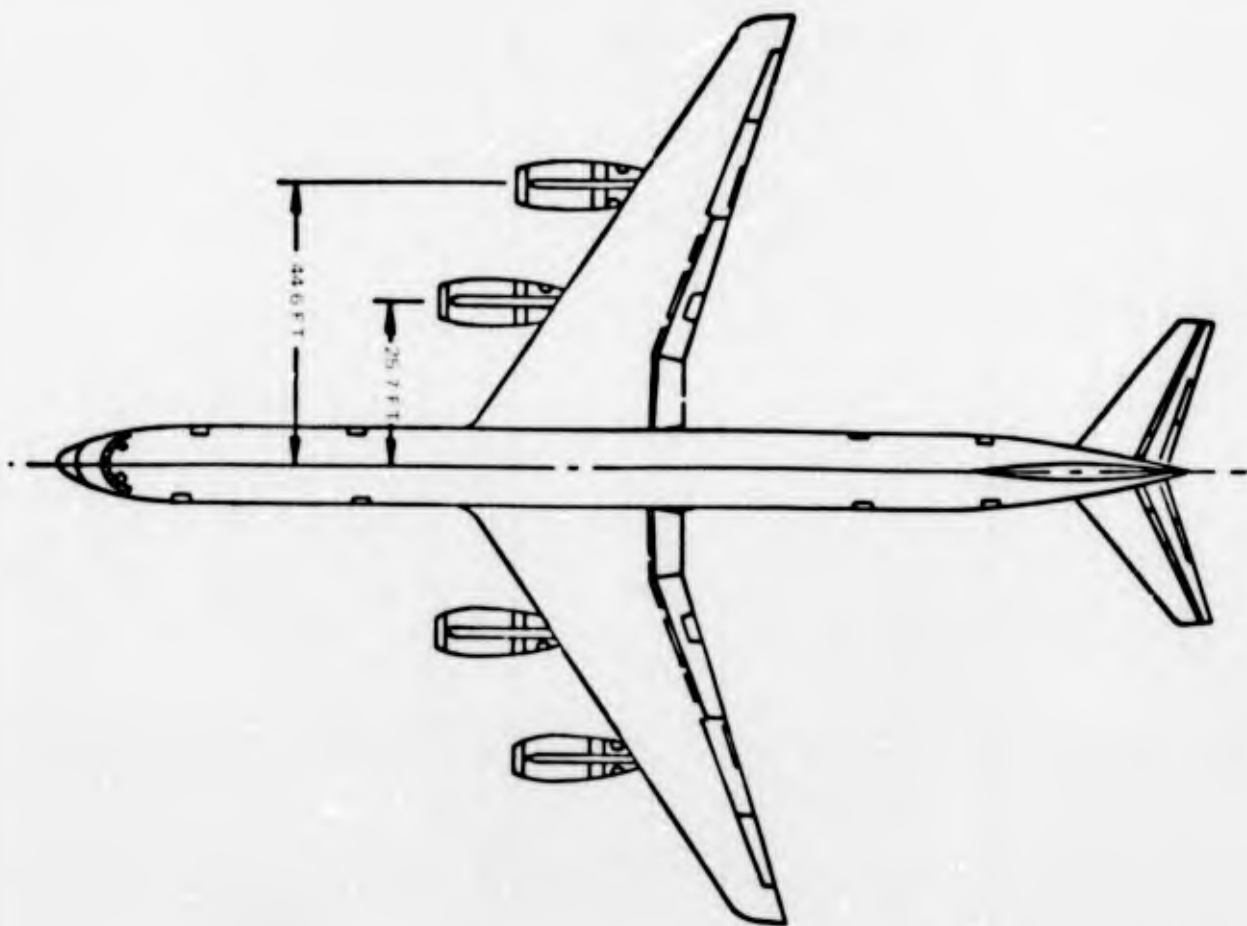


FIGURE 19. DC-8-63

B

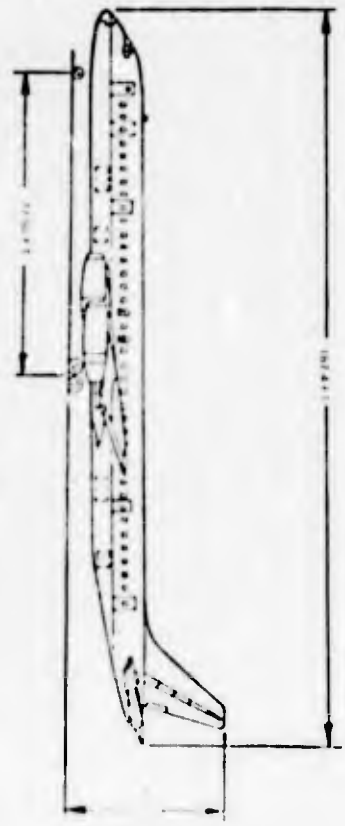
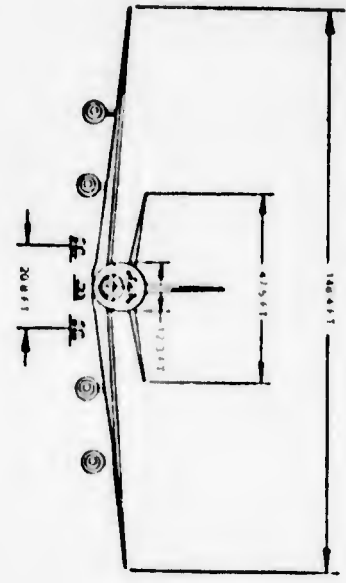
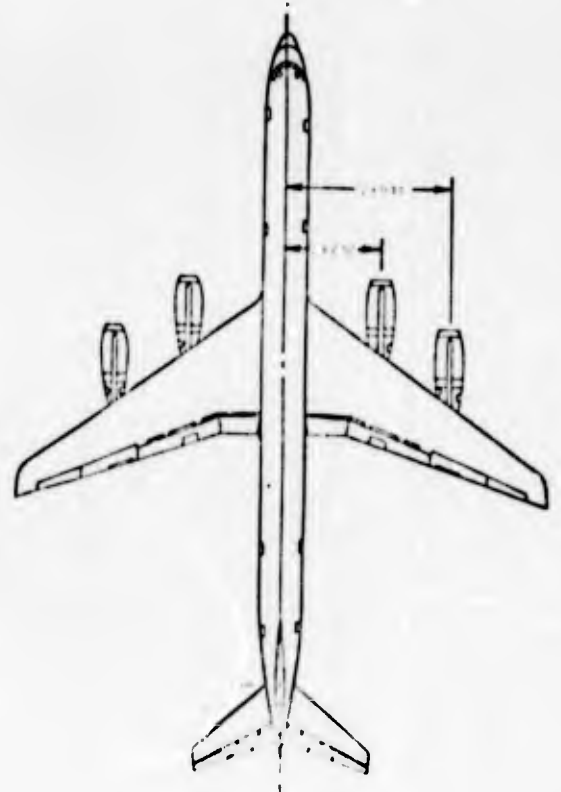


FIGURE 19 DC 8 83



DATE AUGUST 30, 1973

FLYOVER NOISE LEVELS

DC-8-63

FOUR JT3D-7 ENGINES

TEMP 77°F
REL HUM 70%

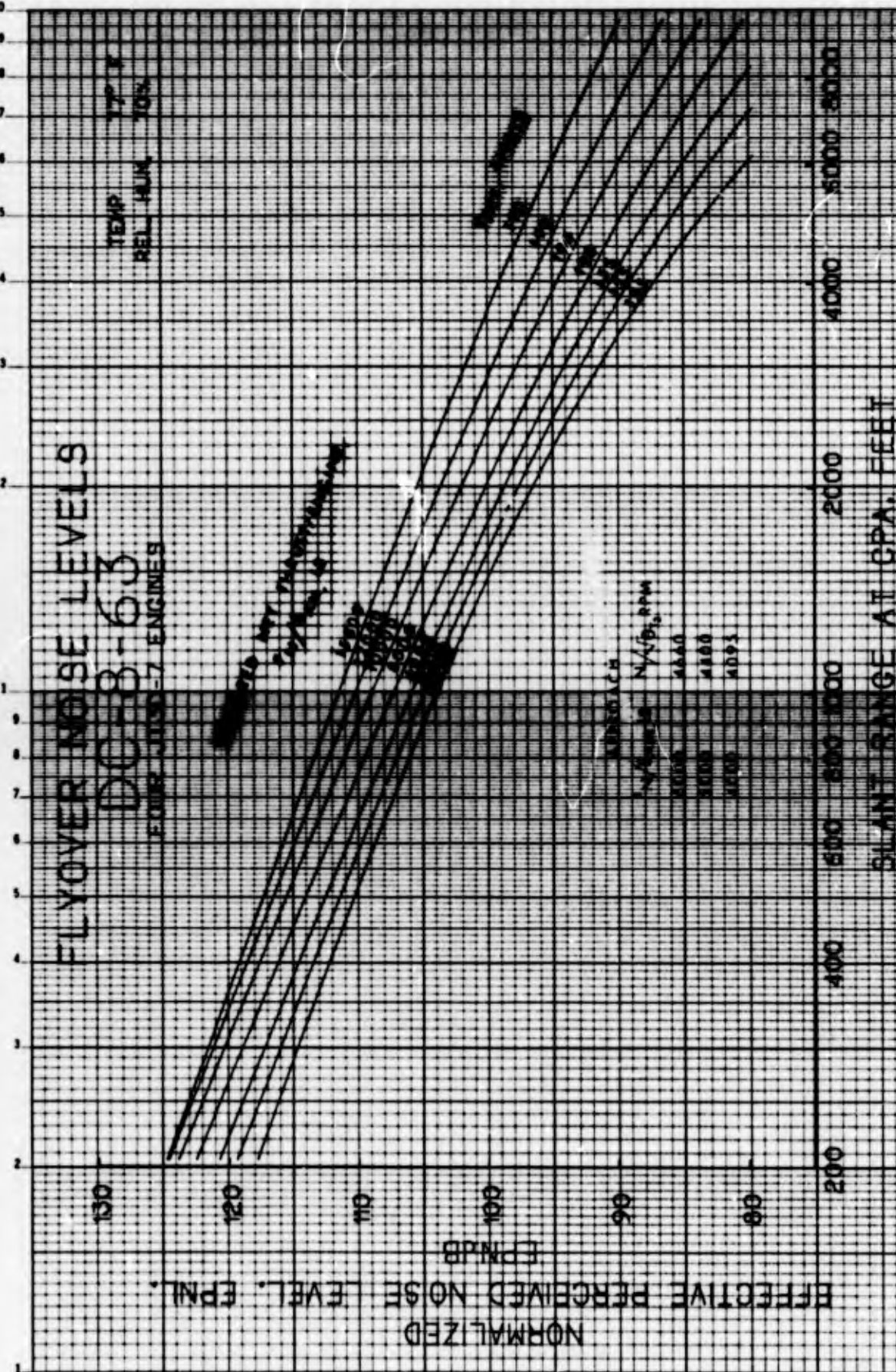


FIGURE 20.

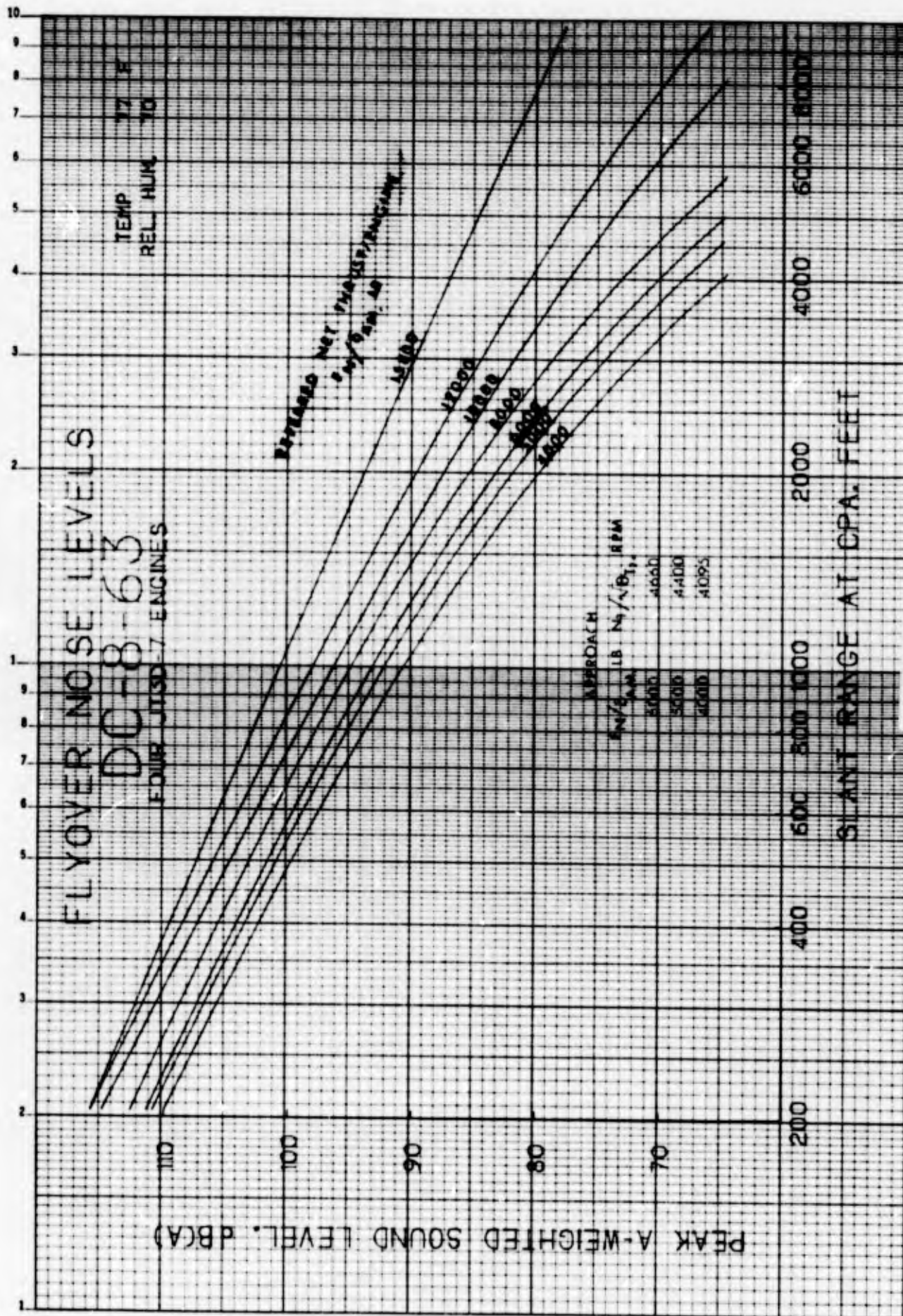


FIGURE 21.

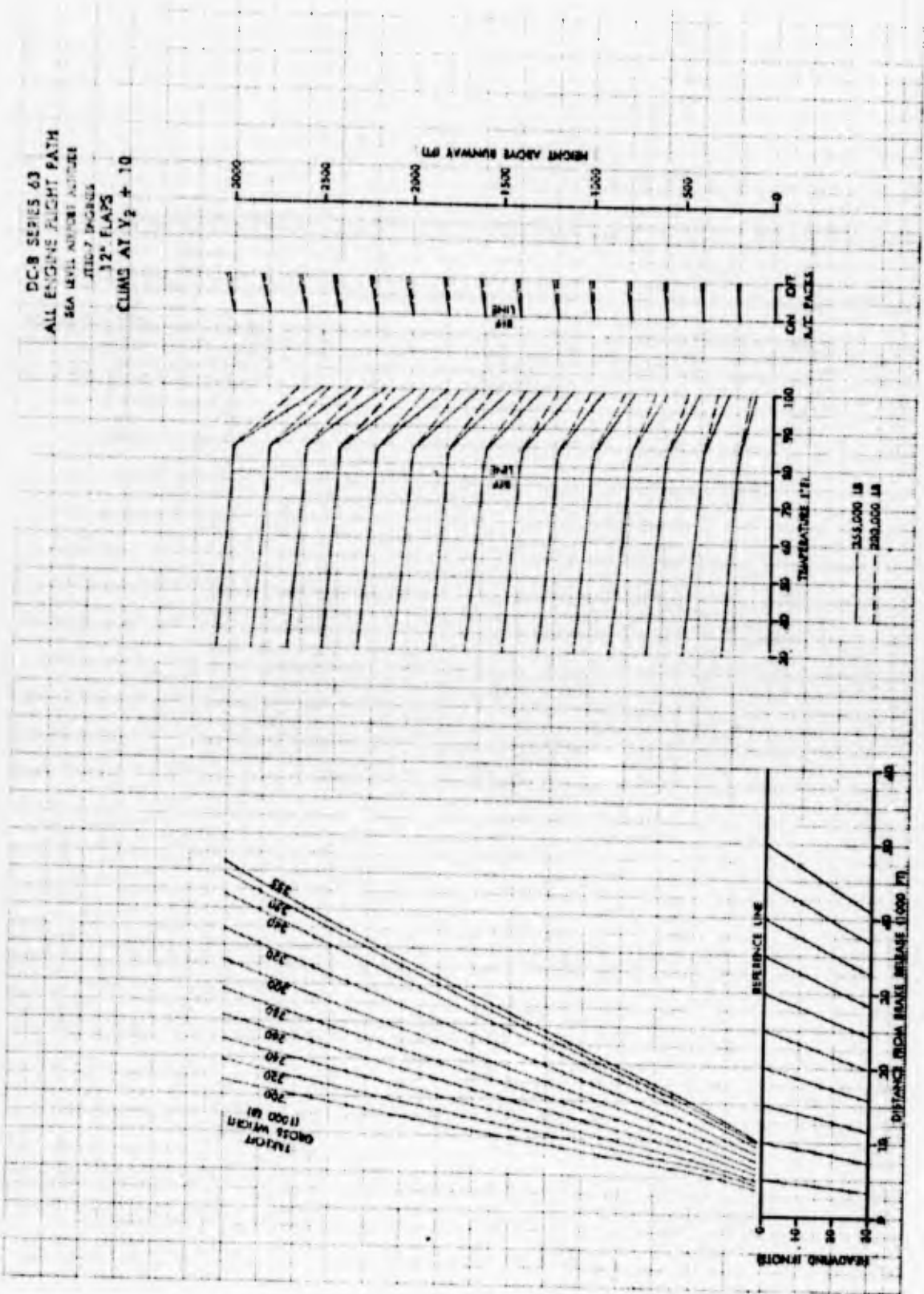
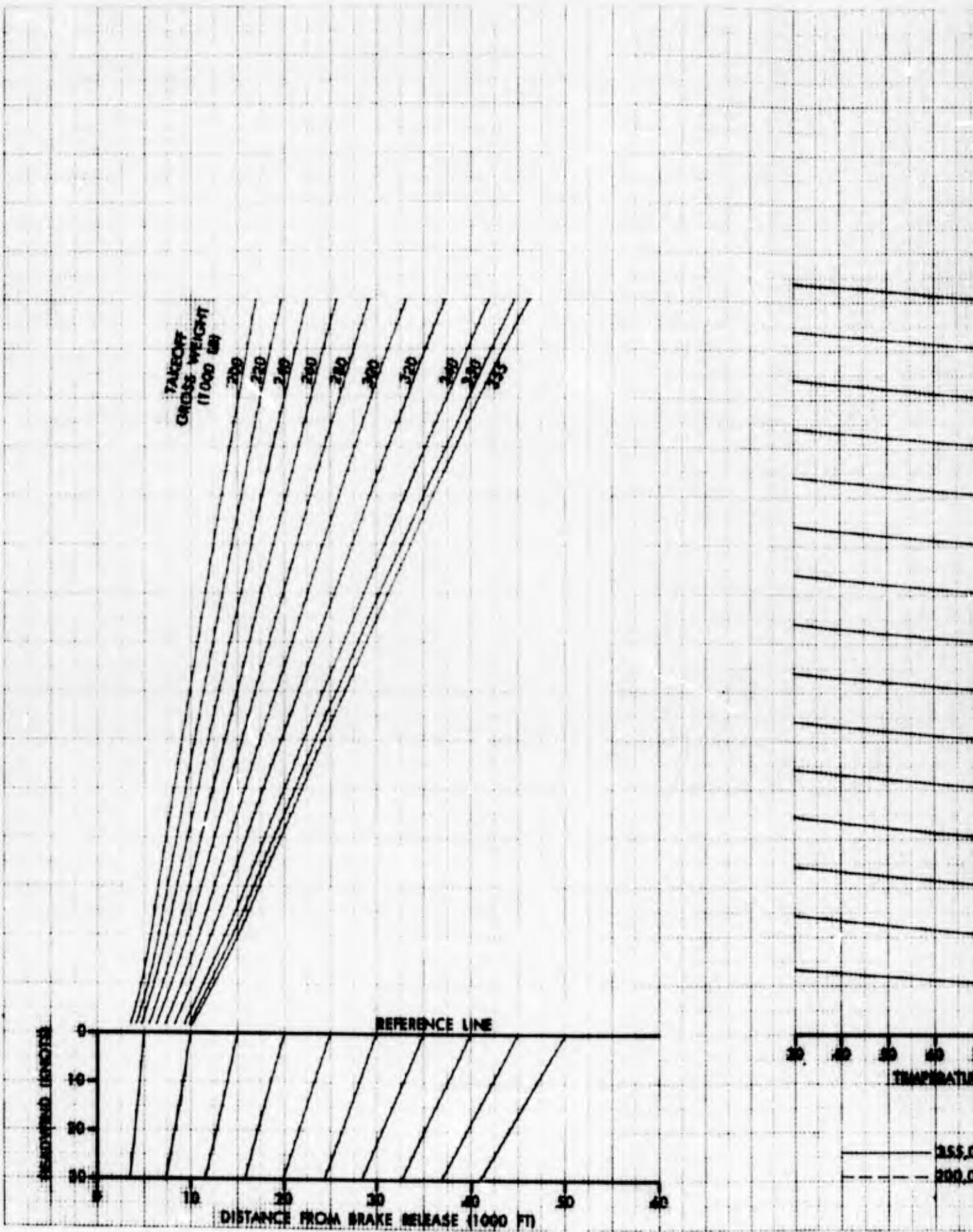


FIGURE 22



A

DC-8 SERIES 63
 ALL ENGINE FLIGHT PATH
 SEA LEVEL AIRPORT ALTITUDE
 STD. 7 DEGREE
 12° FLAPS
 CLIMB AT $V_2 + 10$

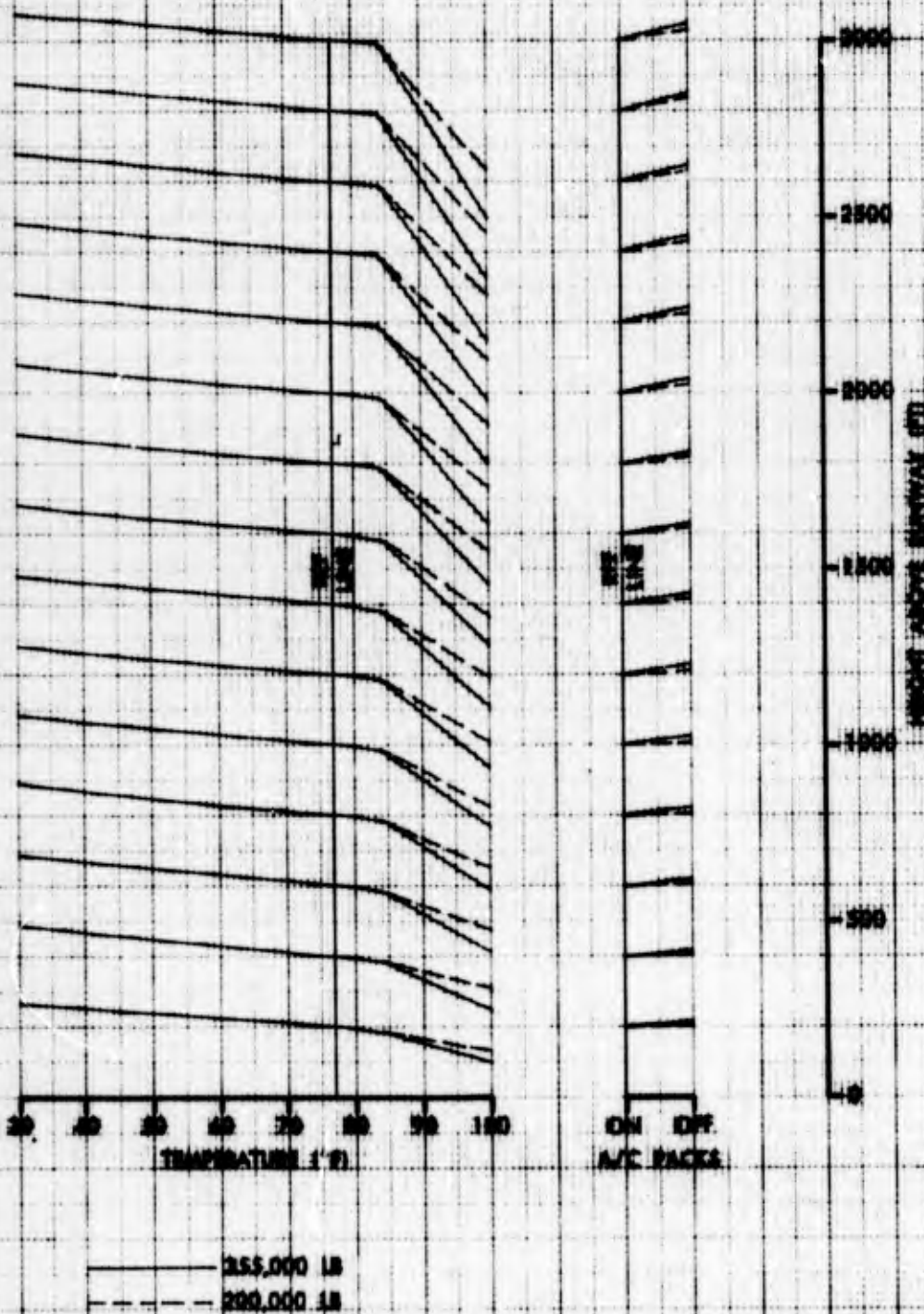
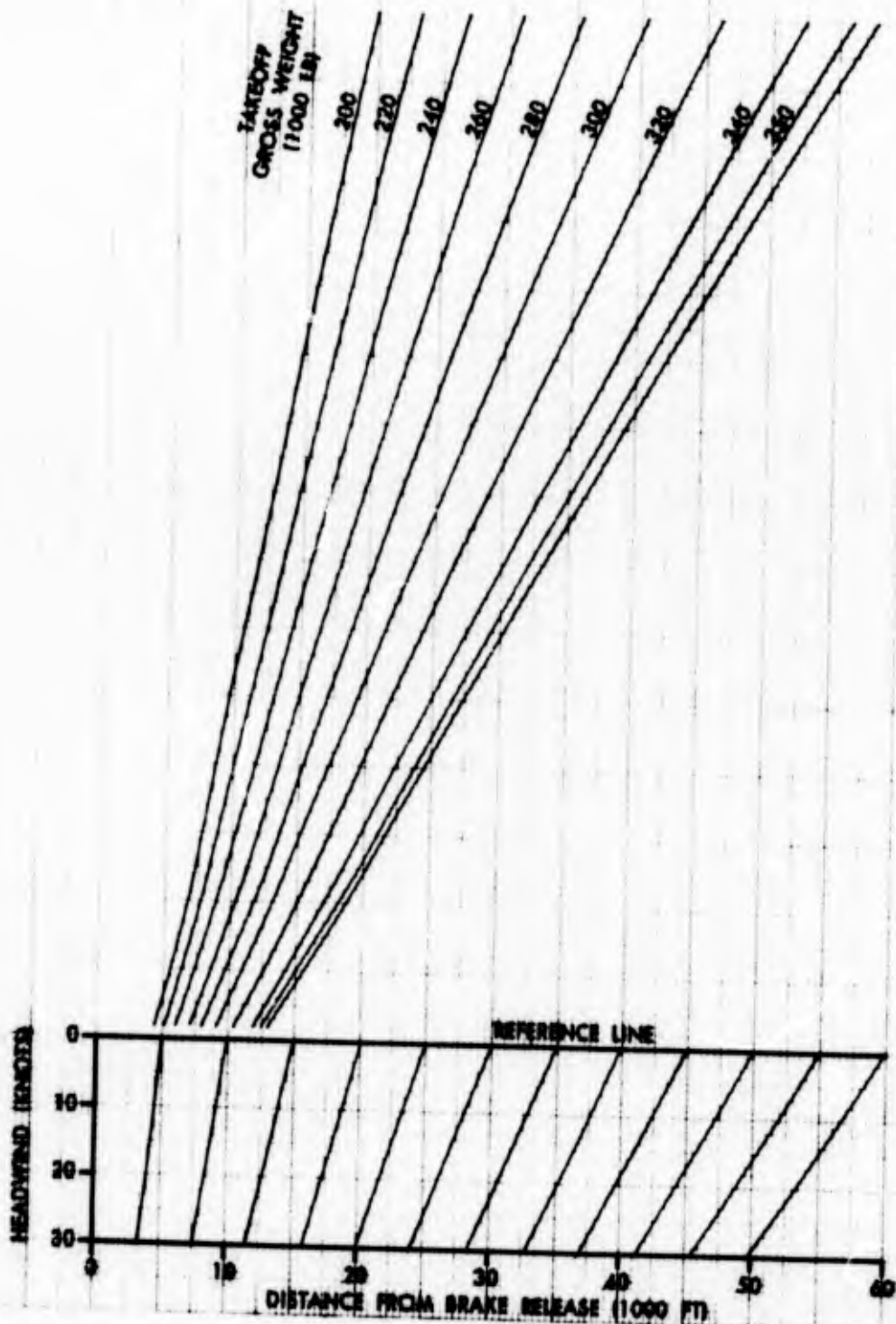


FIGURE 22.

B



DC-8 SERIES 63
 ALL ENGINE FLIGHT PATH
 3000 FT AIRPORT ALTITUDE
 JT3D-7 ENGINES
 12° FLAPS
 CLIMB AT $V_2 + 10$

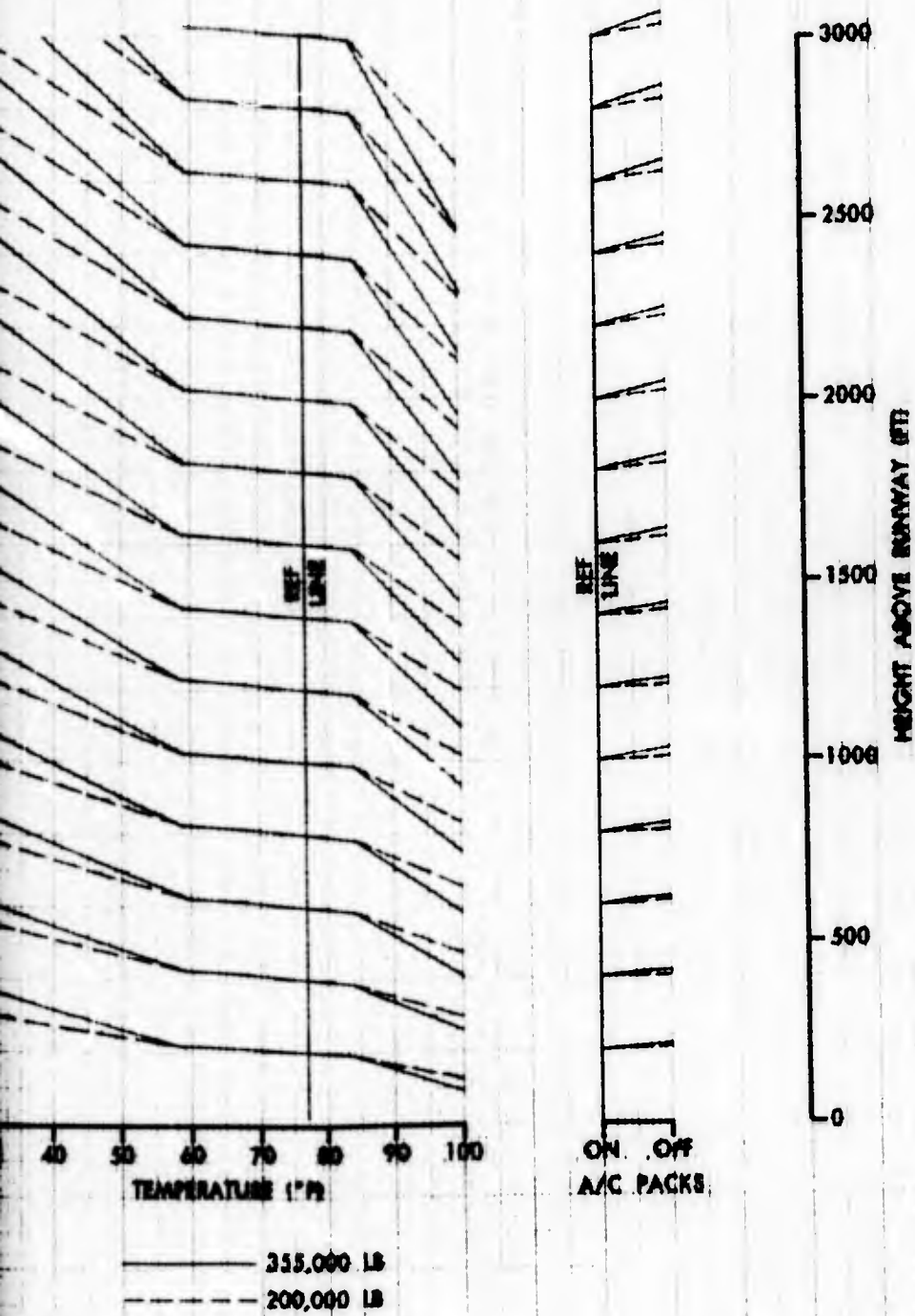


FIGURE 23.

B

DC-8 SERIES 63
 ALL ENGINE FLIGHT PATH
 3000 FT ASPECT ALTITUDE
 J25-7 ENGINES
 12° FLAPS
 CLIMB AT $V_2 + 10$

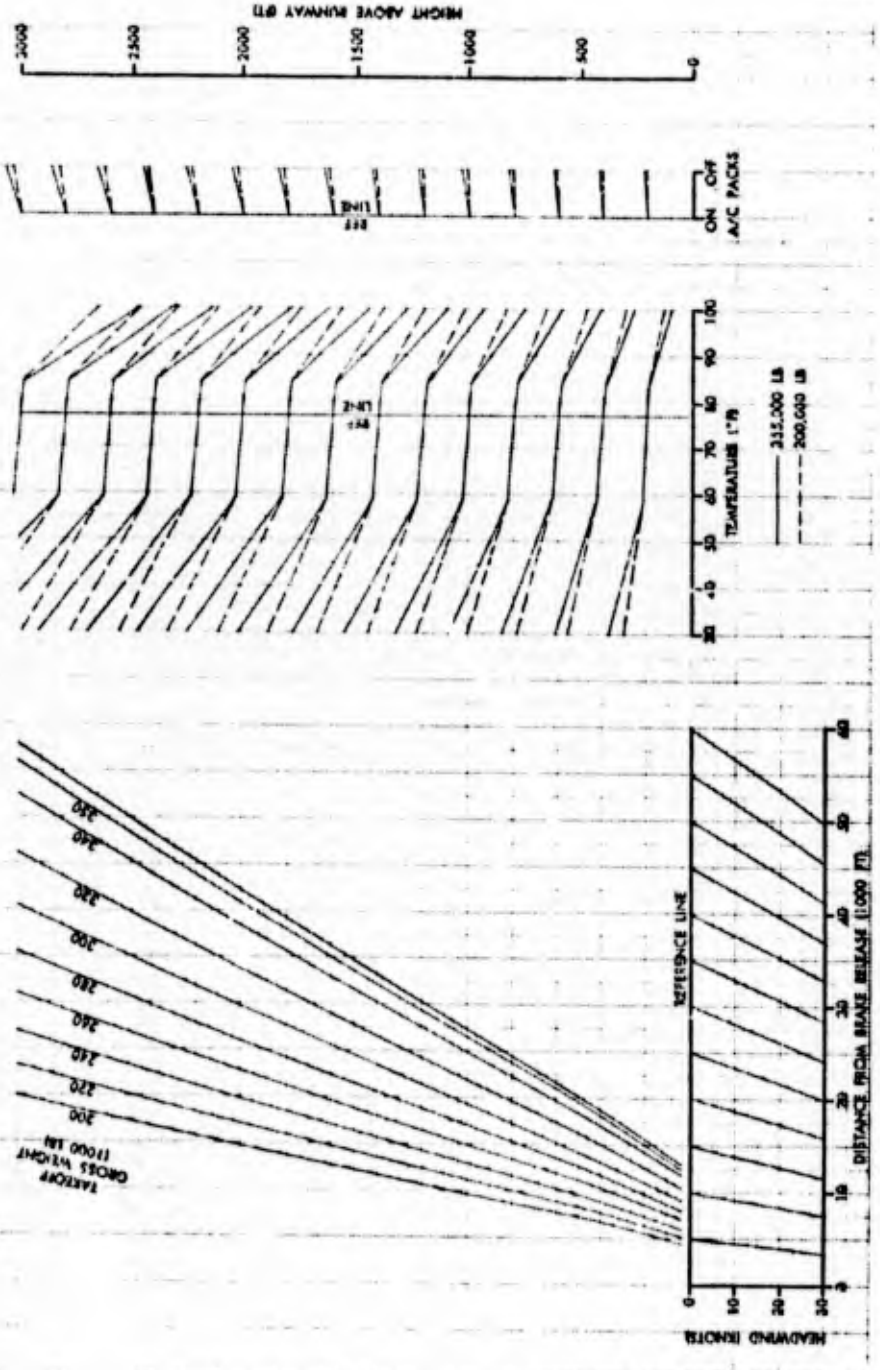


FIGURE 23

DC-8 SERIES 63
 ALL ENGINE FLIGHT PATH
 8000 FT AIRCRAFT ALTITUDE
 JET-7 ENGINES
 12° FLAPS
 CLIMB AT $V_2 + 10$

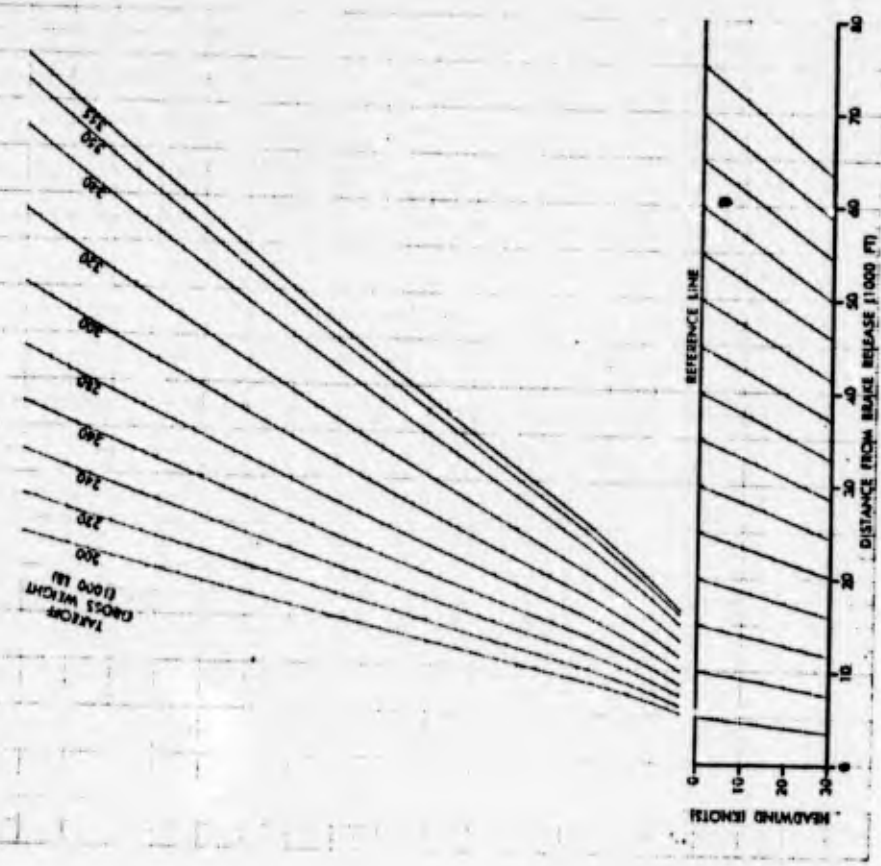
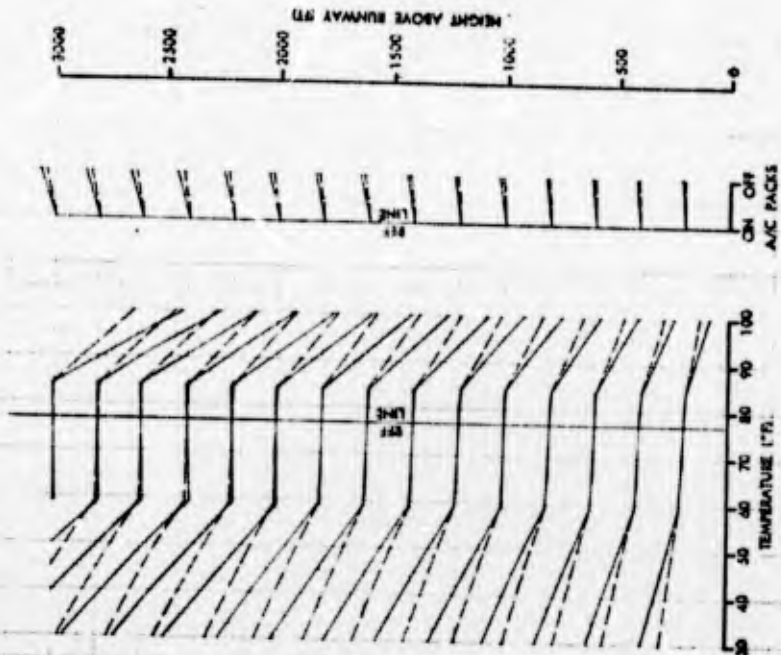
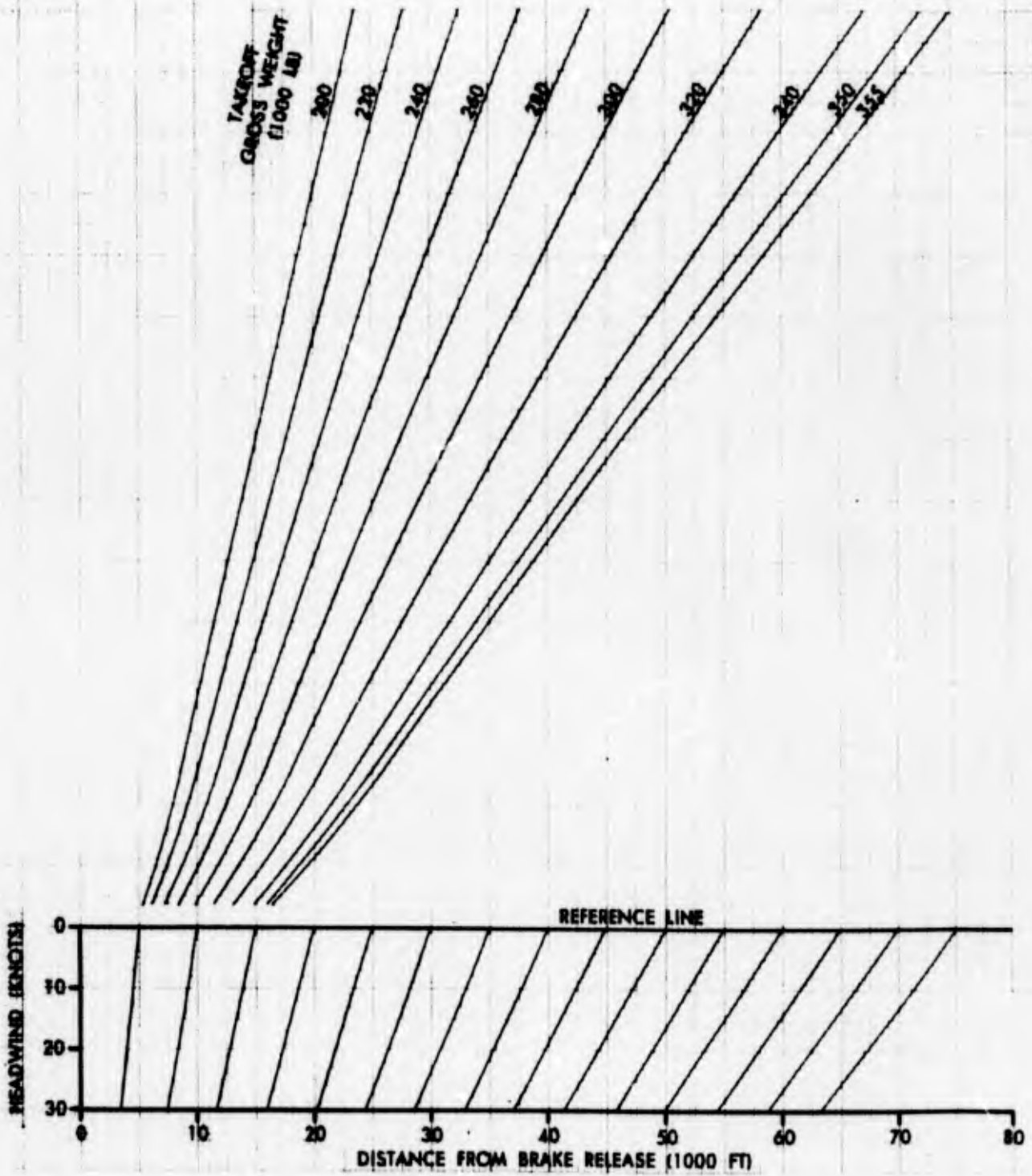


FIGURE 24



R

DC-8 SERIES 63
 ALL ENGINE FLIGHT PATH
 6000 FT AIRPORT ALTITUDE
 JT3D-7 ENGINES
 12° FLAPS
 CLIMB AT $V_2 + 10$

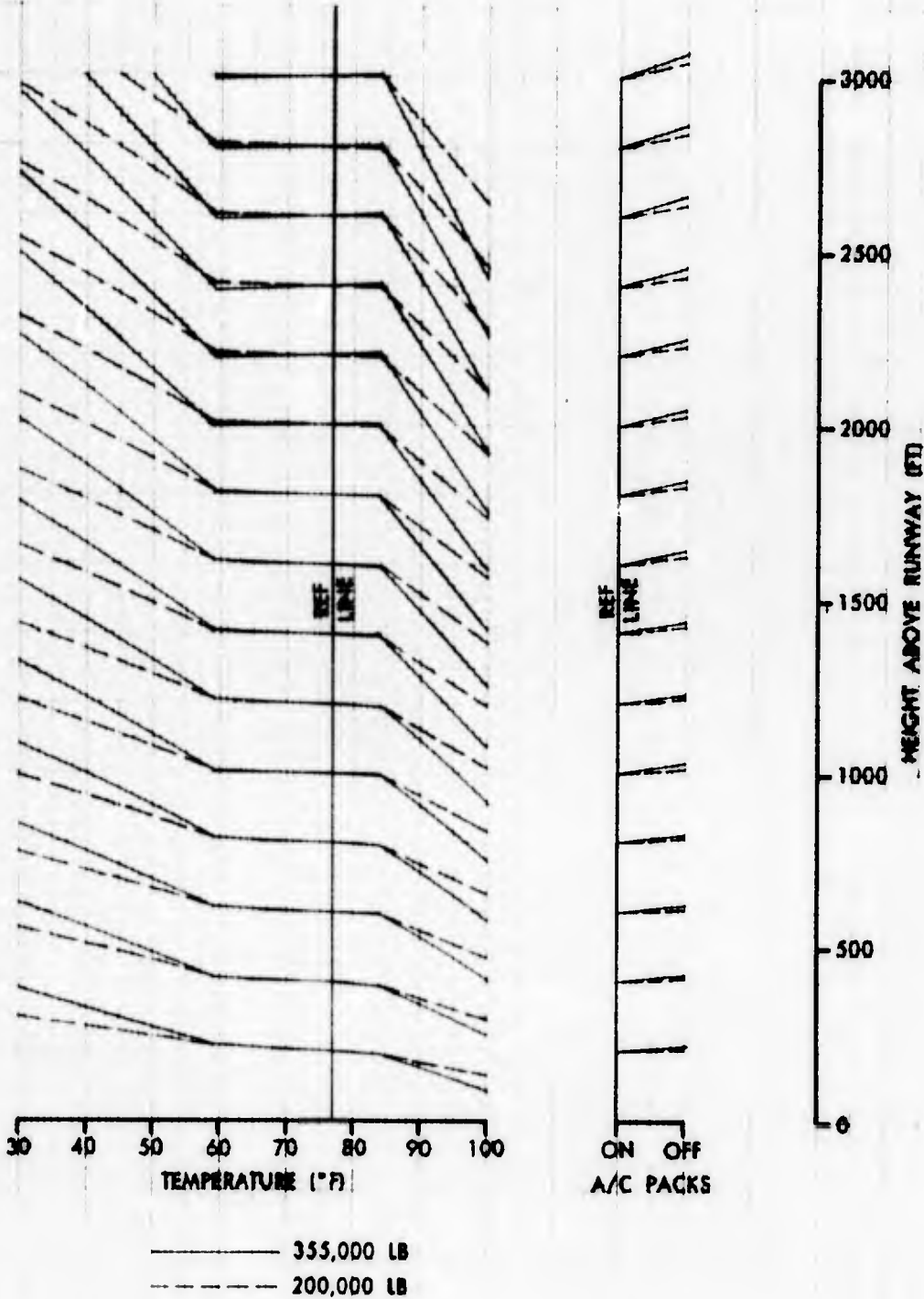
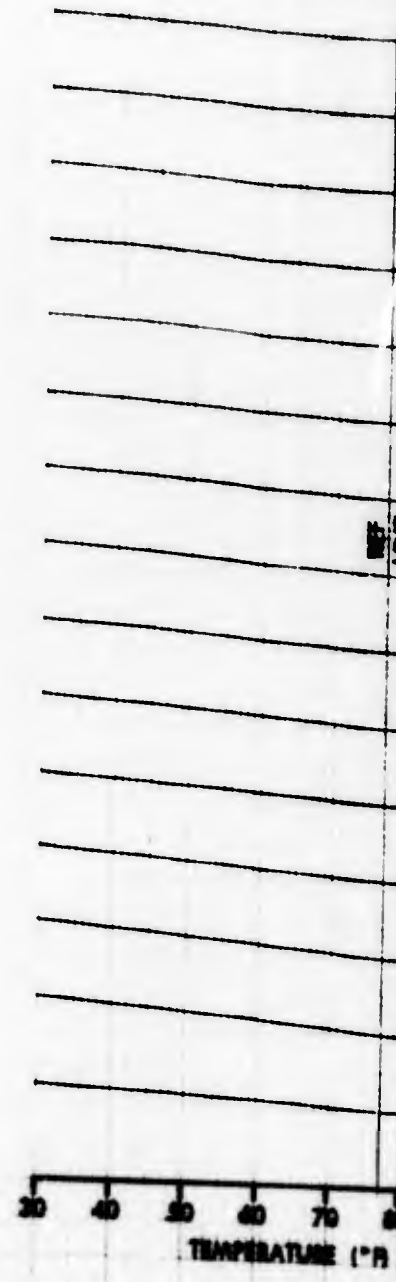
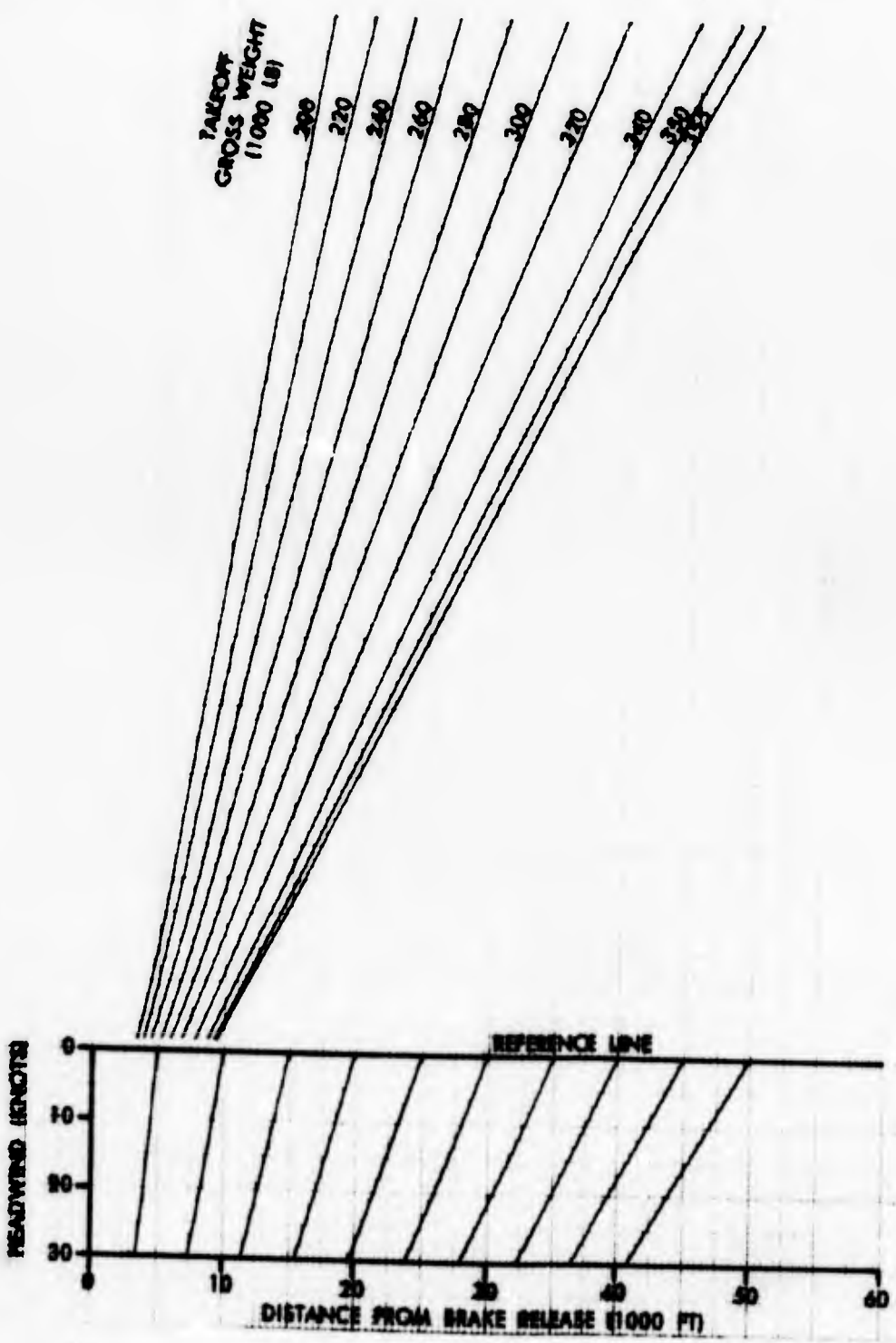


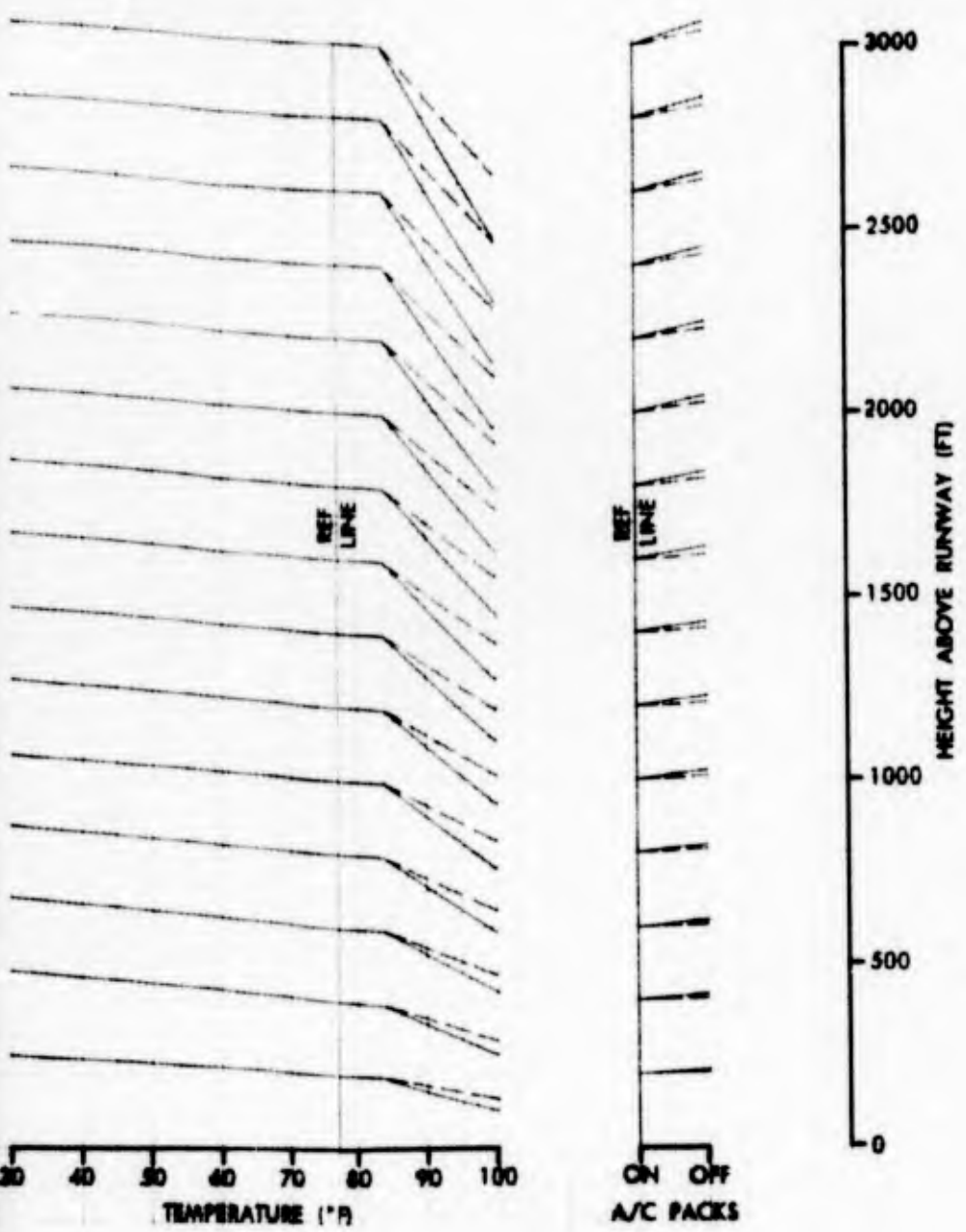
FIGURE 24.

B



355.00
200.00

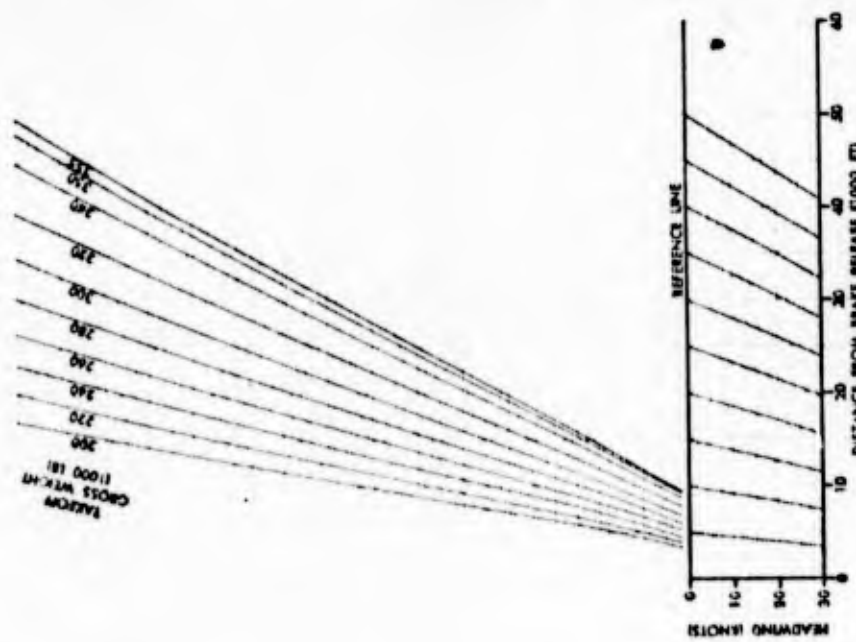
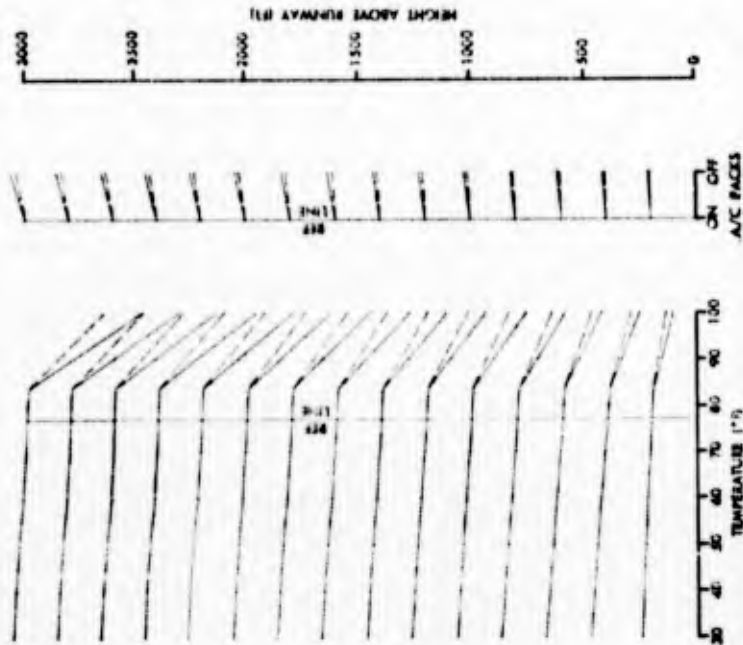
DC-8 SERIES 63
 ALL ENGINE FLIGHT PATH
 SEA LEVEL AIRPORT ALTITUDE
 JT3D-7 ENGINES
 23° FLAPS
 CLIMB AT $V_2 + 10$



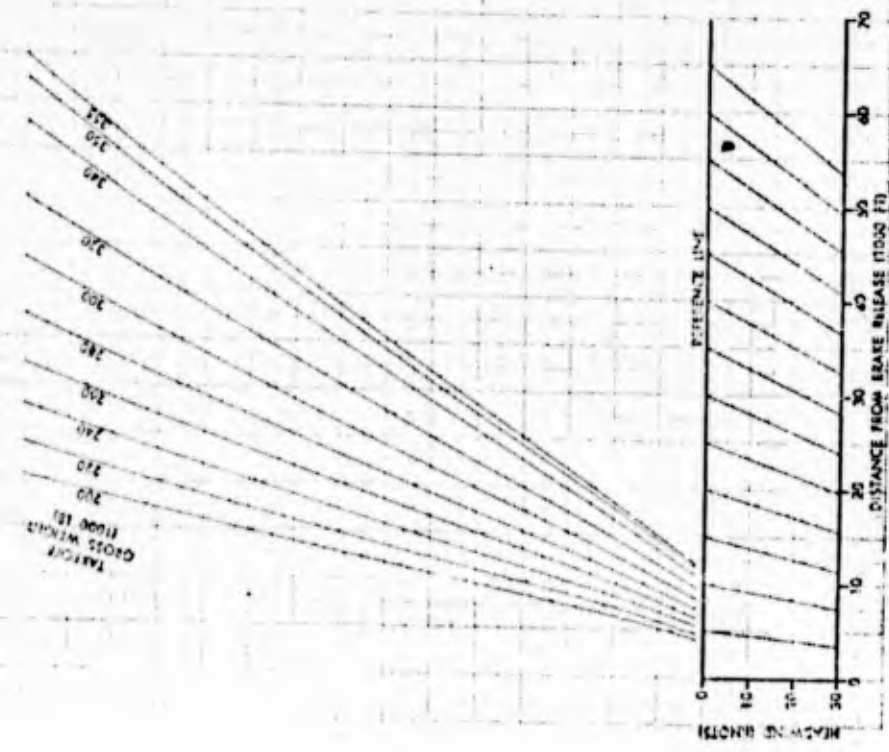
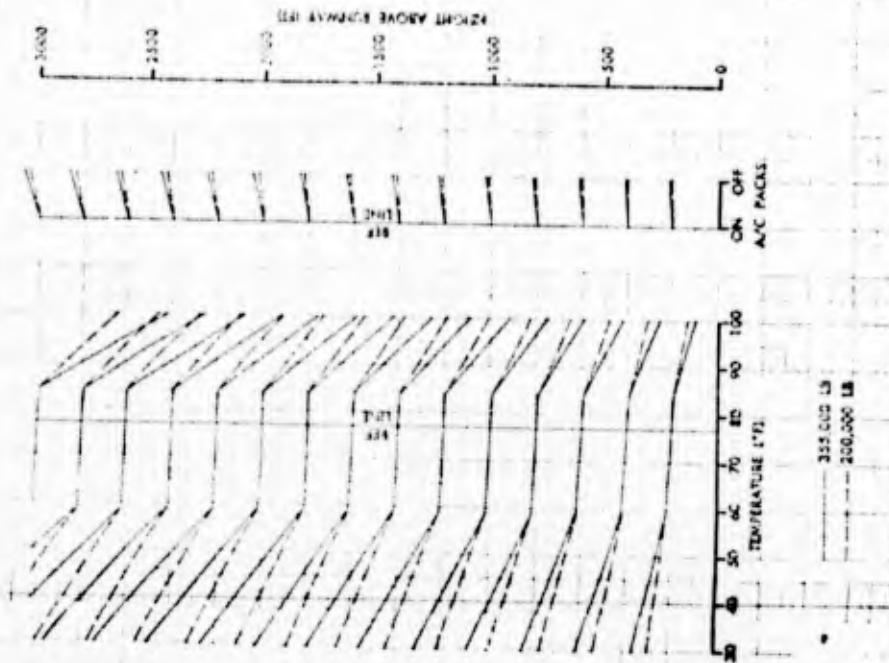
355,000 LB
 200,000 LB

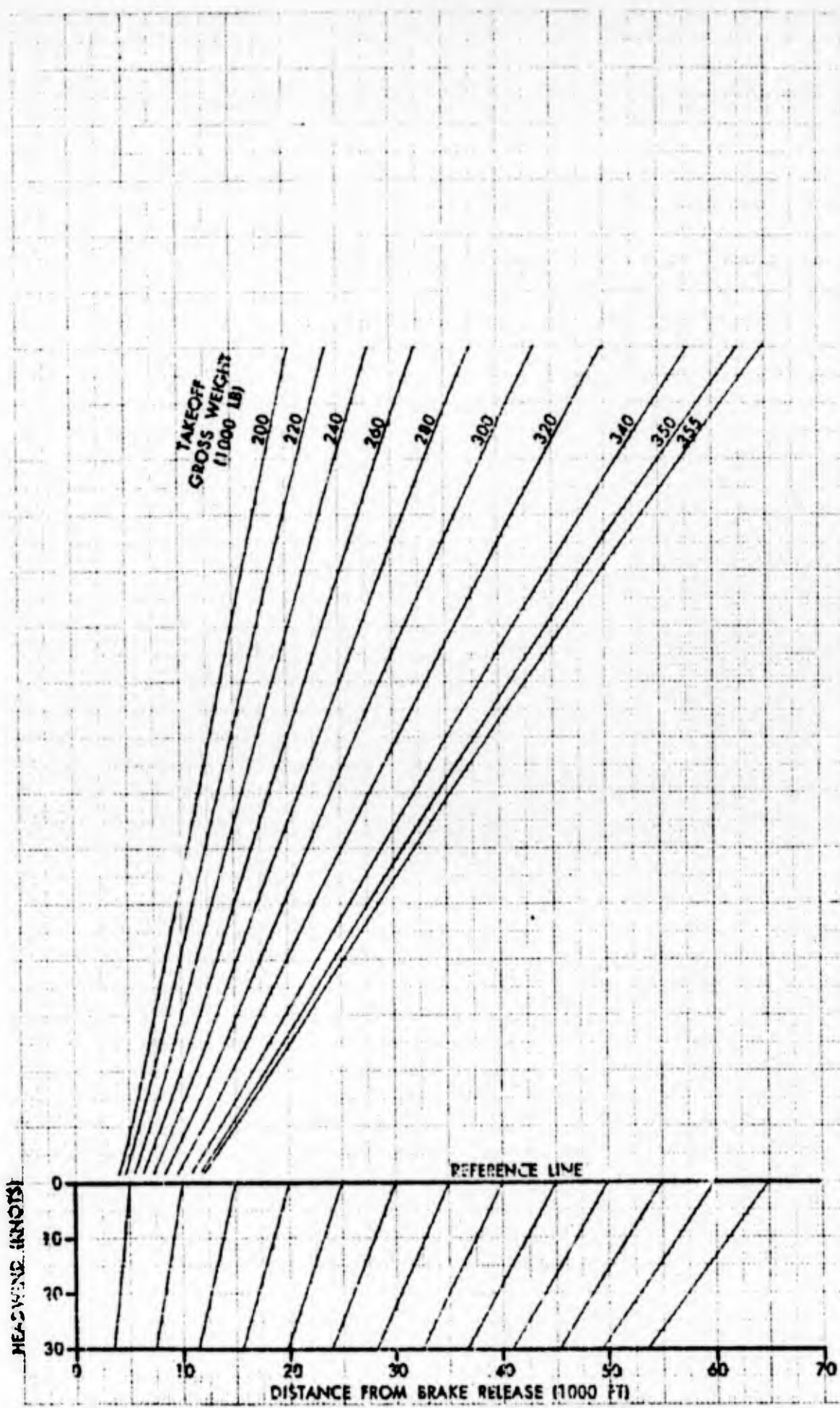
FIGURE 25.

DC-8 SERIES 03
 ALL ENGINE FLIGHT PATH
 SEA LEVEL AIRPORT ALTITUDE
 JET 7 ENGINES
 23° FLAPS
 CLIMB AT $V_2 + 10$



DC-9 SERIES 63
 ALL ENGINE FLIGHT PATH
 3000 FT AEROD ALTITUDE
 2307 ENGINES
 23° FLAPS
 CLIMB AT $V_2 + 10$





DC-8 SERIES 63
ALL ENGINE FLIGHT PATH
3000 FT AIRPORT ALTITUDE
JT3D-7 ENGINES
23° FLAPS
CLIMB AT $V_2 + 10$

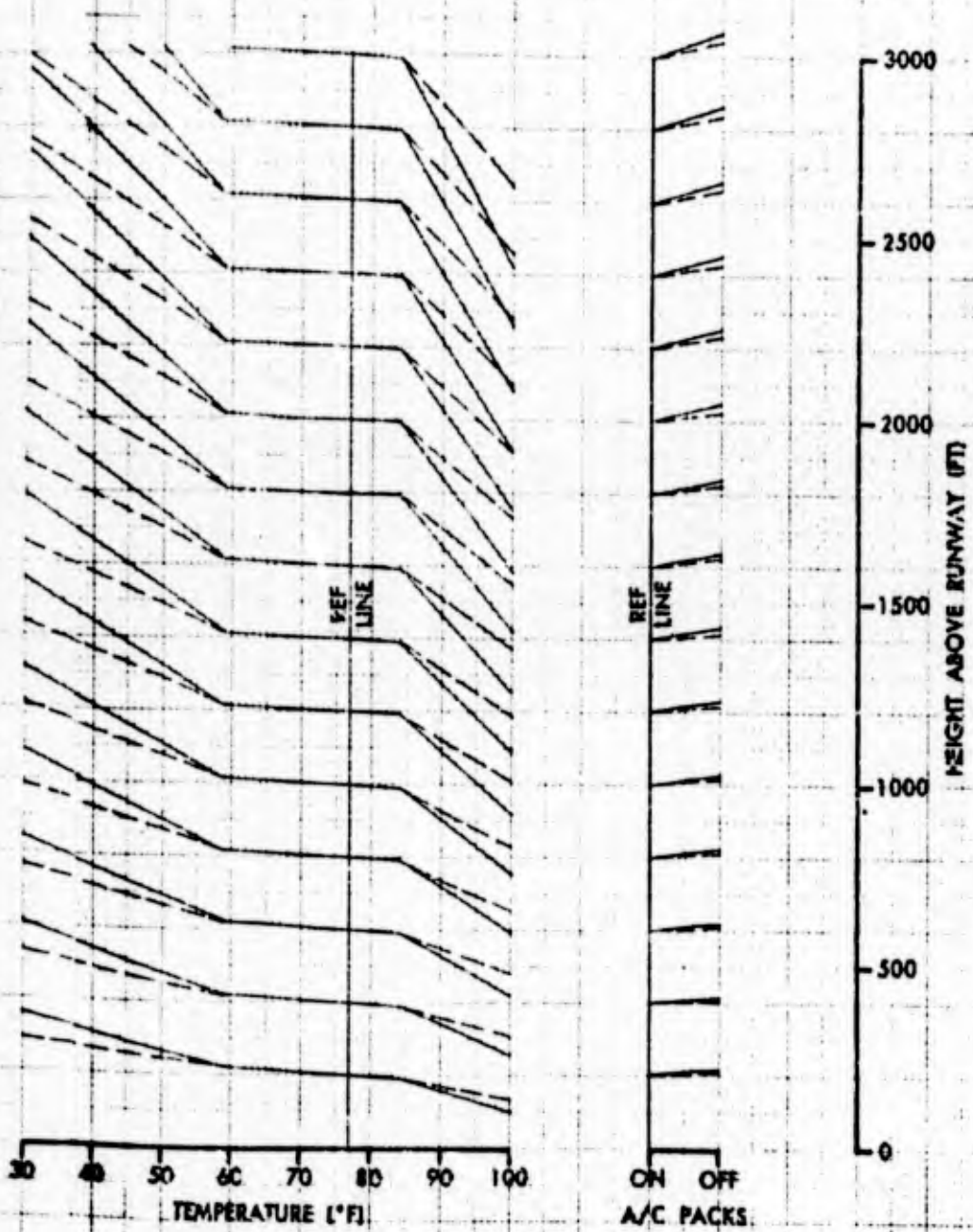


FIGURE 26.

js

1024 (NE. KNOTS)

0
10
20
30

0 10 20 30 40 50 60 70 80 90

DISTANCE FROM BRAKE RELEASE (1000 FT)

REFERENCE LINE

TAKEOFF
GROSS WEIGHT
(1000 LB)

200

220

240

260

280

300

320

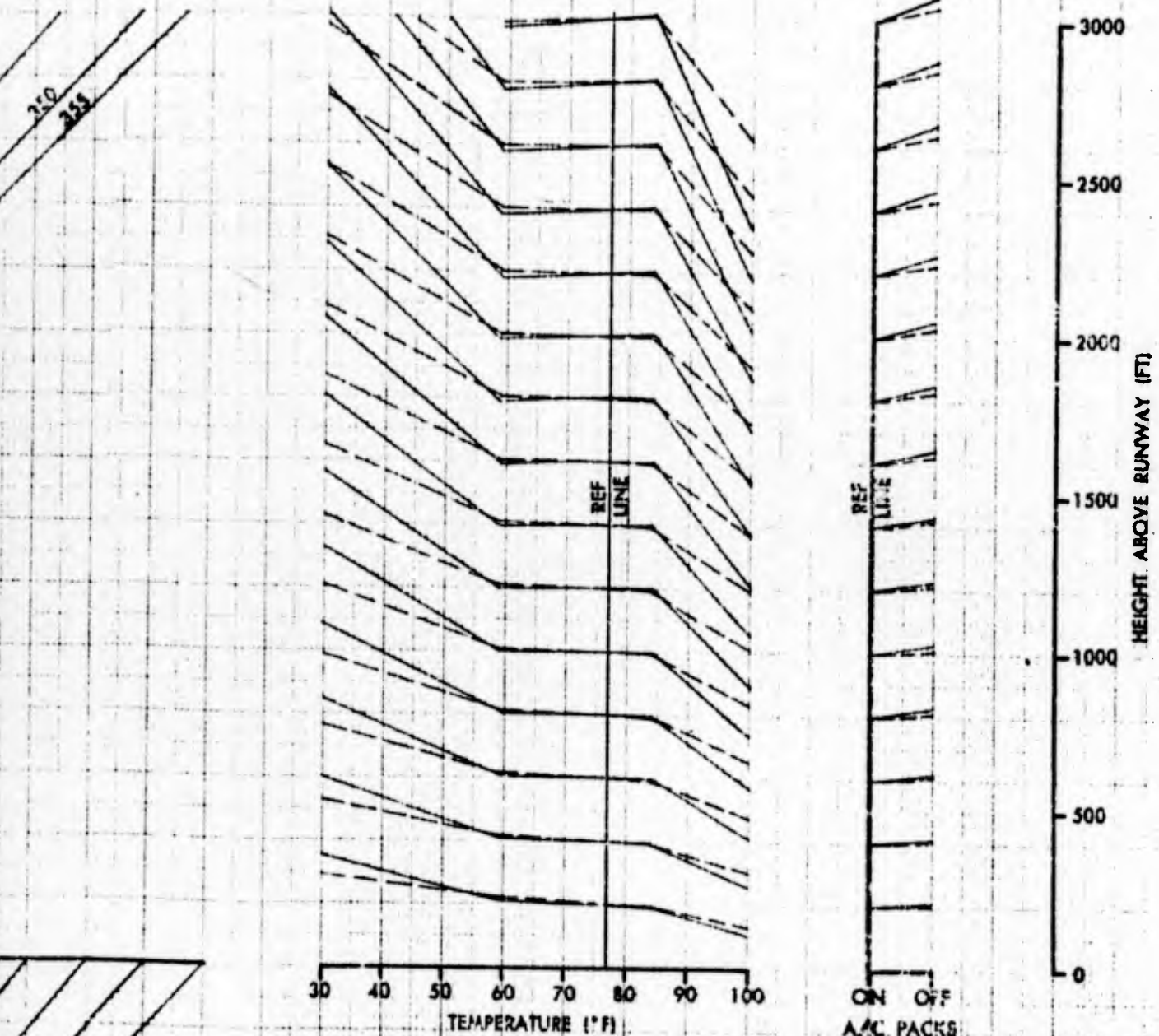
340

360

380

400

DC-8 SERIES 63
 ALL ENGINE FLIGHT PATH
 4000 FT AIRPORT ALTITUDE
 JT3D-7 ENGINES
 23° FLAPS
 CLIMB AT $V_2 + 10$



— 355,000 LB
 - - - 200,000 LB

ON OFF
 A/C PACKS

FIGURE 27.

DC-8 SERIES 63
 ALL ENGINE FLIGHT PATH
 6500 FT AIRPORT ALTITUDE
 JET 27 ENGINES
 23° FLAPS
 CLIMB AT $V_2 + 10$

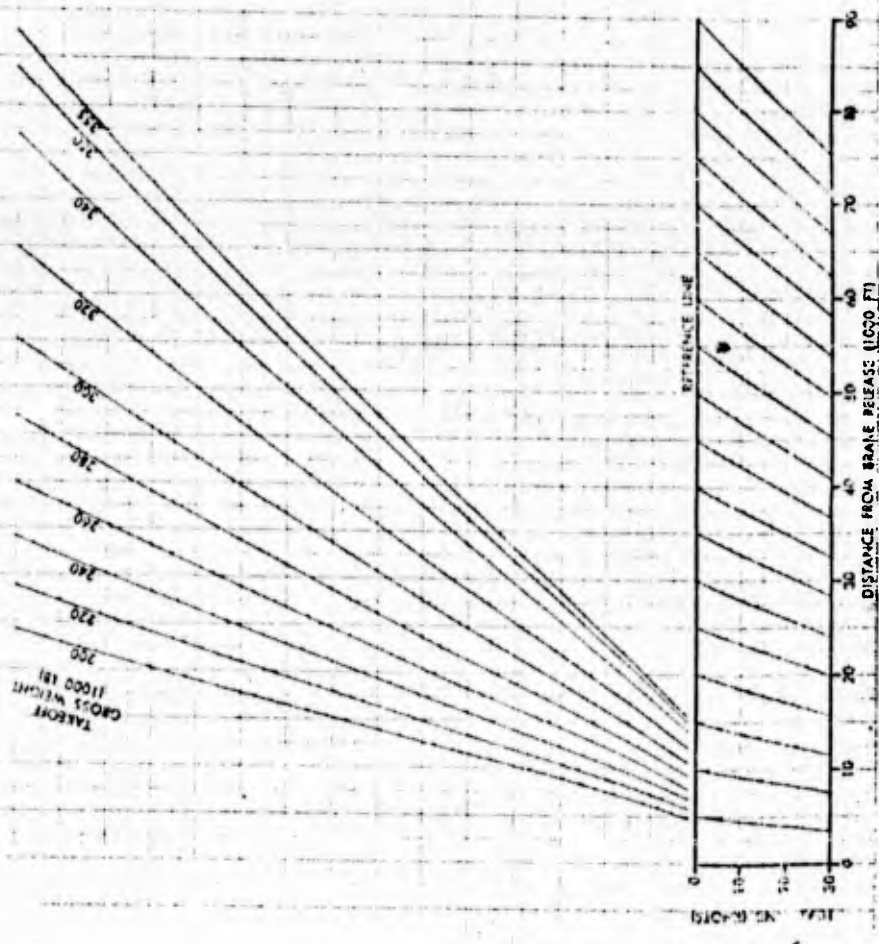
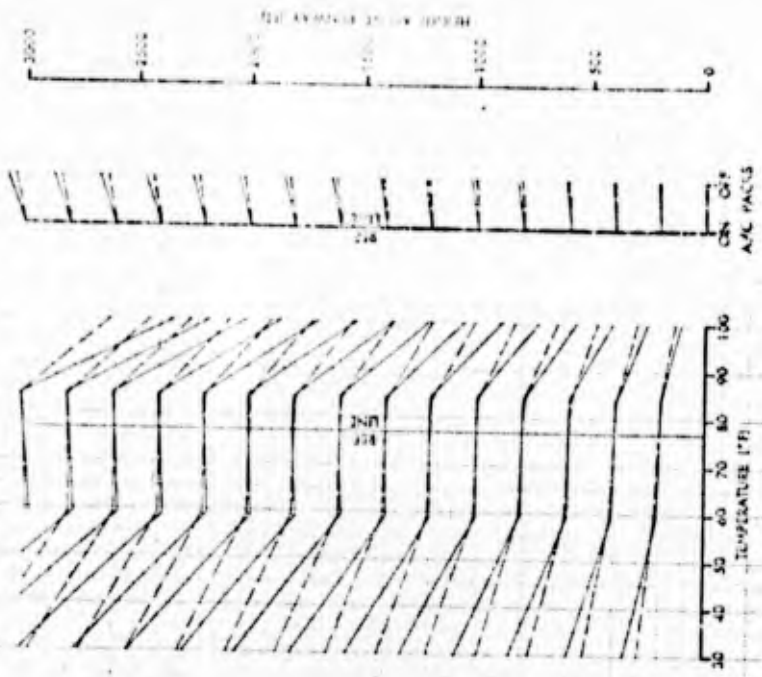


FIGURE 27

DC-8 SERIES 63
 F₄₁/F_{41A} AT CUTBACK
 JT3D-7 ENGINES
 CLIMB, 11°

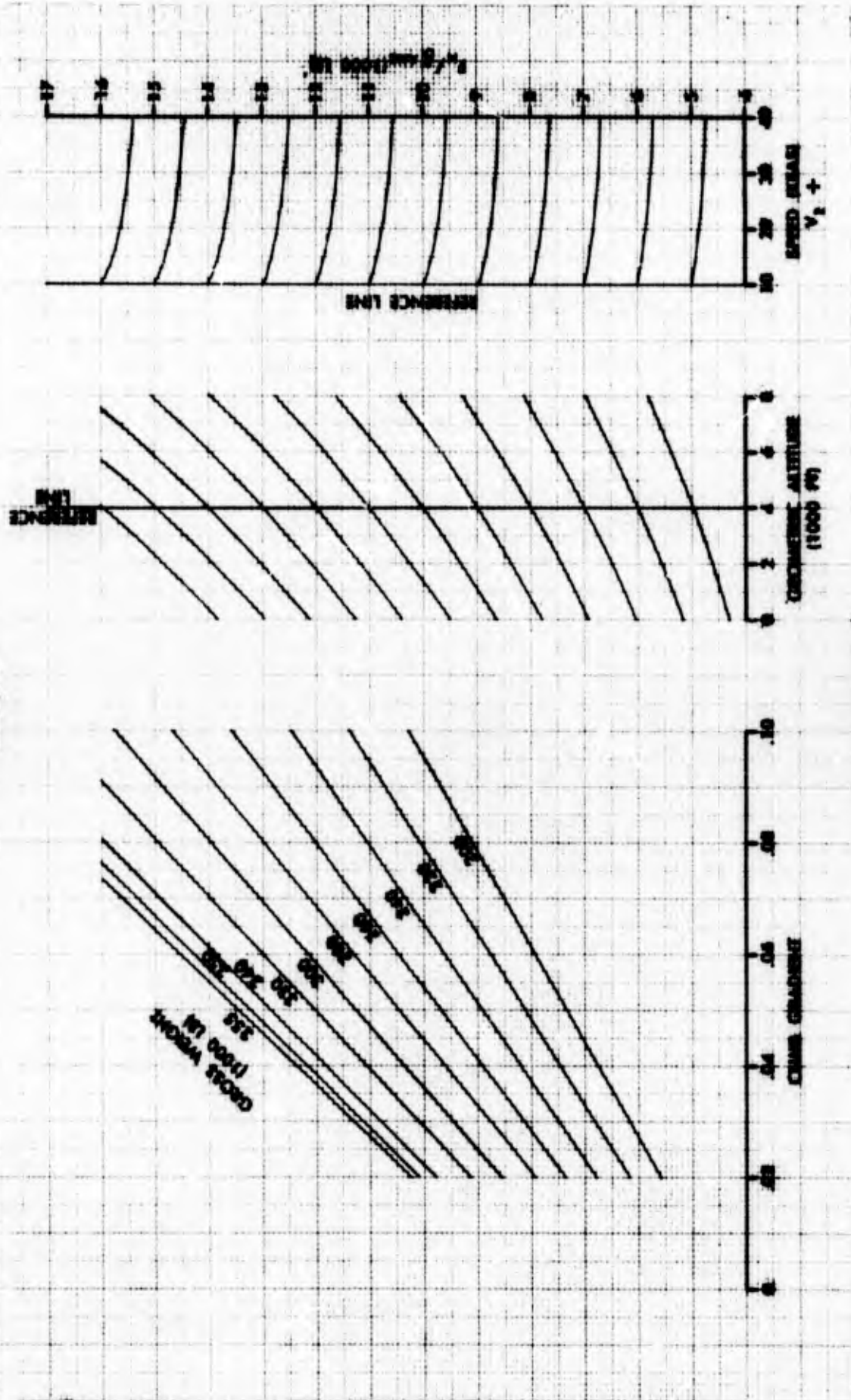


FIGURE 28.

DC-8 SERIES 63
 FN/8 AMB AT CUTBACK
 JT3D-7 ENGINES
 FLAPS 23°

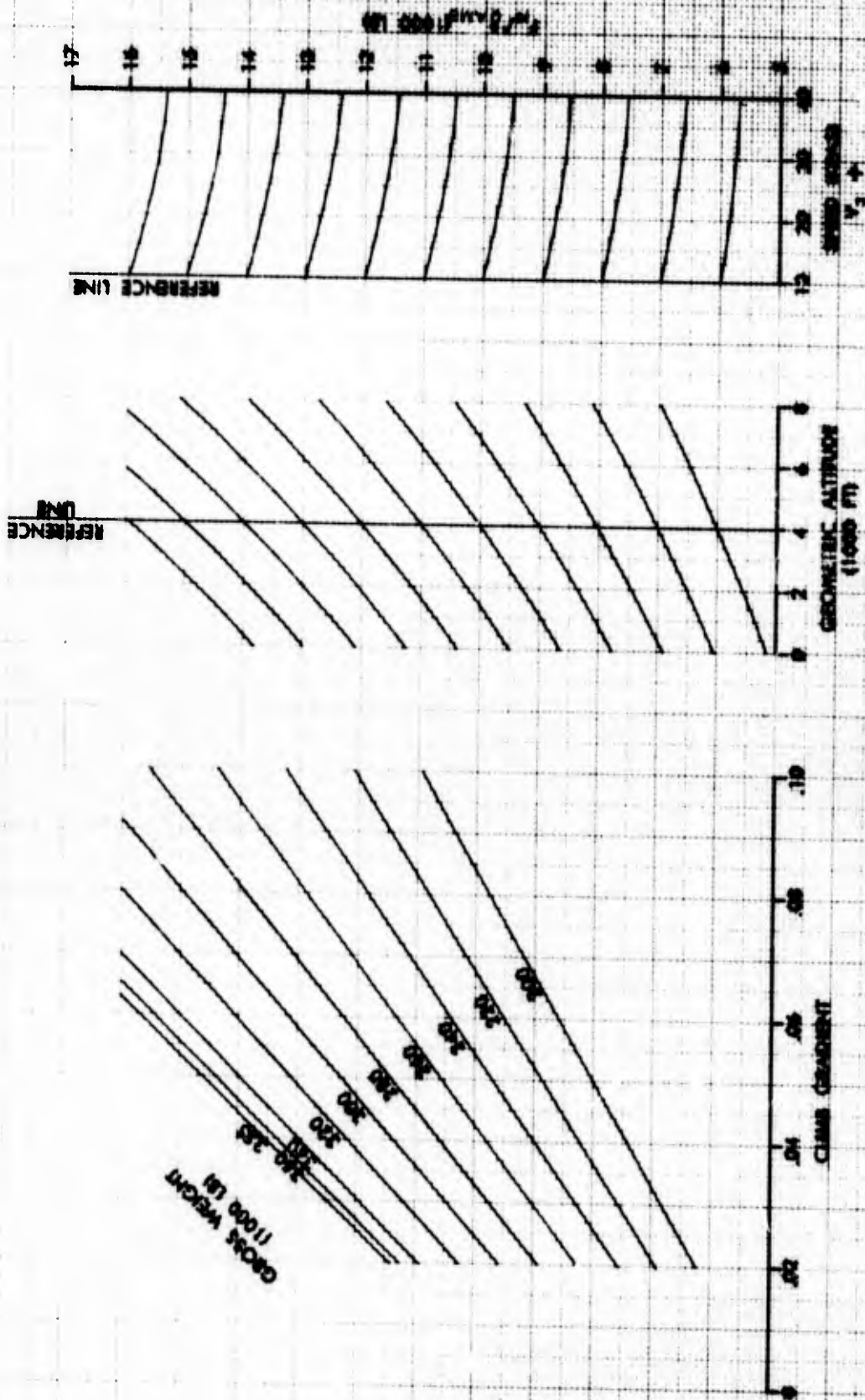


FIGURE 29

DC-8 SERIES 63
 F_{N1}/δ_{AMB} AT CUTBACK
 JT3D-7 ENGINES
 CLEAN CONFIGURATION
 250 KNOTS, IAS

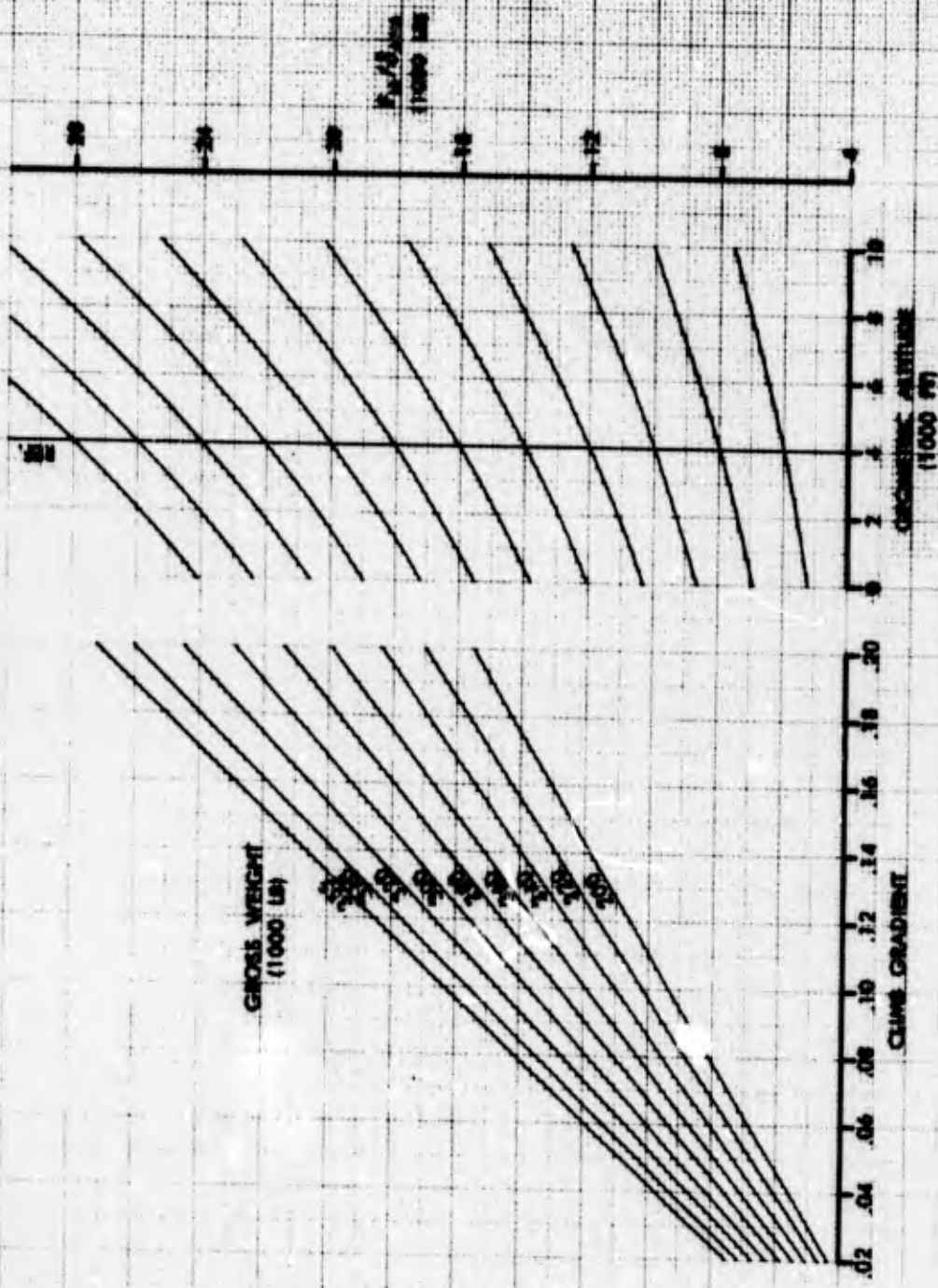


FIGURE 30.

DC-8 SERIES 63
REFERRED FAN SPEED VS GLIDE SLOPE
 JT20-7 ENGINES
 20° FLAPS

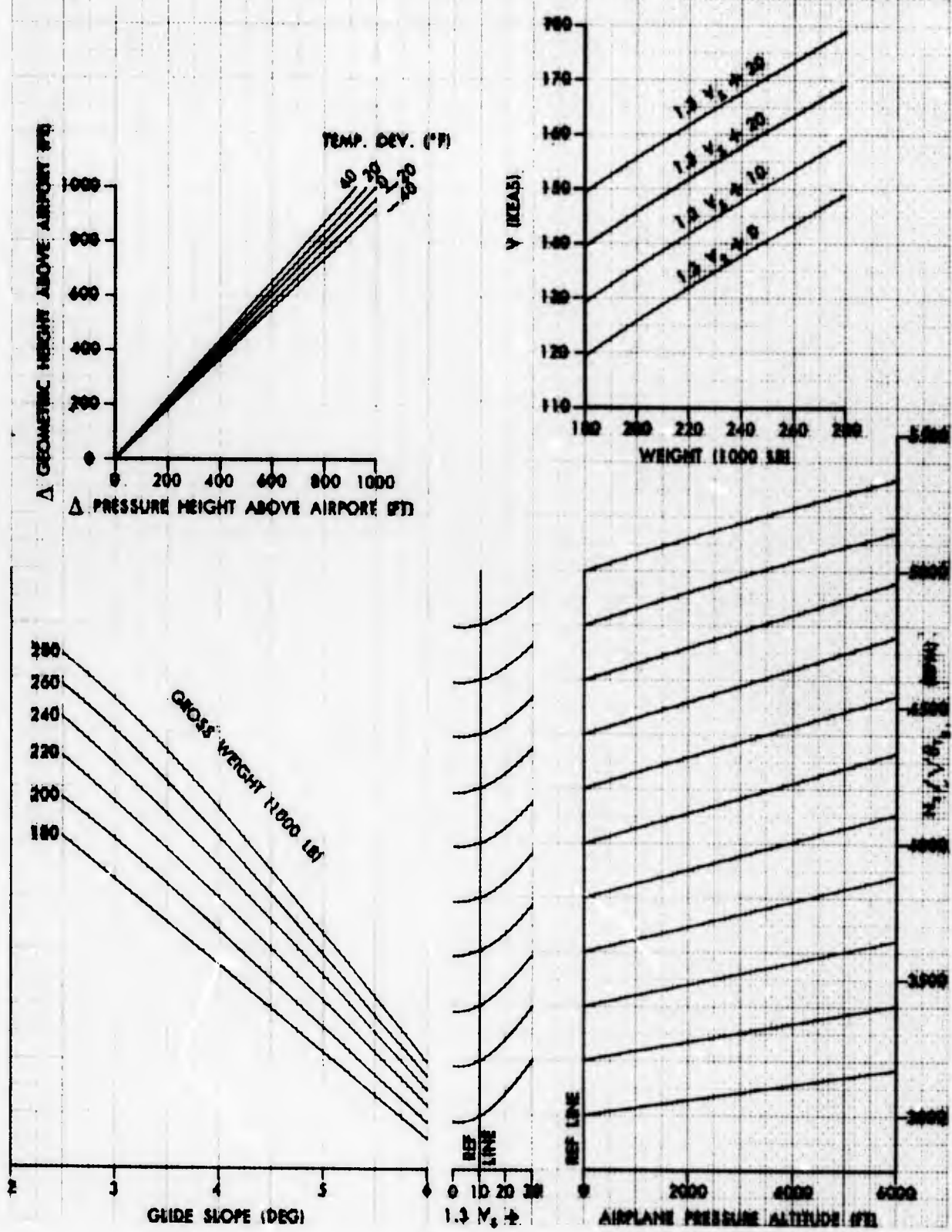
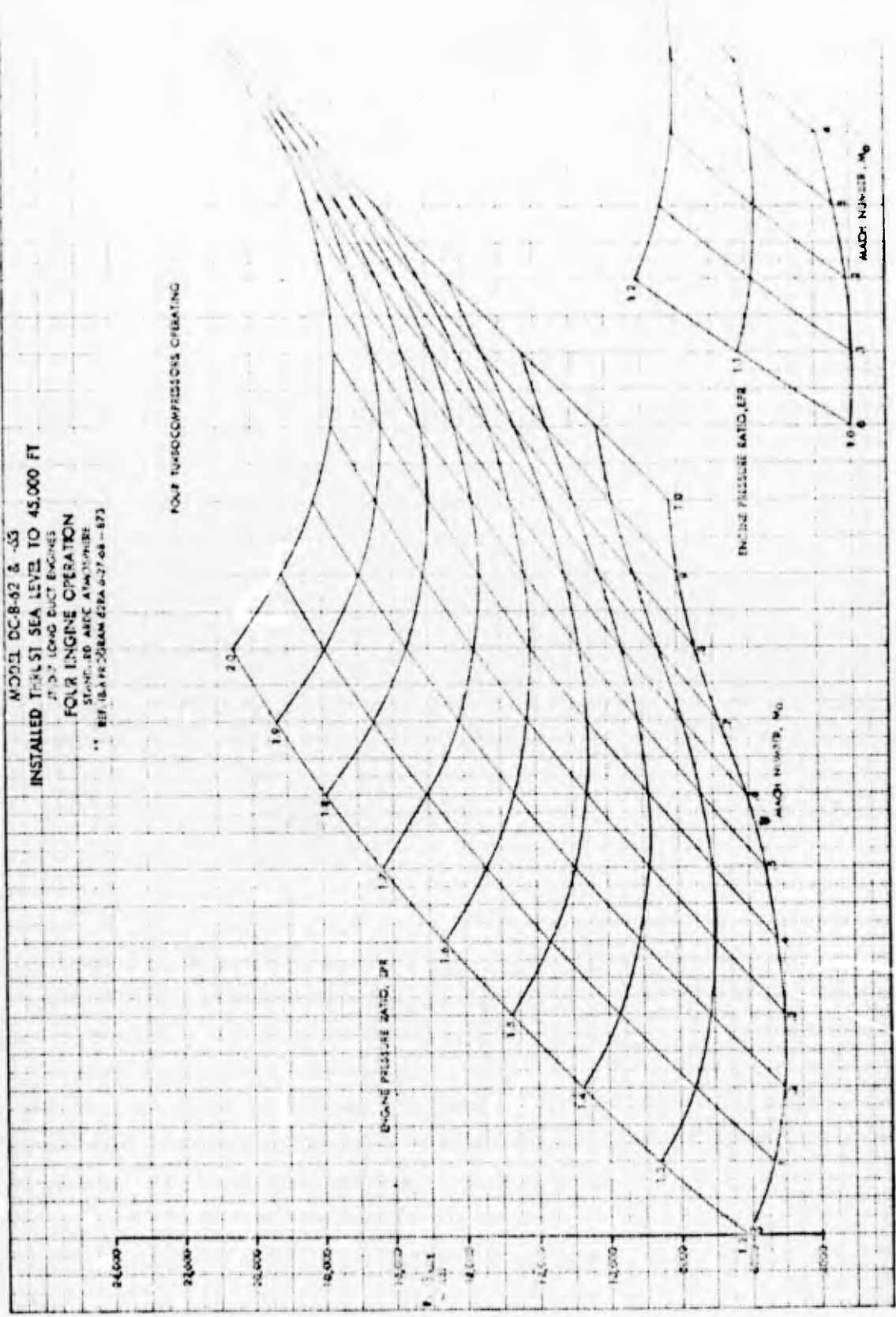


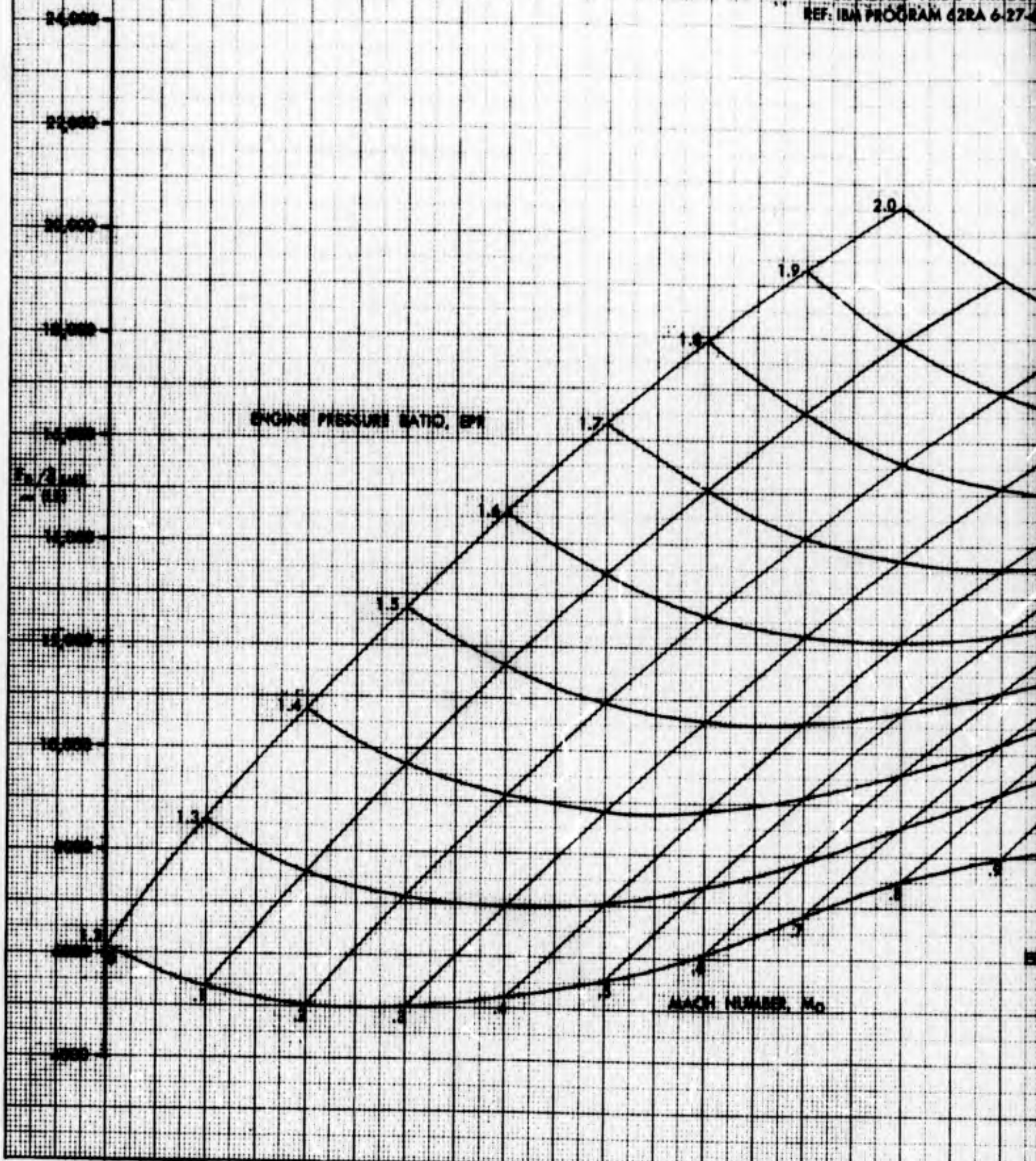
FIGURE 31.

MODEL DC-8-62 & -63
 INSTALLED TURBOJET SEA LEVEL TO 45,000 FT
 JT 3D LONG DUCT ENGINES
 FOUR ENGINE OPERATION
 STAGE: 10 A/RFC 174437-10/10/10/10/10/10
 ** REF. ISAE JOURNAL 622A 9-27-68 - 873

FOUR TURBOCOMPRESSORS OPERATING



MODEL DC-8-62 &
INSTALLED THRUST SEA LEVEL
 JT3D-7 LONG DUCT ENGE
FOUR ENGINE OPERA
 STANDARD ARDC ATMOSP
 REF: IBA PROGRAM 62RA 6-27-4



A

MODEL DC-8-62 & -63
 THRUST SEA LEVEL TO 45,000 FT
 JT3D-7 LONG DUCT ENGINES
 FOUR ENGINE OPERATION
 STANDARD ARDC ATMOSPHERE
 IBM PROGRAM 62RA 6-27-68 - 873

FOUR TURBOCOMPRESSORS OPERATING

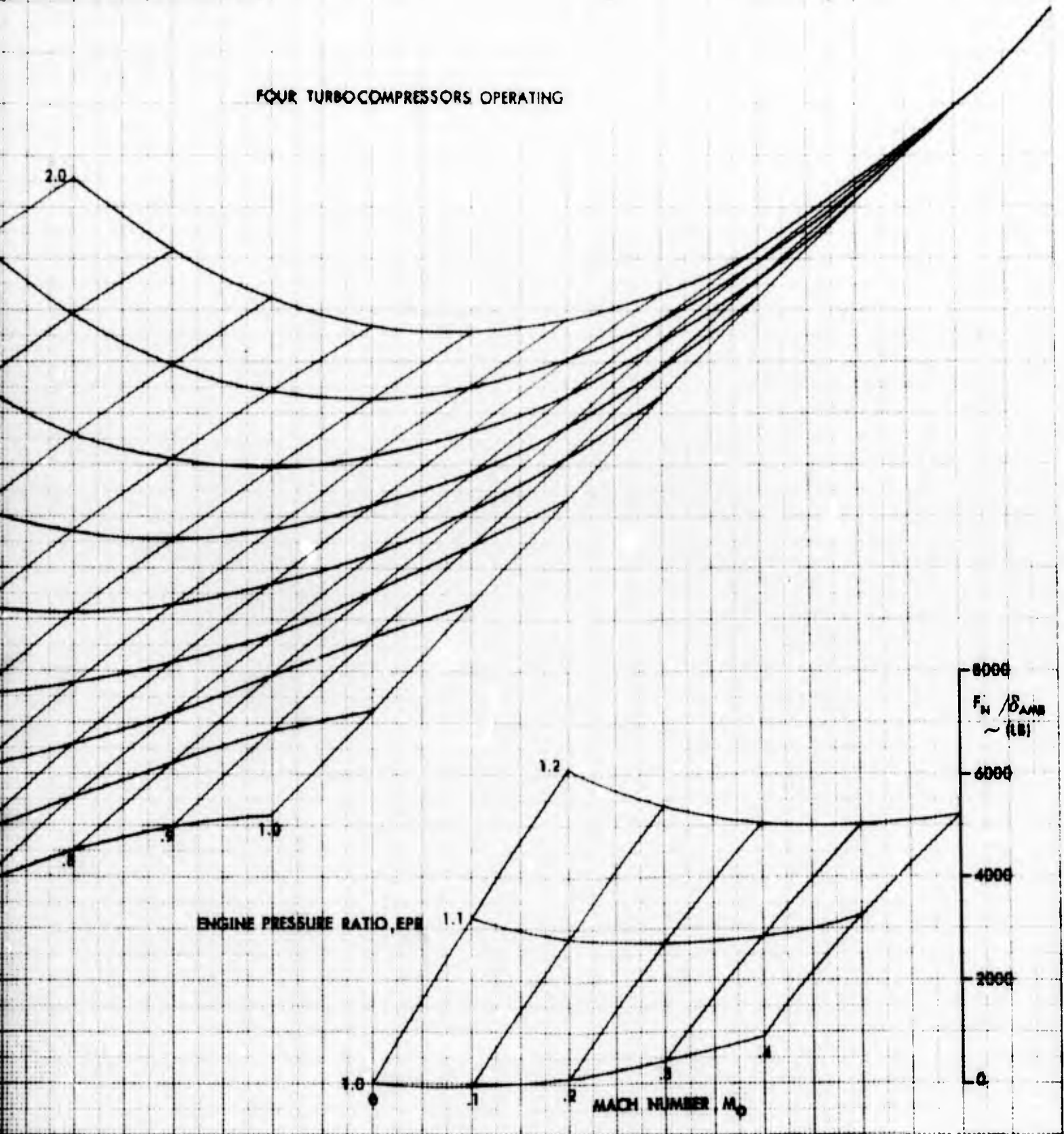
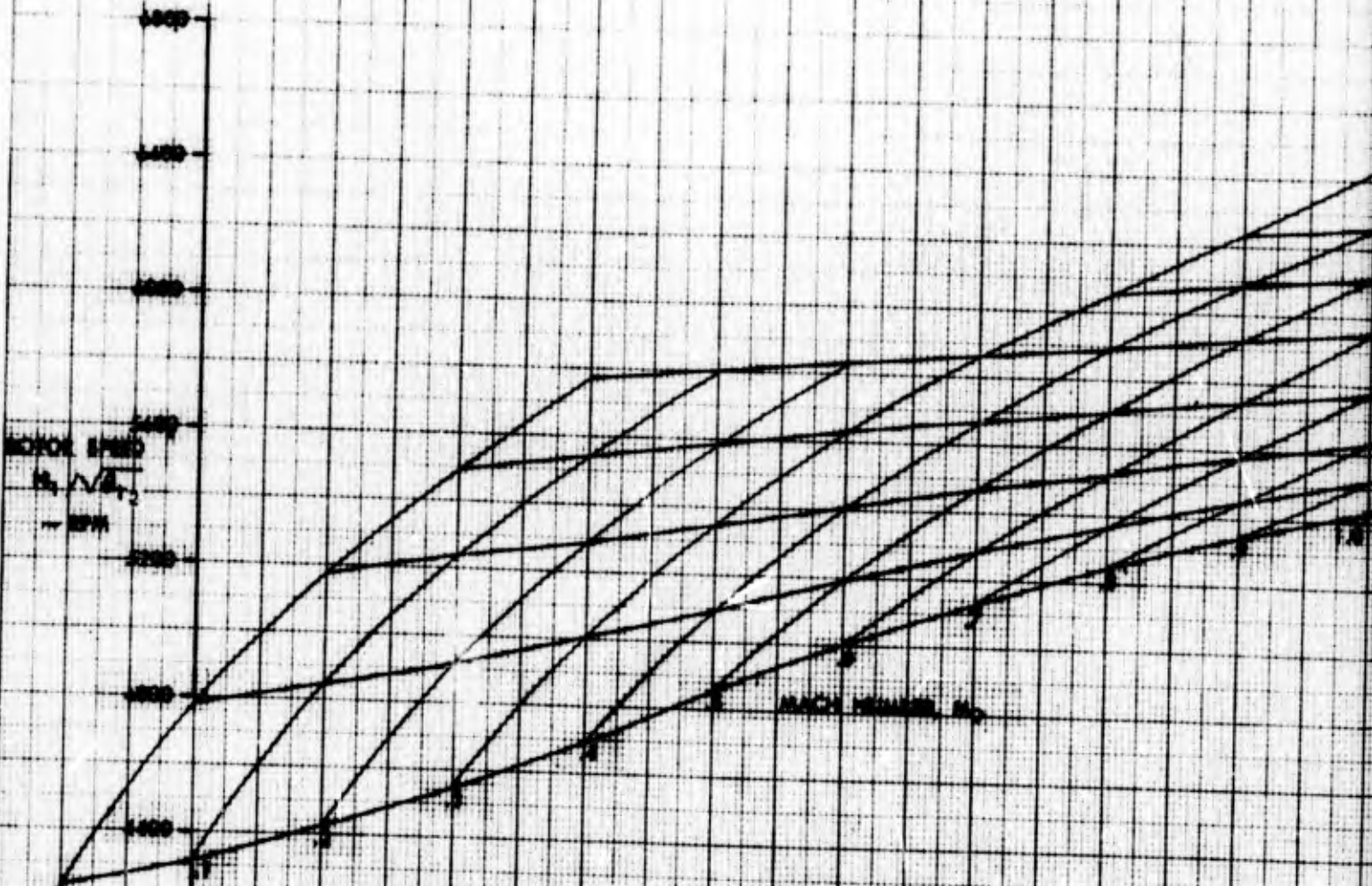


FIGURE 32.

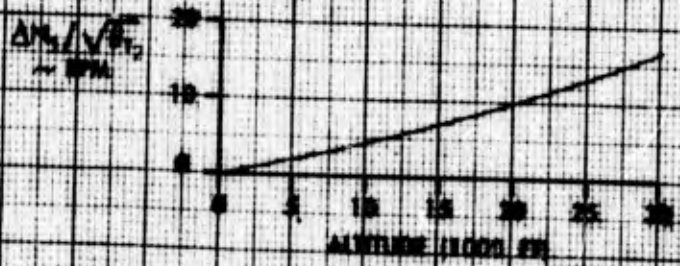
B

MODEL DC-8-62 &
 INSTALLED LOW PRESSURE ROTOR SPEED
 JT3D-7 LONG DUCT ENGINES
 FOUR ENGINE OPERATION
 STANDARD ARDC ATMOSPHERE
 REF: BA PROGRAM 62RA 6-27-68 -- 873

CURVE BASED ON SEA LEVEL PERFORMANCE



ALTITUDE CORRECTION



A

MODEL DC-8-62 & -63
 PURE ROTOR SPEED, SEA LEVEL TO 30,000 FT
 TWIN DUCT ENGINES
 ENGINE OPERATION
 STANDARD ATMOSPHERE
 MIL-STD-883C-17-83

FOUR TURBOCOMPRESSORS OPERATING

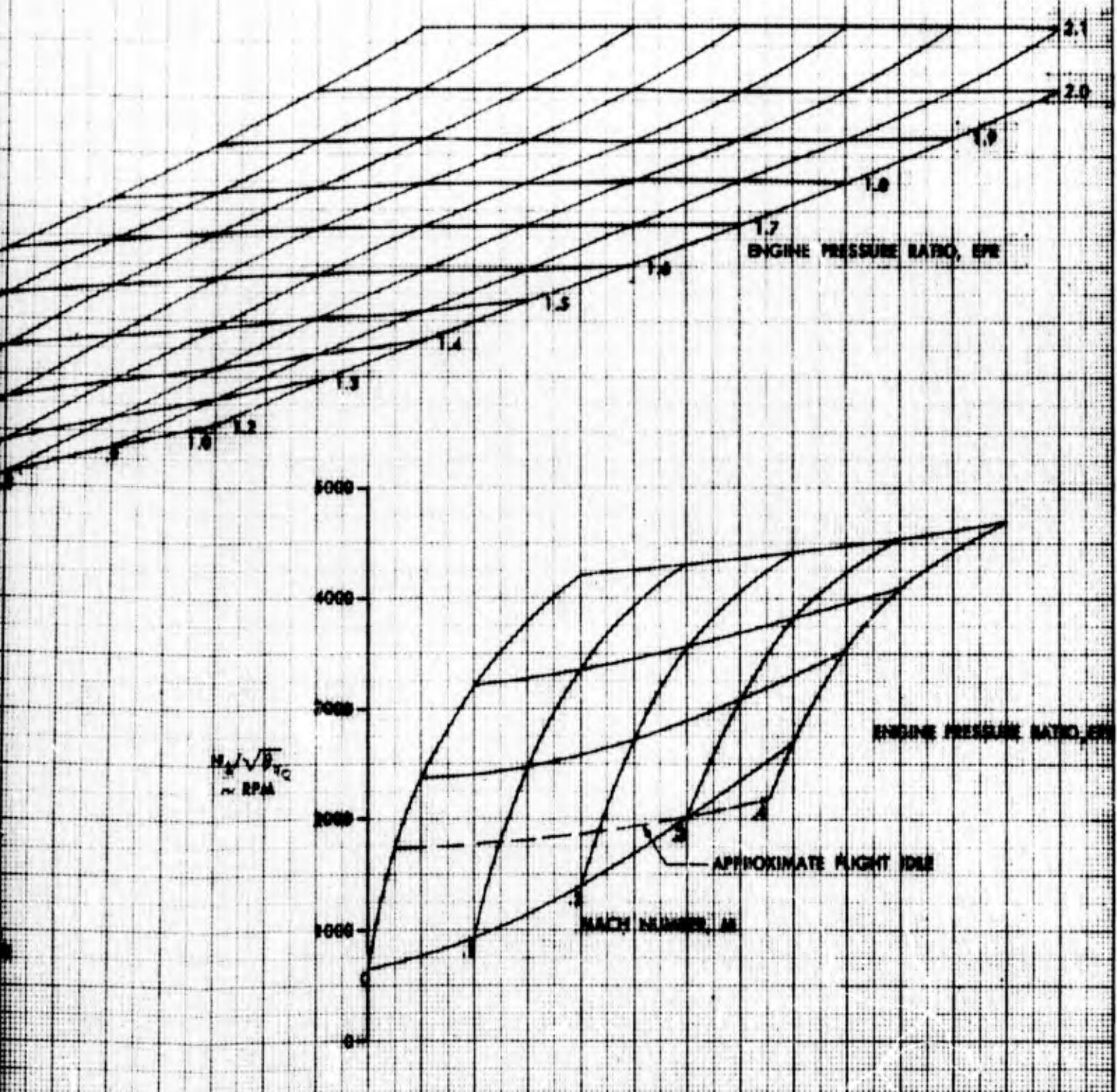


FIGURE 33.

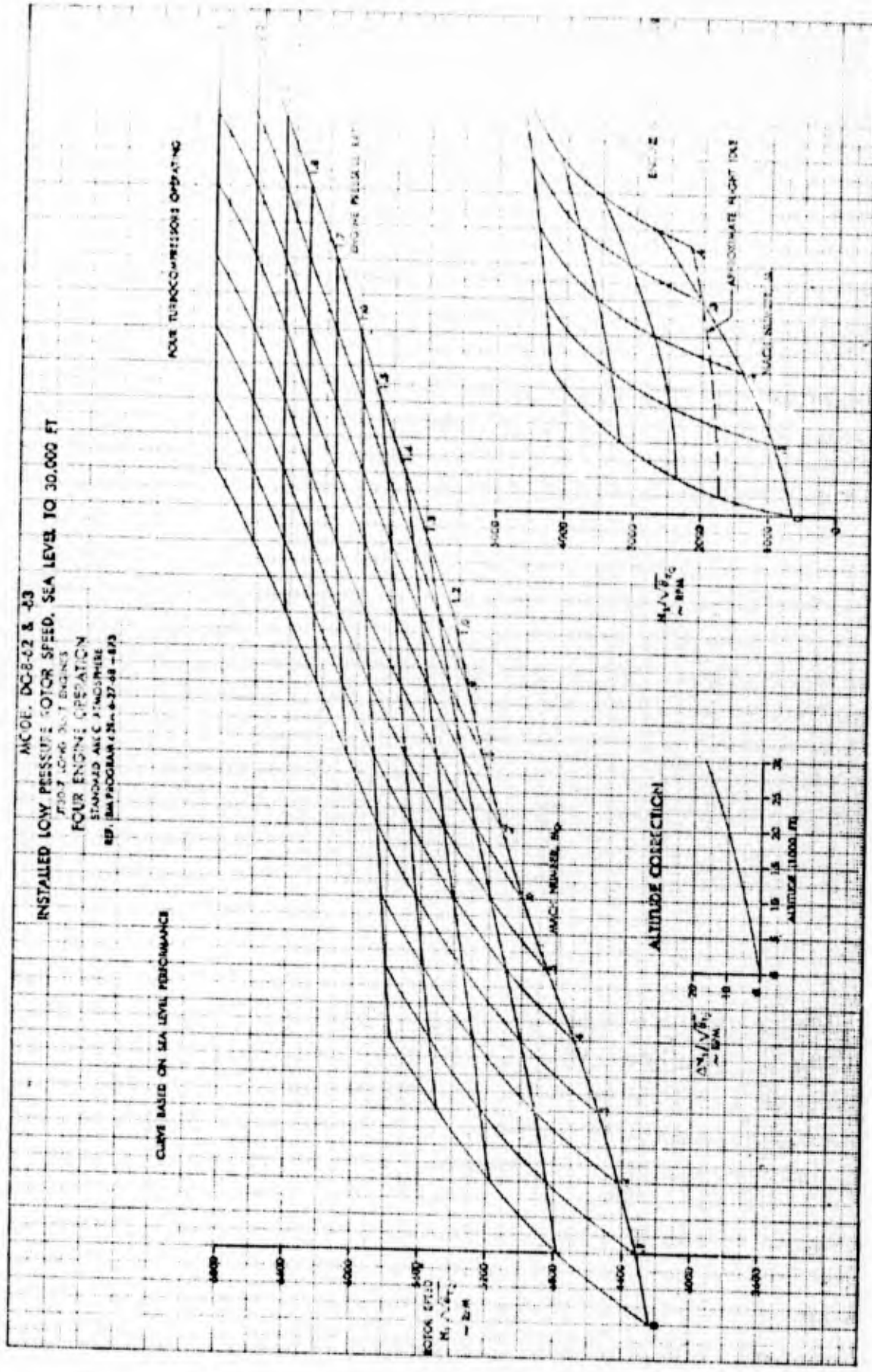


FIGURE 33

2.5 DC-9-30 WITH JT8D-7 ENGINES

2.5.1 Aircraft Description

The DC-9-30, shown in Figure 34, is a short- to medium-range fan-jet powered by two aft-fuselage mounted JT8D engines manufactured by Pratt and Whitney Aircraft. The aircraft, which has a maximum takeoff gross weight of 108,000 pounds and a maximum landing weight of 99,000 pounds, is shown in a dimensioned three-view drawing in Figure 35. The seating capacity (high density) is 135.

The JT8D-7 engine is rated at 14,000 pounds, flat rated to 84°F, and the bypass ratio is 1.1. Takeoff power is set at approximately an EPR of 1.95, decreasing somewhat as the aircraft achieves forward speed.

2.5.2 Acoustic Data

Figures 36 and 37 present the EPNL and A-weighted noise plots for six power settings from 4000 pounds to the takeoff thrust of 12,000 pounds. The curves are based on data obtained during Douglas-funded flyover noise tests for a DC-9-10 and a DC-9-30, each powered by JT8D-1 engines. The original analog magnetic tapes were reprocessed as described in Appendix G to obtain digitized data. Since the JT8D-1 is flat rated only to 59°F, the data for that engine were adjusted to account for the variation in the takeoff thrust level from the JT8D-7 due to the difference in flat-rated temperatures.

2.5.3 Performance Data

Figures 38 through 43 present the takeoff flight paths for 5 and 15-deg flap settings, and Figures 44 through 49 present the takeoff flight paths for a 15-deg pitch limit. The takeoff flight paths for a 0-deg flap setting are omitted since some versions of the Series 30 aircraft are not certified for it. These data combined with the data in curves of Figures 50, 51, and 52, the cutback charts, and in Figures 36 and 37, the noise curves, will provide the aircraft noise levels.

Figure 53 presents the approach referred fan speeds and Figures 54 and 55 present curves relating thrust, fan speed, and EPR for various Mach numbers.

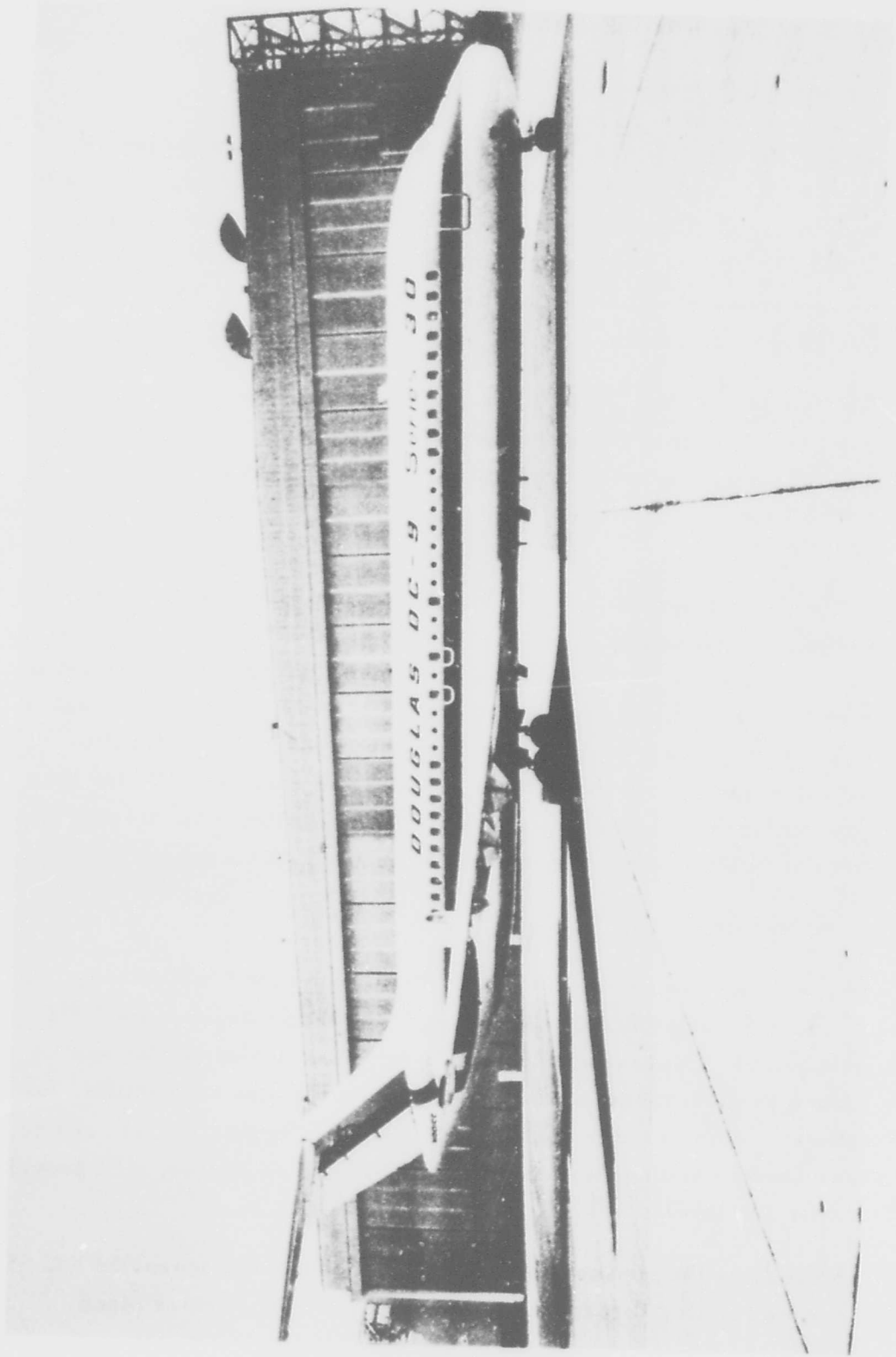


FIGURE 34.

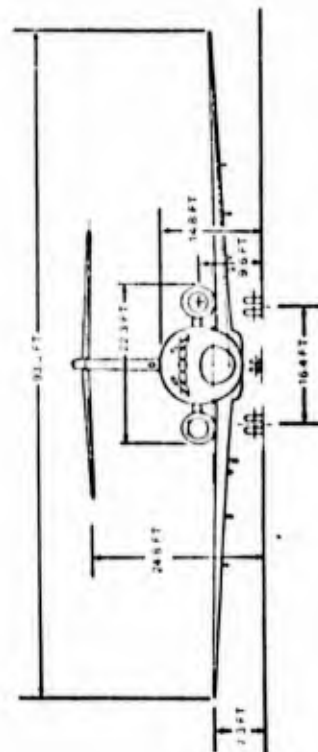
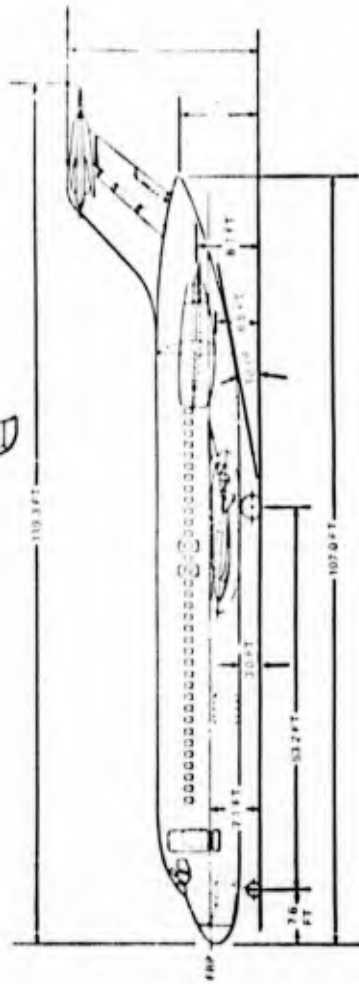
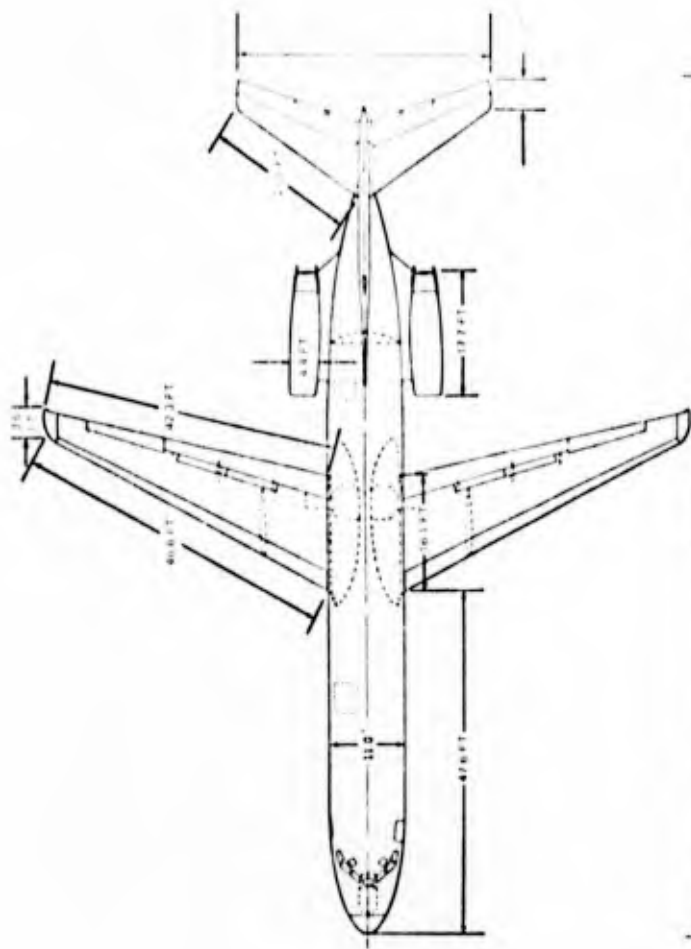
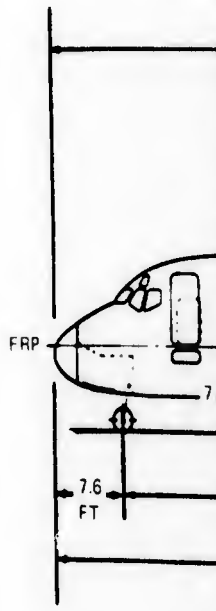
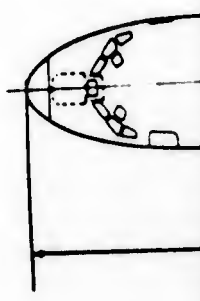
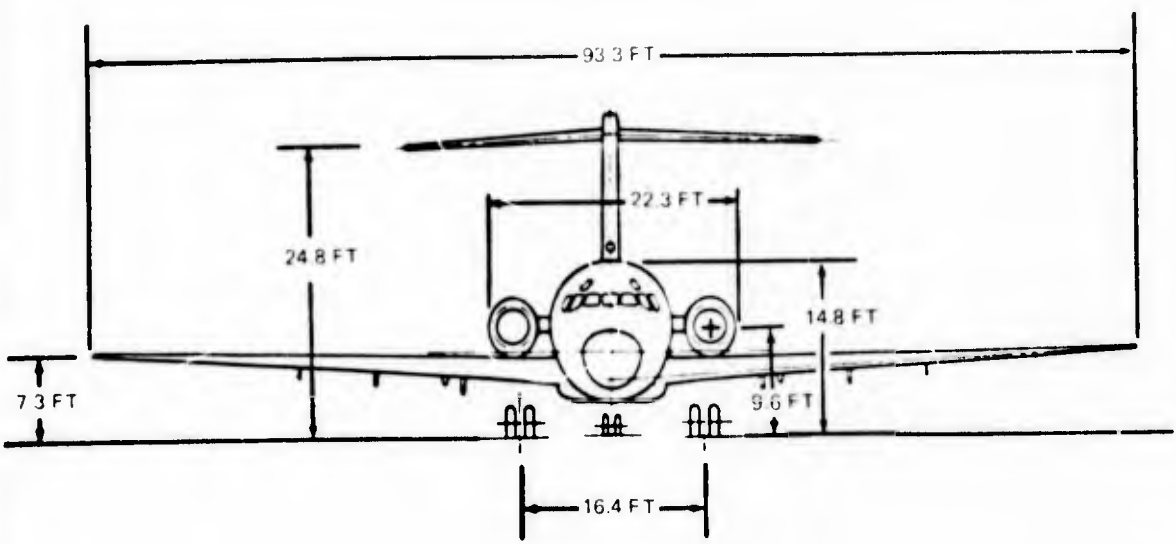


FIGURE 35. DC 9-30



Handwritten mark or signature.

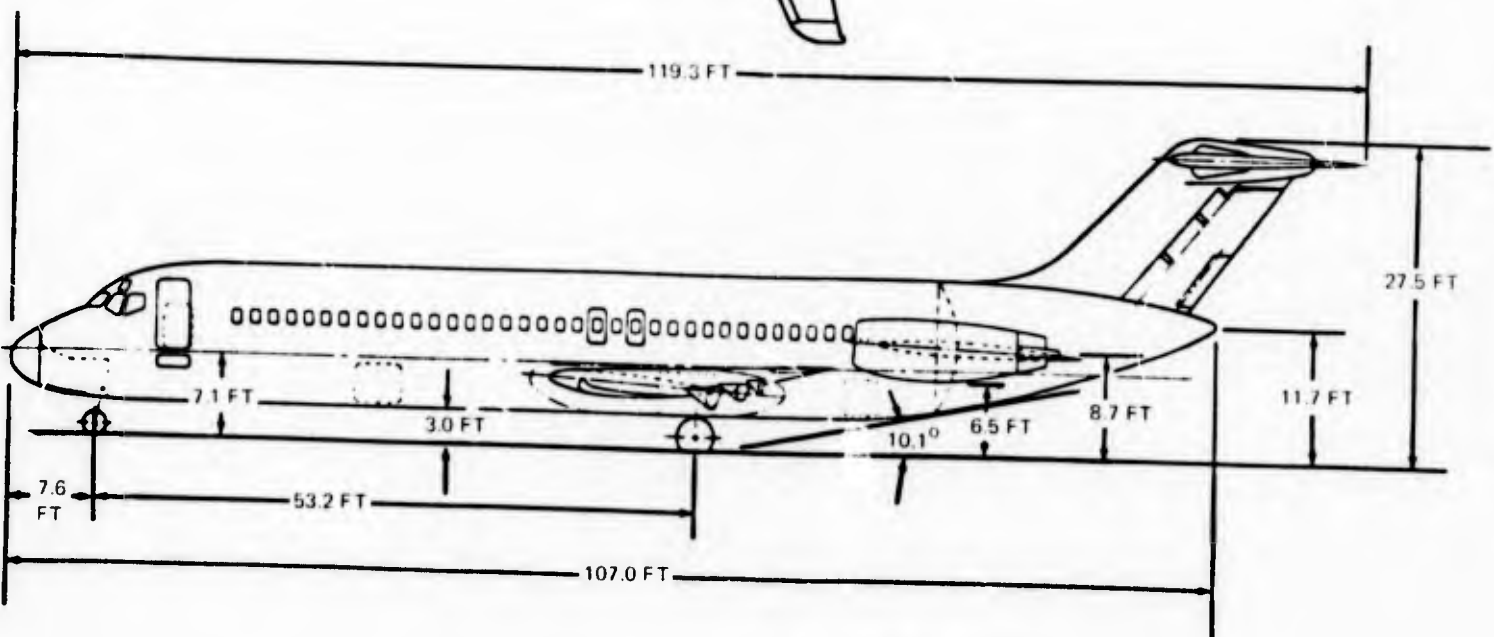
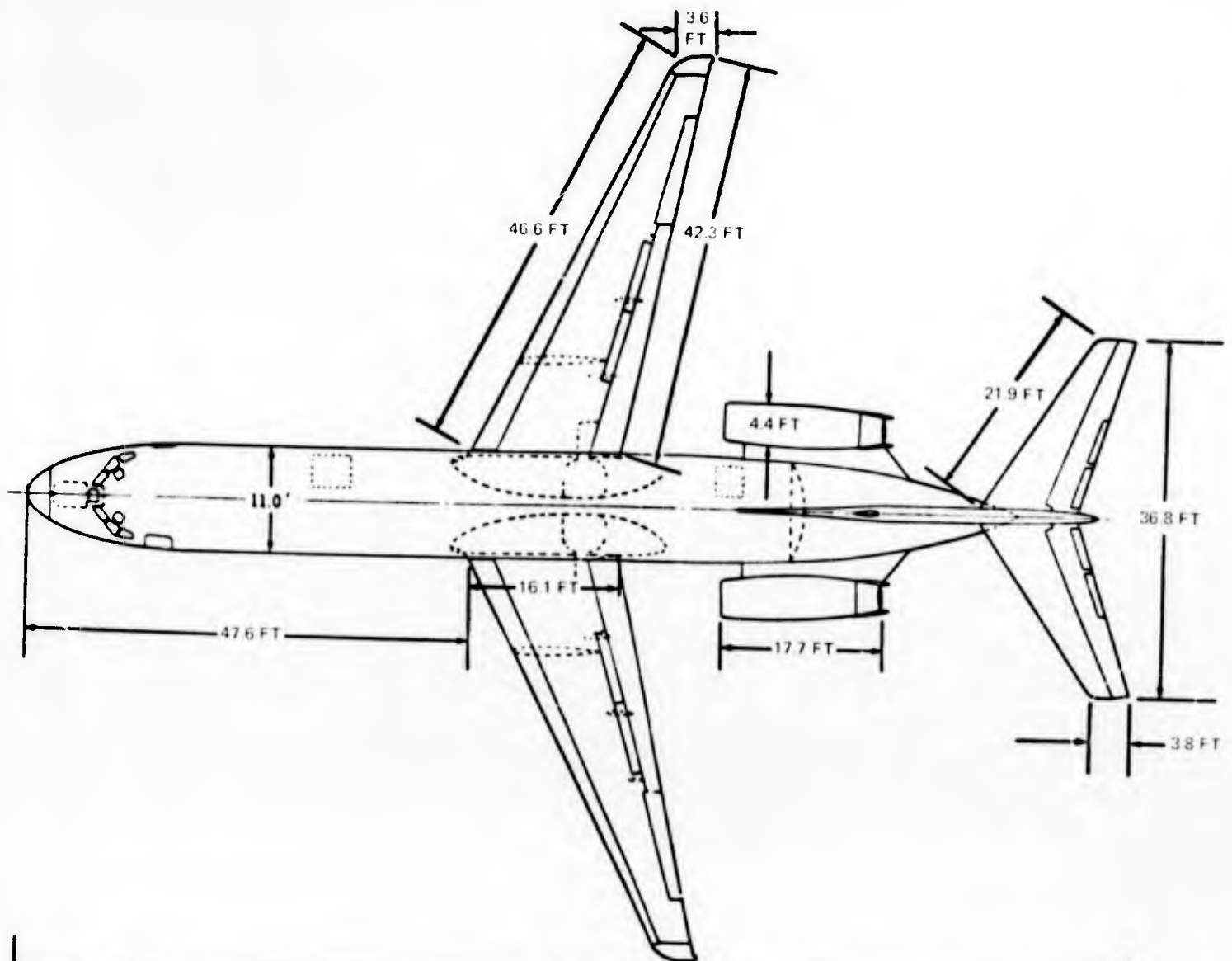


FIGURE 35. DC-9-30

6

DATE AUGUST 30, 1973

FLYOVER NOISE LEVELS

DC-9-30

TWO JT8D-7 ENGINES

TEMP 77° F
REL. HUM. 70%

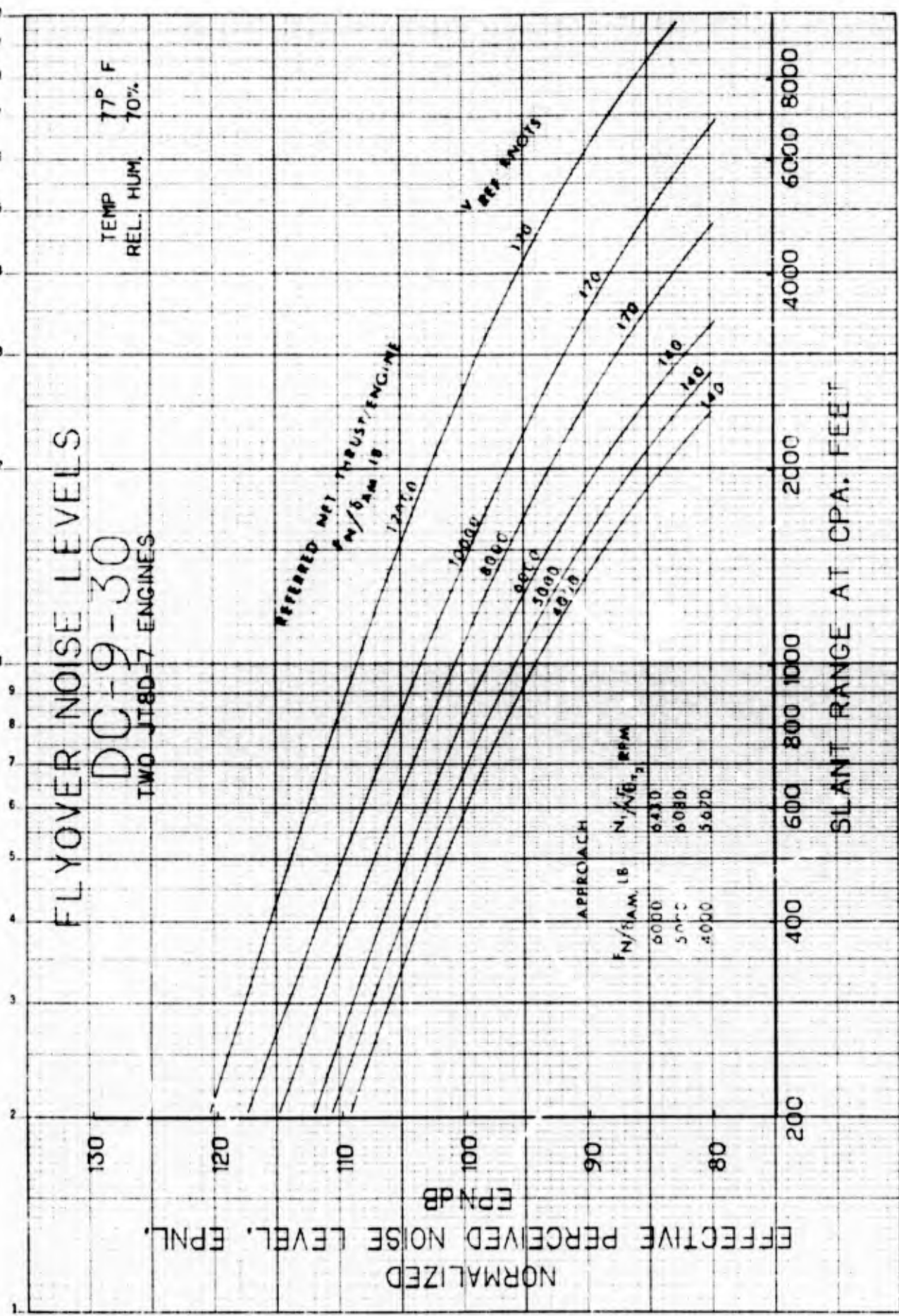


FIGURE 36.

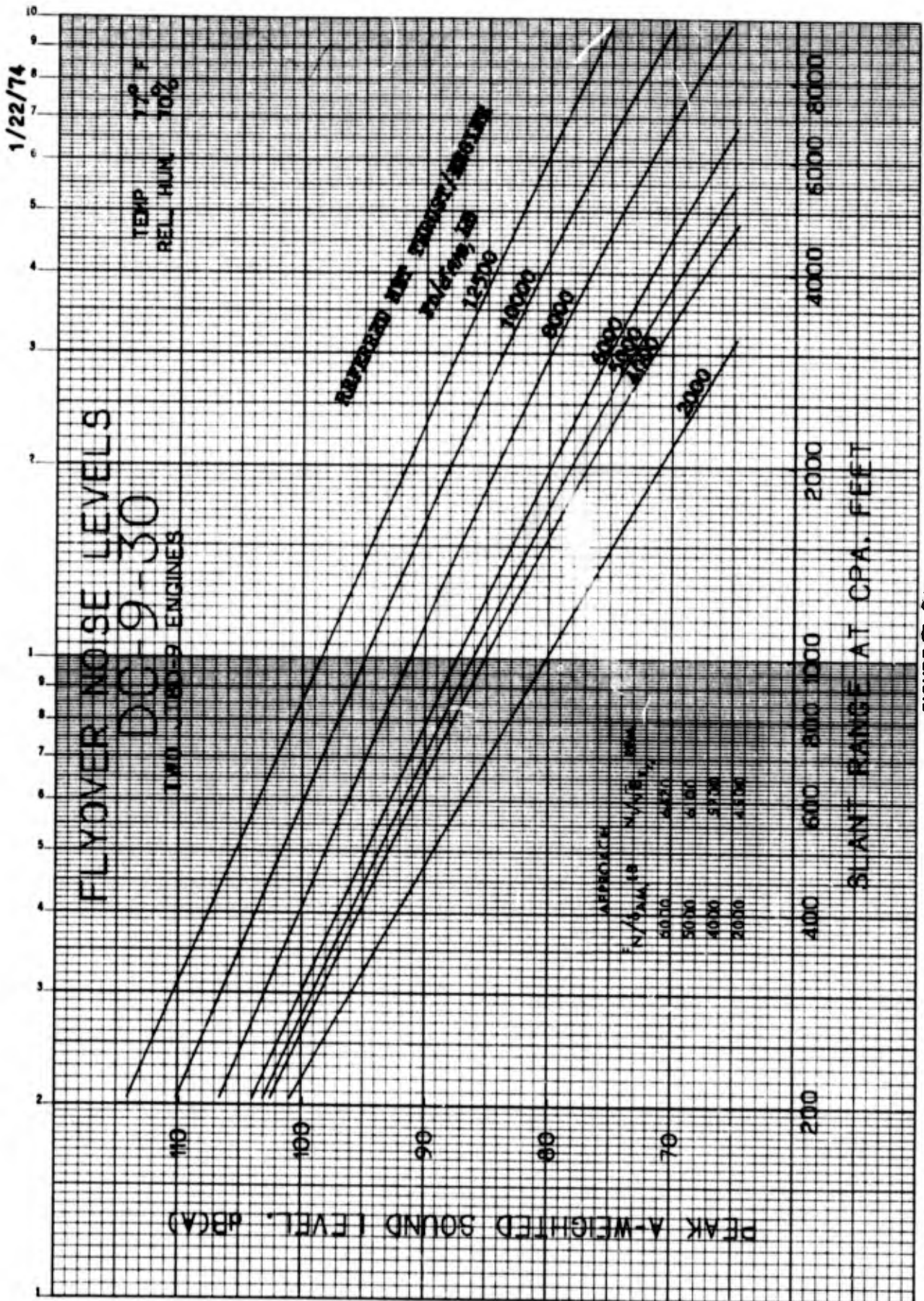


FIGURE 37

DC-9 SERIES 30
 ALL ENGINE FLIGHT PATH
 SEA LEVEL AIRPORT ALTITUDE
 J85-7 ENGINES
 5° FLAPS
 CLIMB AT $V_2 + 10$

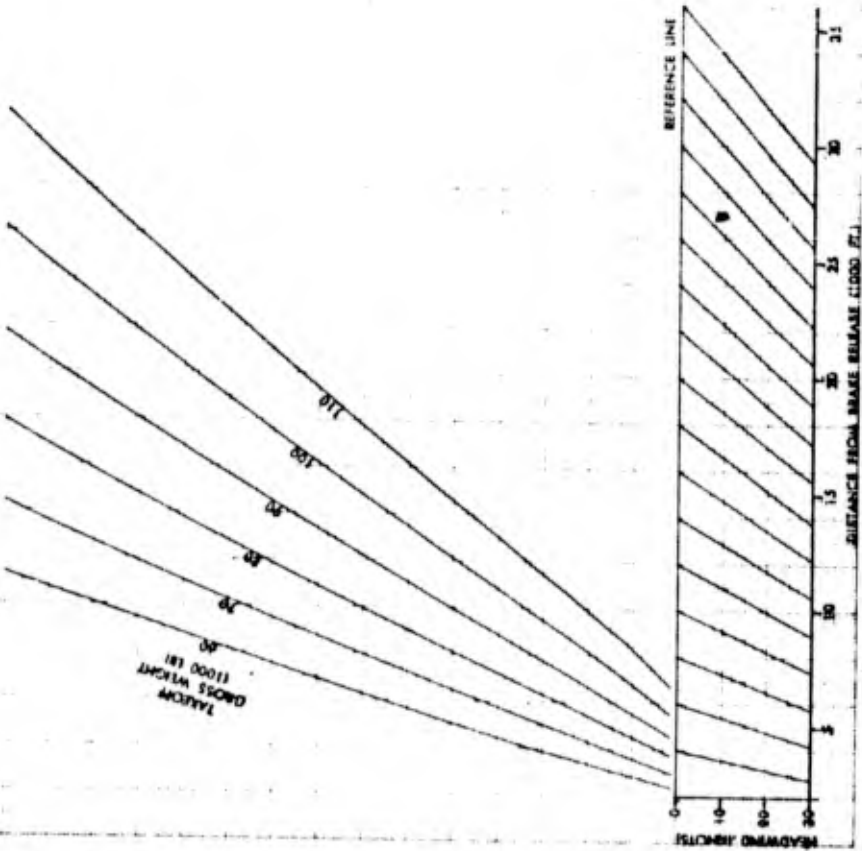
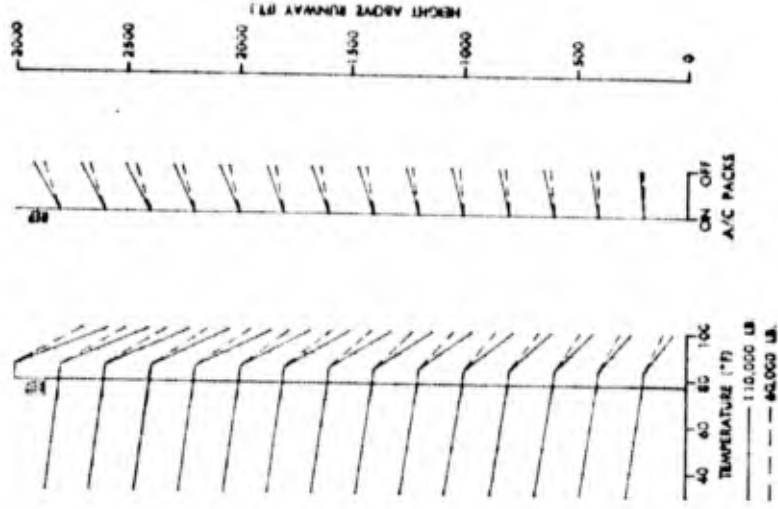
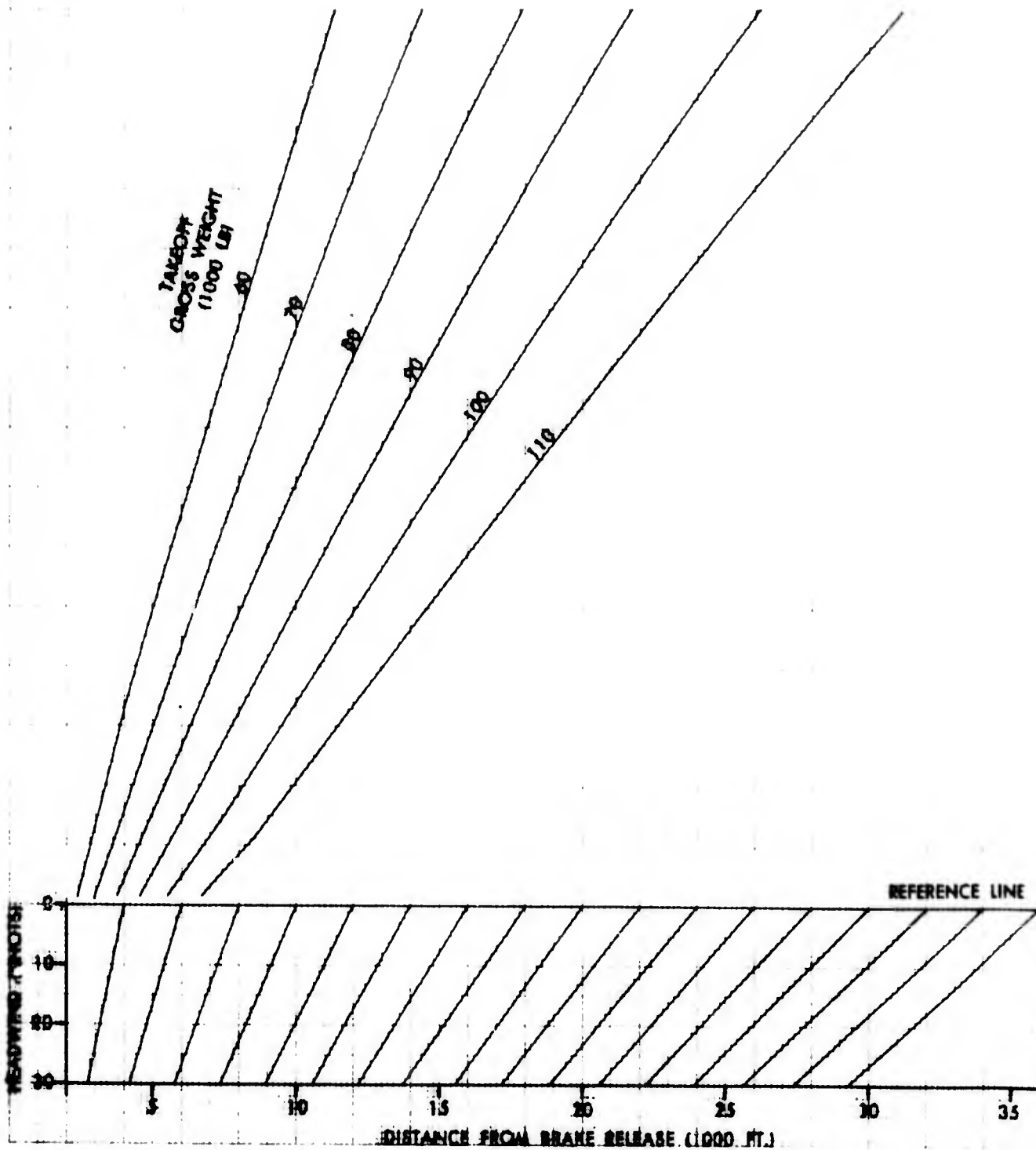


FIGURE 38

DC-9 SERIES 30
ALL ENGINE FLIGHT PA
SEA LEVEL AIRPORT ALTITUDE
JT8C-7 ENGINES
5° FLAPS
CLIMB AT $V_2 + 10$



40
TEMP

DC-9 SERIES 30
 ALL ENGINE FLIGHT PATH
 SEA LEVEL AIRPORT ALTITUDE
 JT8D-7 ENGINES
 5° FLAPS
 CLIMB AT $V_2 + 10$

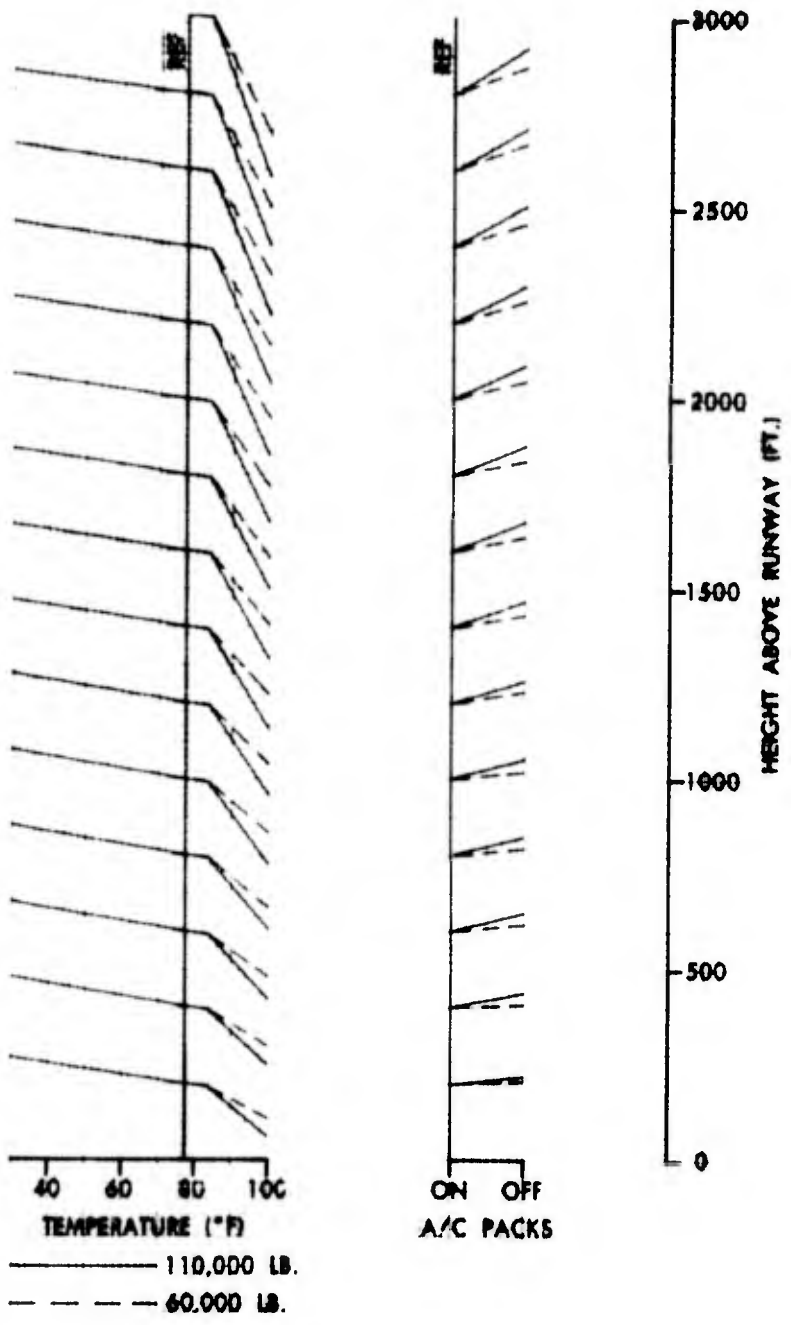
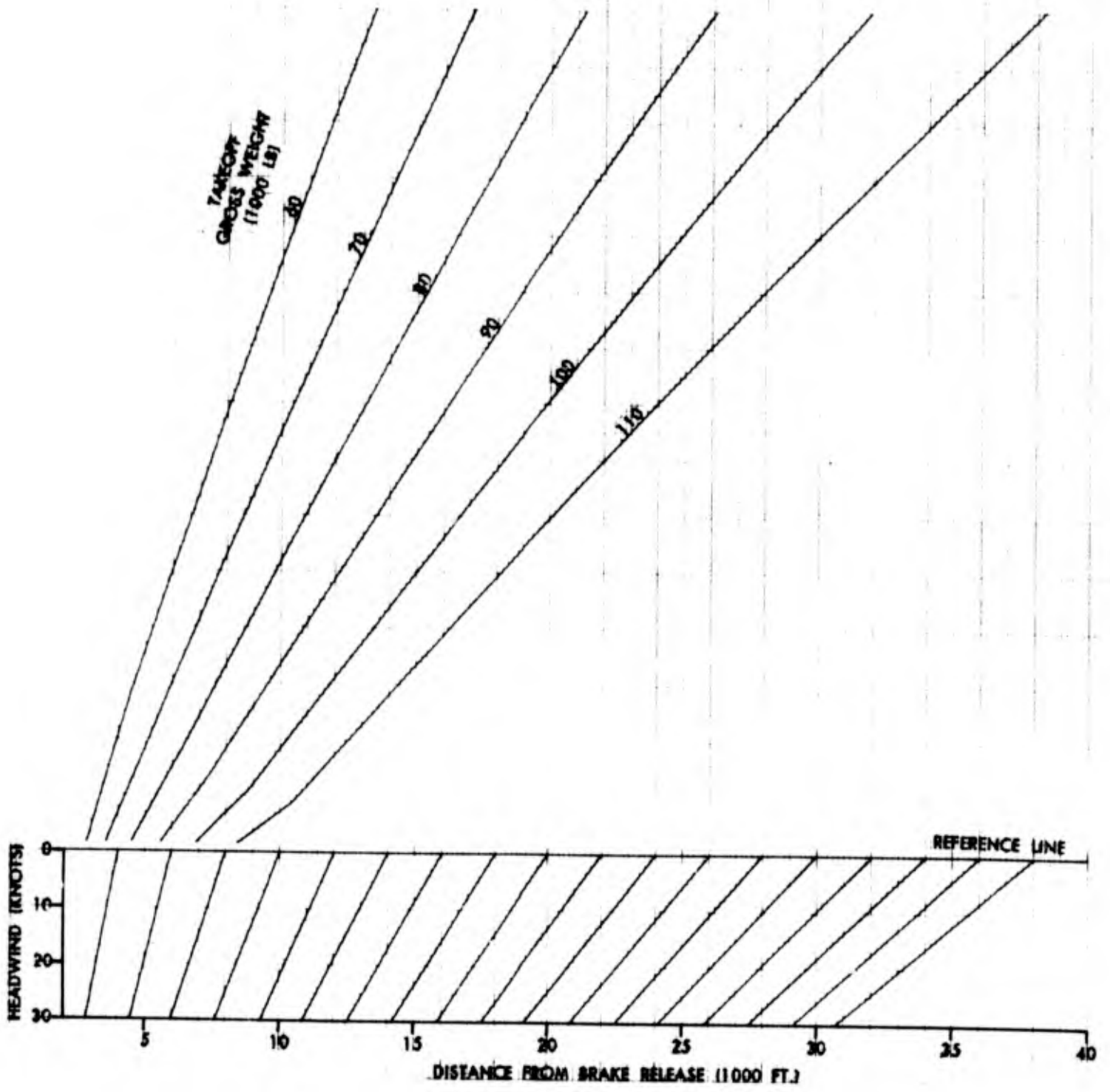


FIGURE 38.

DC-9 SERIES 30
ALL ENGINE FLIGHT PA
3000 FT AIRPORT ALTITUDE
JT8D-7 ENGINE
5° FLAPS
CLIMB AT $V_2 + 10$



DC-9 SERIES 30
ALL ENGINE FLIGHT PATH
 3000 FT AIRPORT ALTITUDE
 JT8D-7 ENGINE
 5° FLAPS
 CLIMB AT $V_2 + 10$

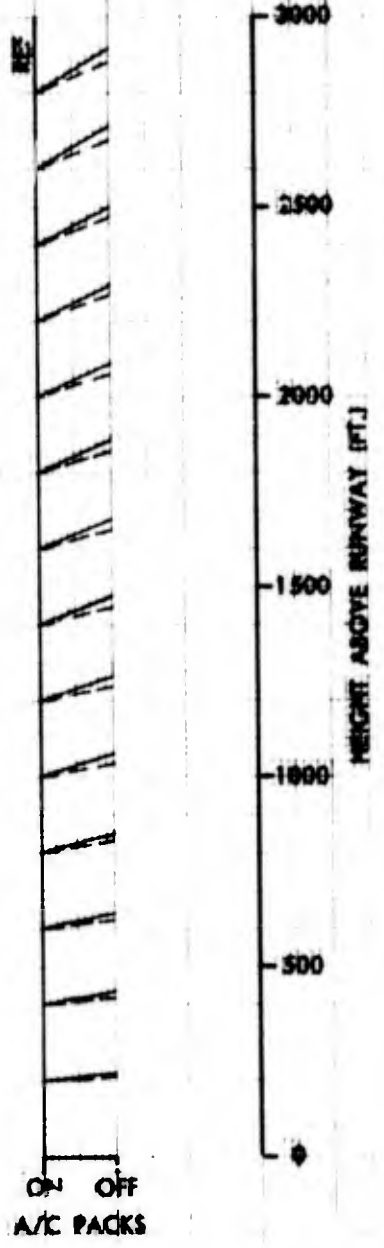
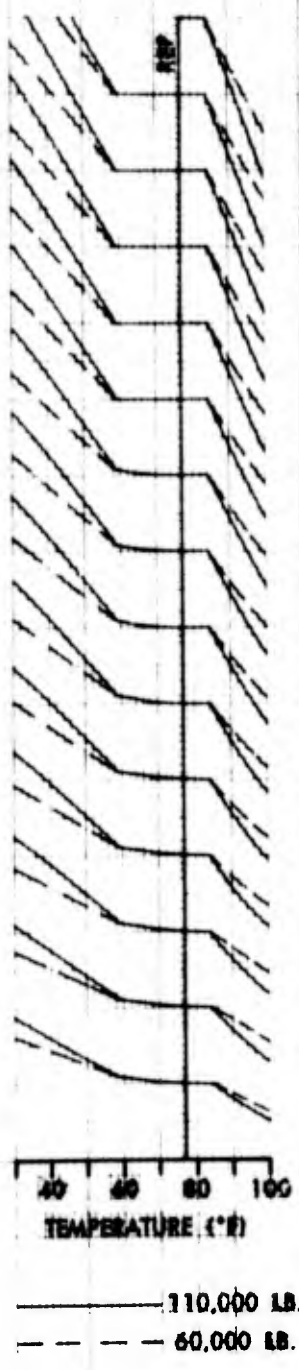


FIGURE 39.

DC-9 SERIES 30
 ALL ENGINE FLIGHT PATH
 3000 FT AIRPORT ALTITUDE
 -181° 7' ENGINE
 5° FLAPS
 CLIMB AT $V_2 + 10$

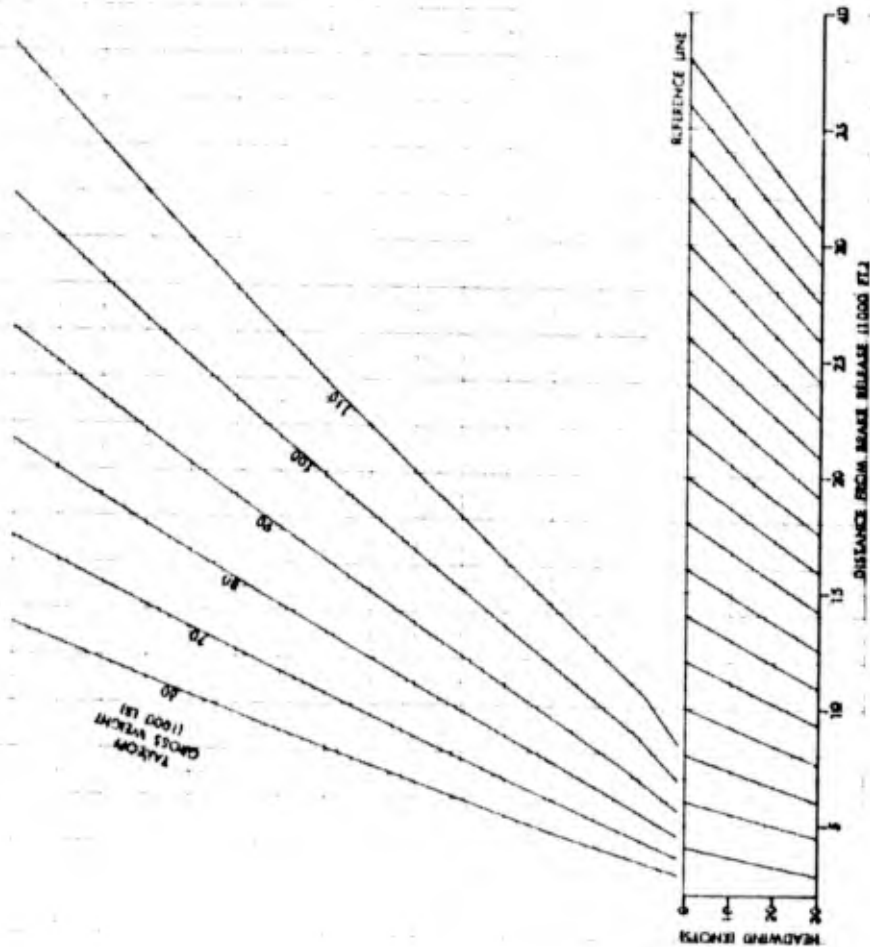
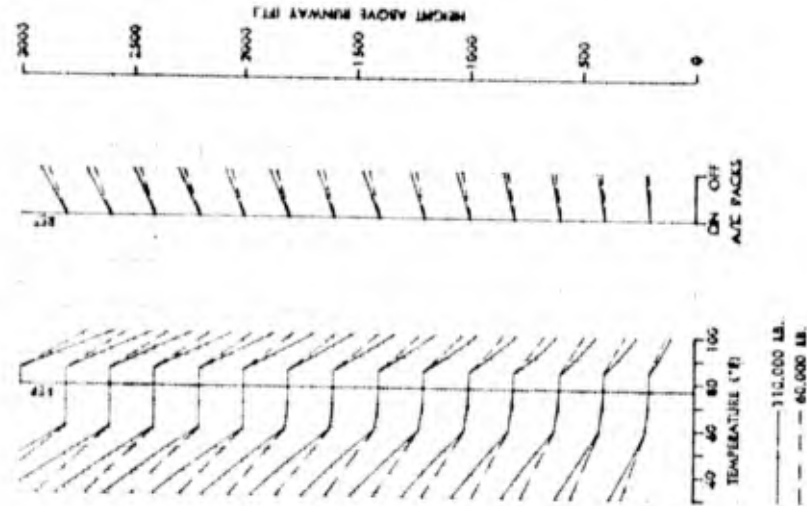


FIGURE 30

DC-9 SERIES 30
 ALL ENGINE FLIGHT PATH
 6000 FT AIRPORT ALTITUDE
 7180 FT ENGINES
 5° FLAPS
 CLIMB AT $V_2 + 10$

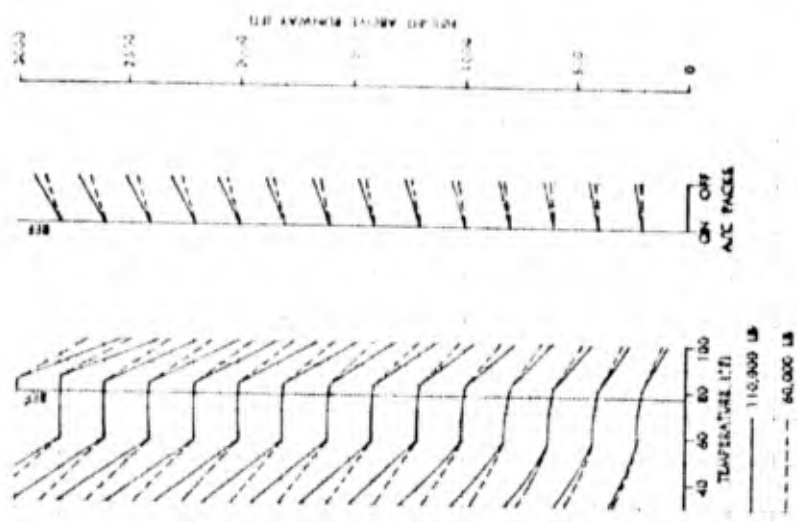
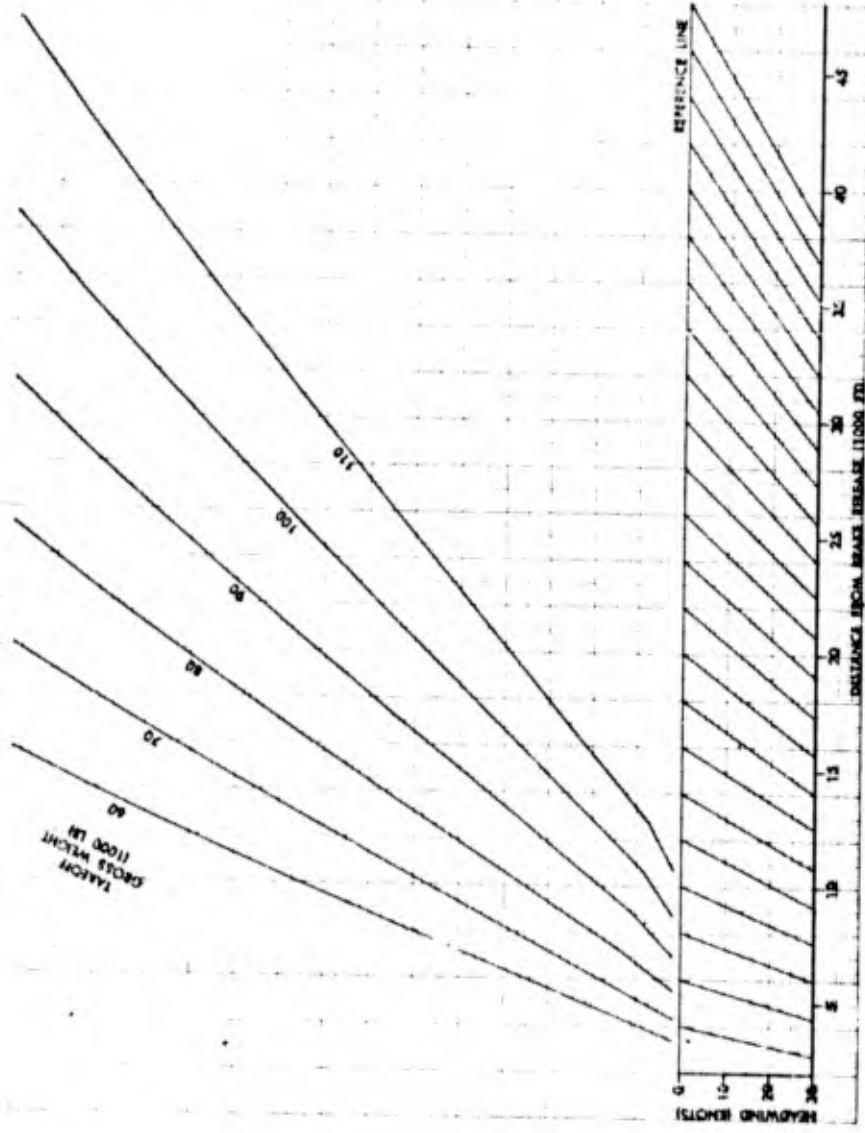
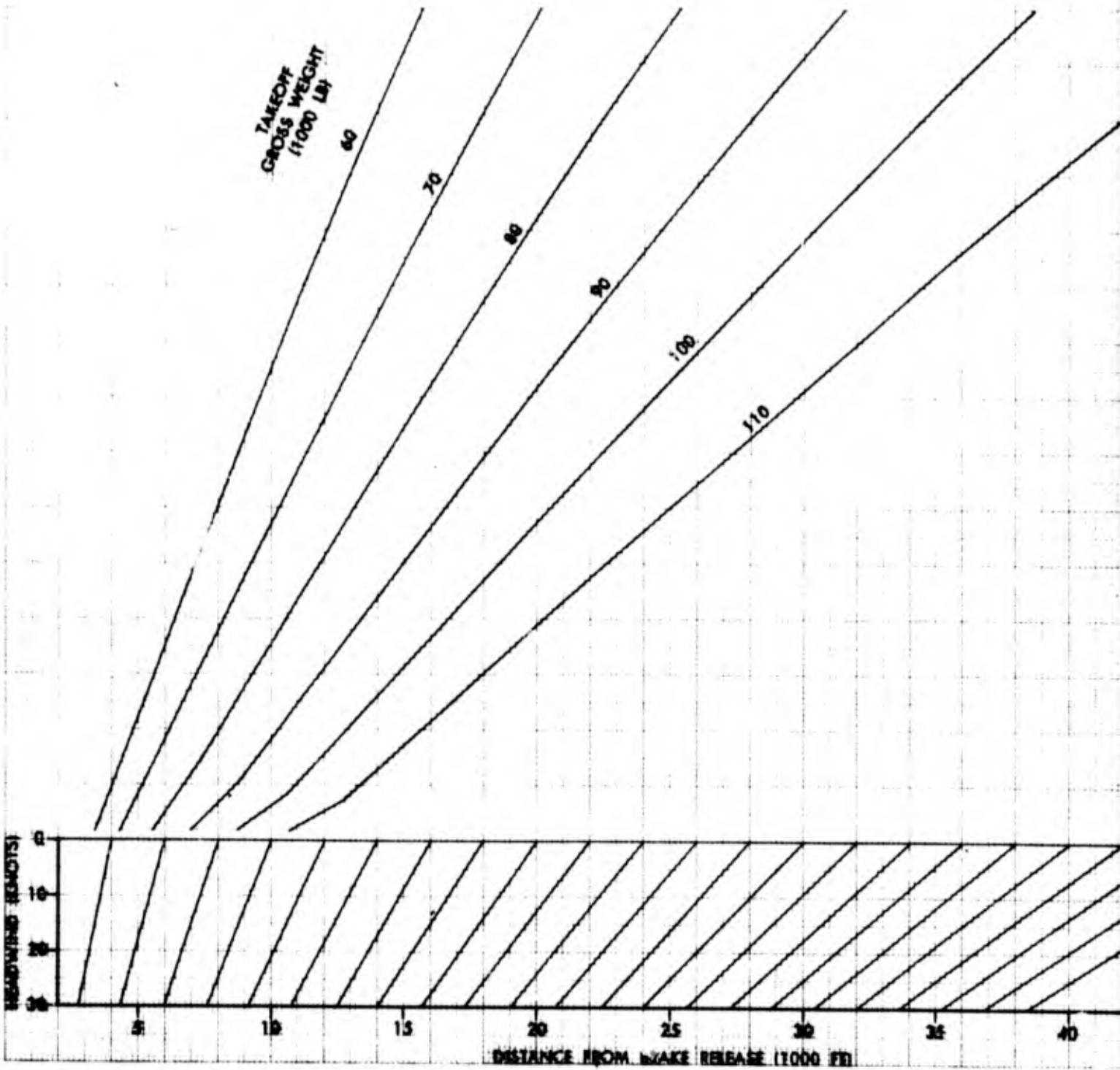


FIGURE 40

DC-9 SERIES 30
ALL ENGINE FLIGHT P
6000 FT AIRPORT ALTITUDE
JT8D-7 ENGINES
5° FLAPS
CLIMB AT $V_2 + 10$



R

DC-9 SERIES 30
 ALL ENGINE FLIGHT PATH
 6000 FT AIRPORT ALTITUDE
 JT8D-7 ENGINES
 5° FLAPS
 CLIMB AT $V_2 + 10$

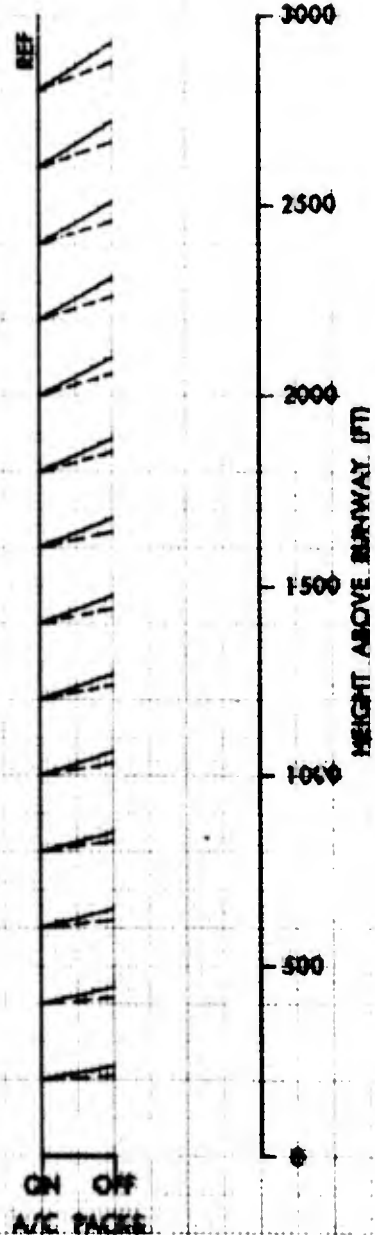
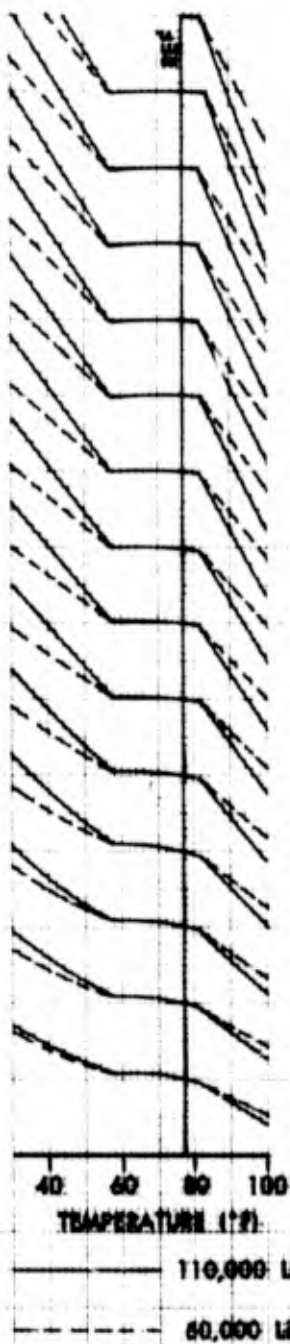
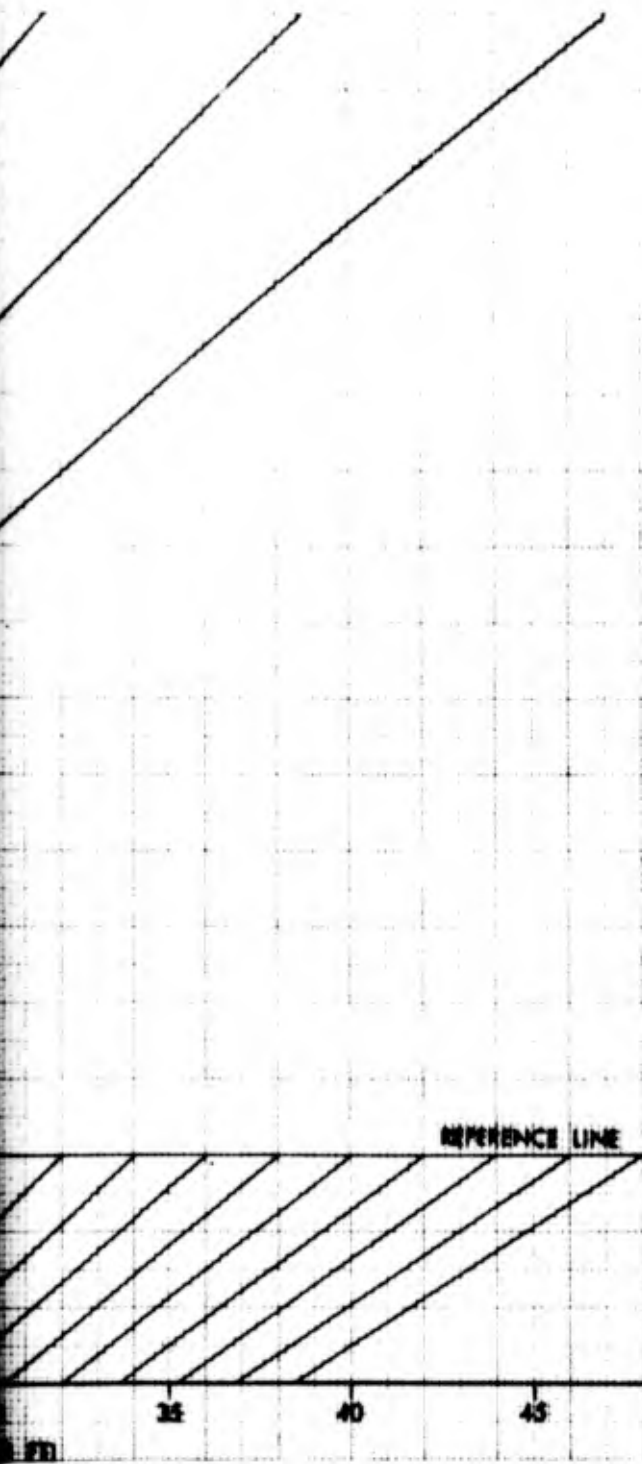
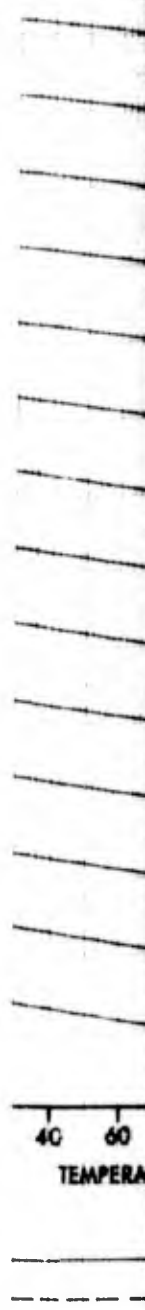
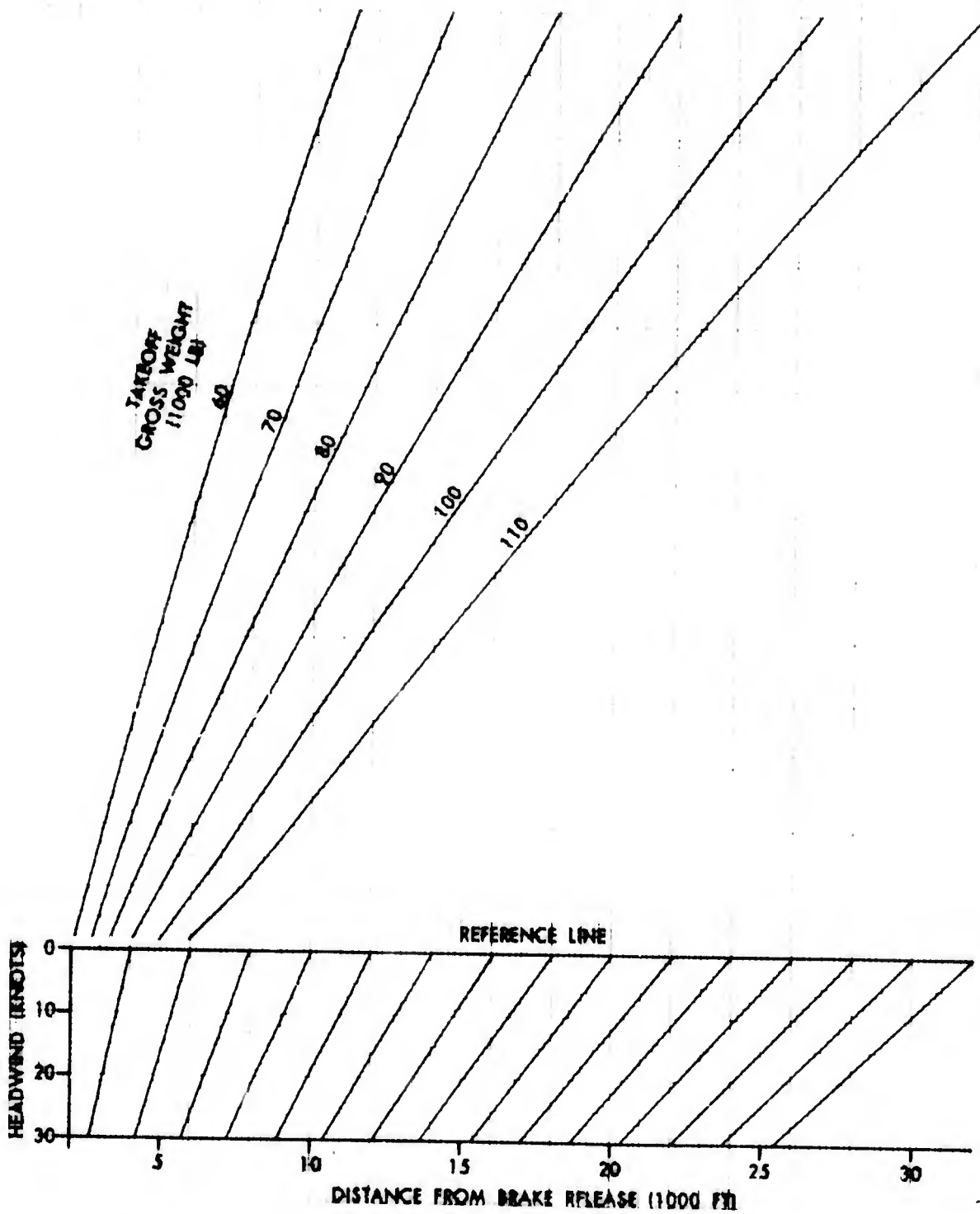


FIGURE 40.

B

DC-9 SERIES 30
ALL ENGINE FLIGHT PATH
SEA LEVEL AIRPORT ALTITUDE
JTBD-7 ENGINES
15° FLAPS
CLIMB AT $V_2 + 10$



DC-9 SERIES 30
 ALL ENGINE FLIGHT PATH
 SEA LEVEL AIRPORT ALTITUDE
 JT8D-7 ENGINES
 15° FLAPS
 CLIMB AT $Y_2 + 10$

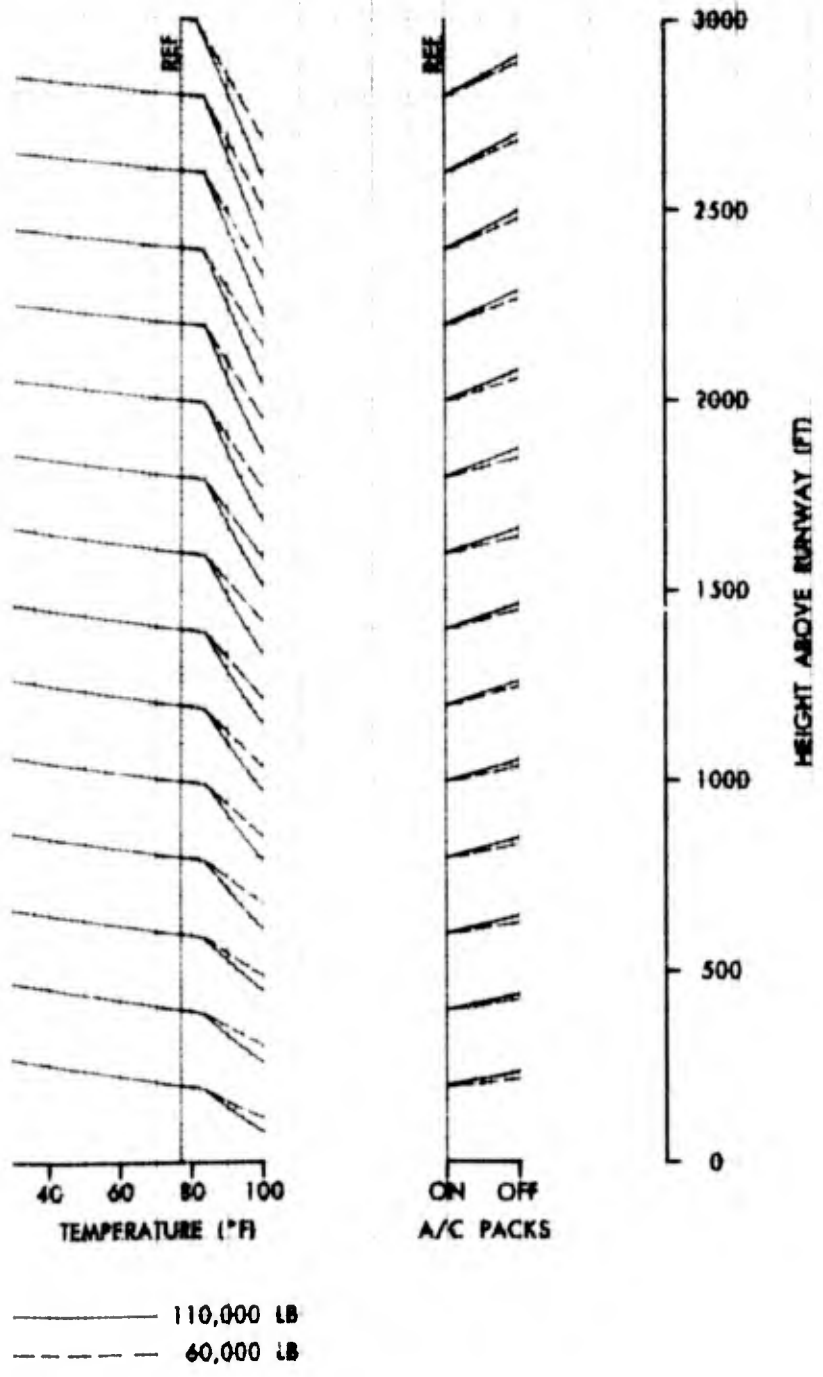


FIGURE 41.

DC-3 SERIES 30
ALL ENGINE FLIGHT PATH
 SEA LEVEL AIRPORT ALTITUDE
 1100-7 ENGINES
 15° FLAPS
 CLIMB AT $V_2 + 10$

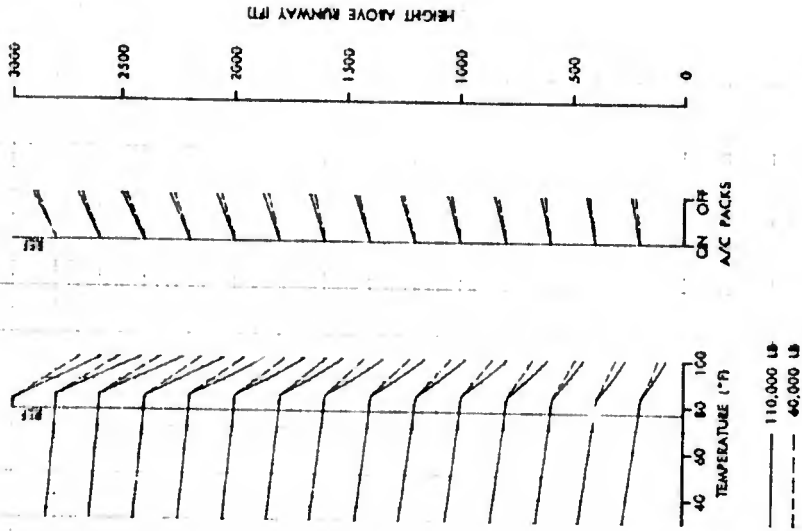
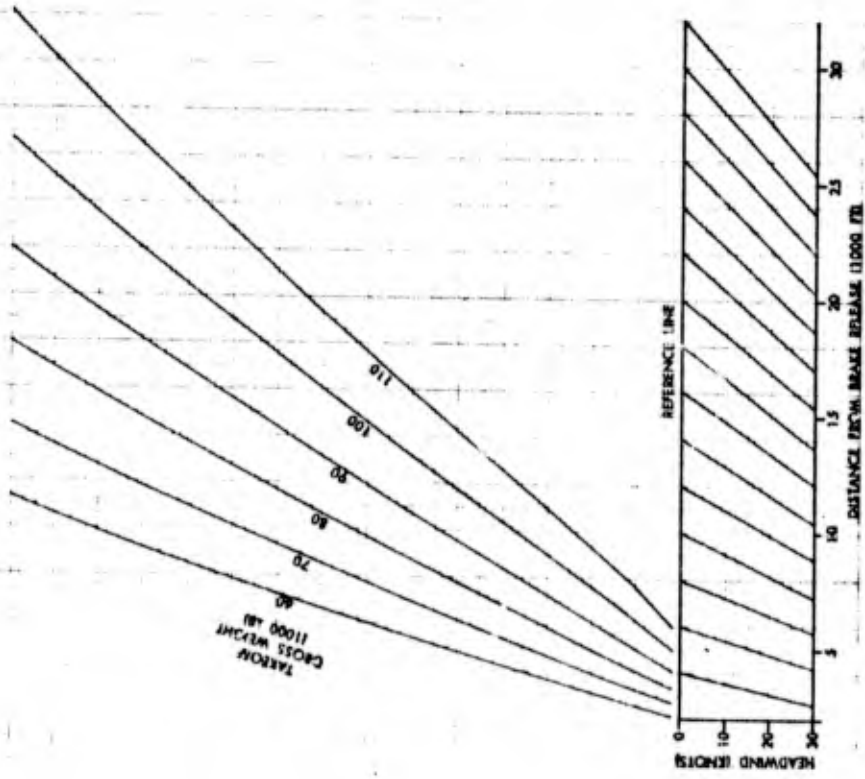
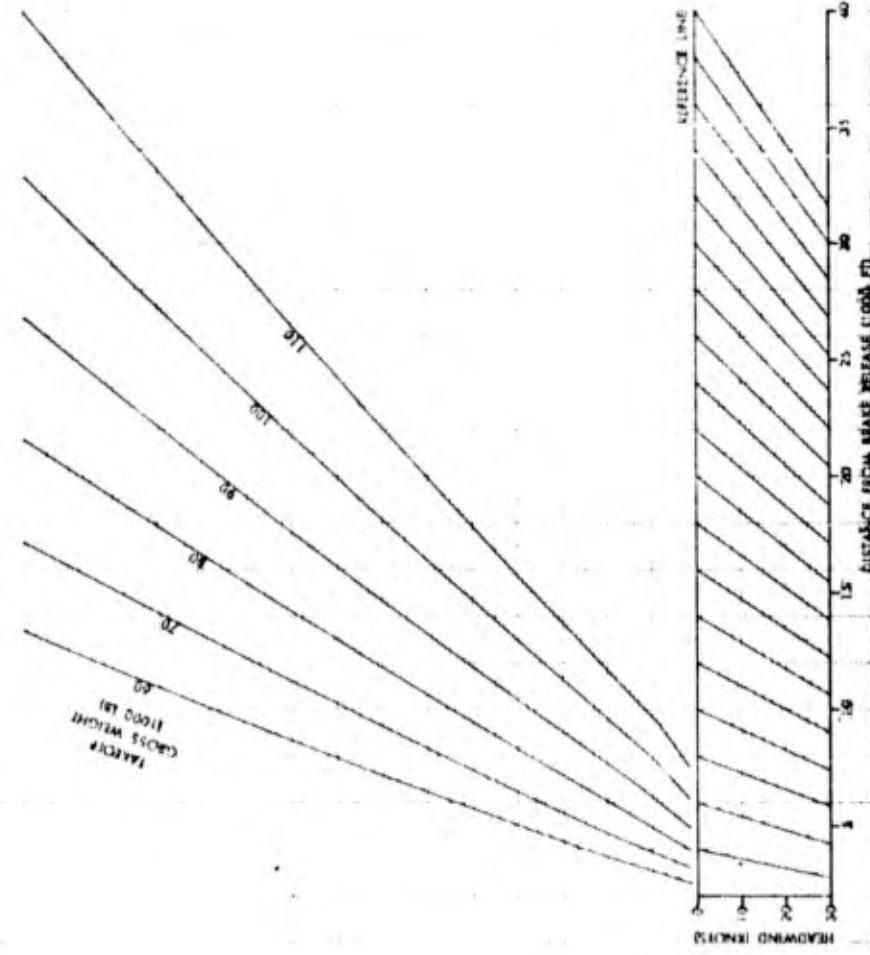
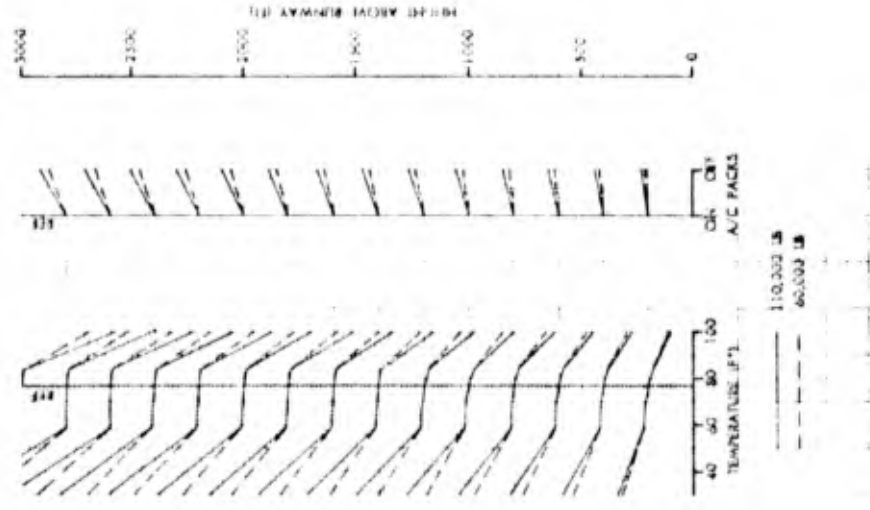
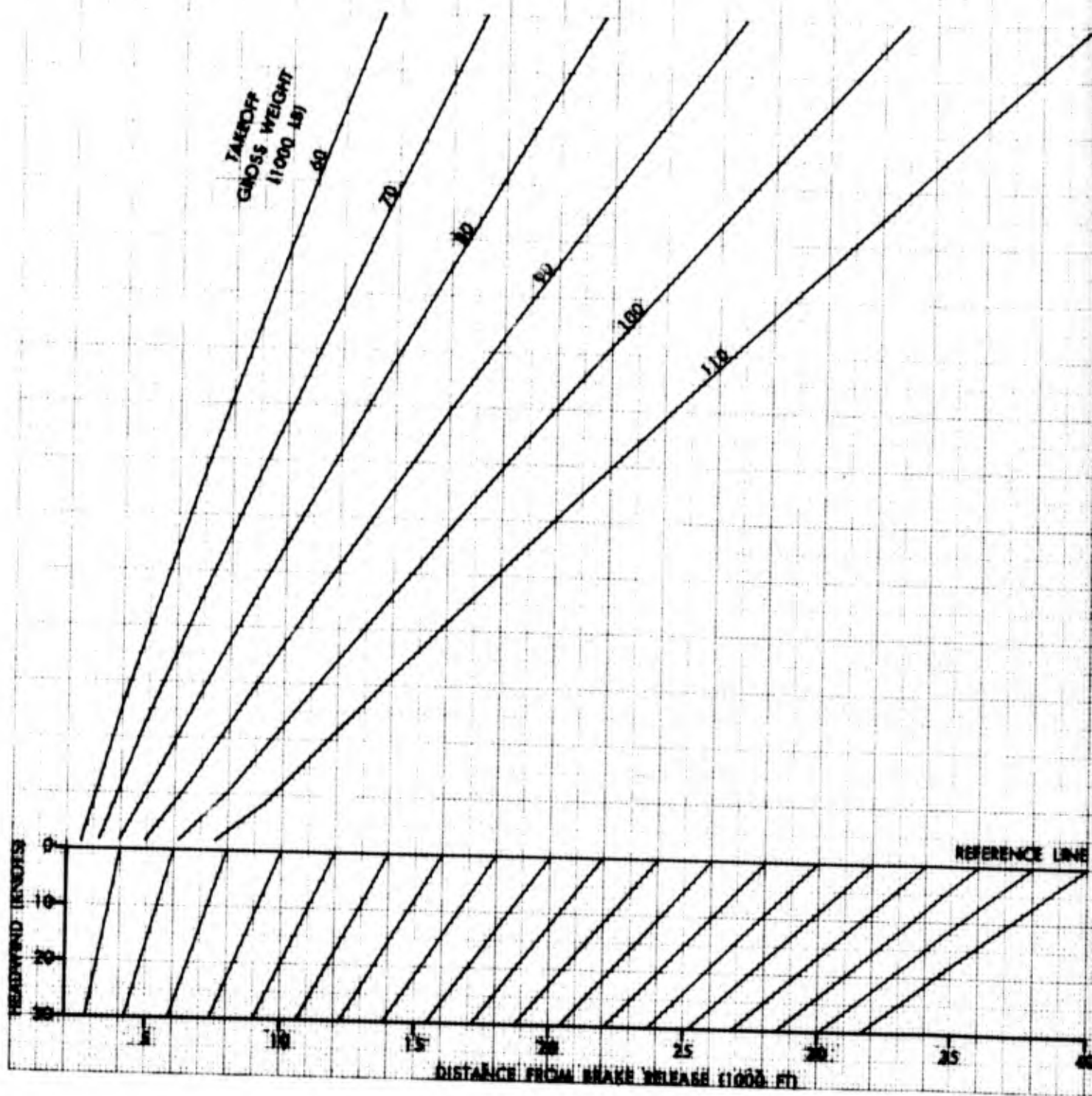


FIGURE 41.

IC-9 SERIES 30
 ALL ENGINE FLIGHT PATH
 2000 FT RUNWAY ALTITUDE
 1780.7 ENGINE
 13° FLAPS
 CLIMB AT V_{L+10}



DC-9 SERIES
ALL ENGINE FLIC
3000 FT RUNWAY
JT8D-7 ENCS
15° FLAPS
CLIMB AT V_2



2

DC-9 SERIES 30
ALL ENGINE FLIGHT PATH
 3000 FT RUNWAY ALTITUDE
 JT8D-7 ENGINE
 15° FLAPS
 CLIMB AT $V_2 + 10$

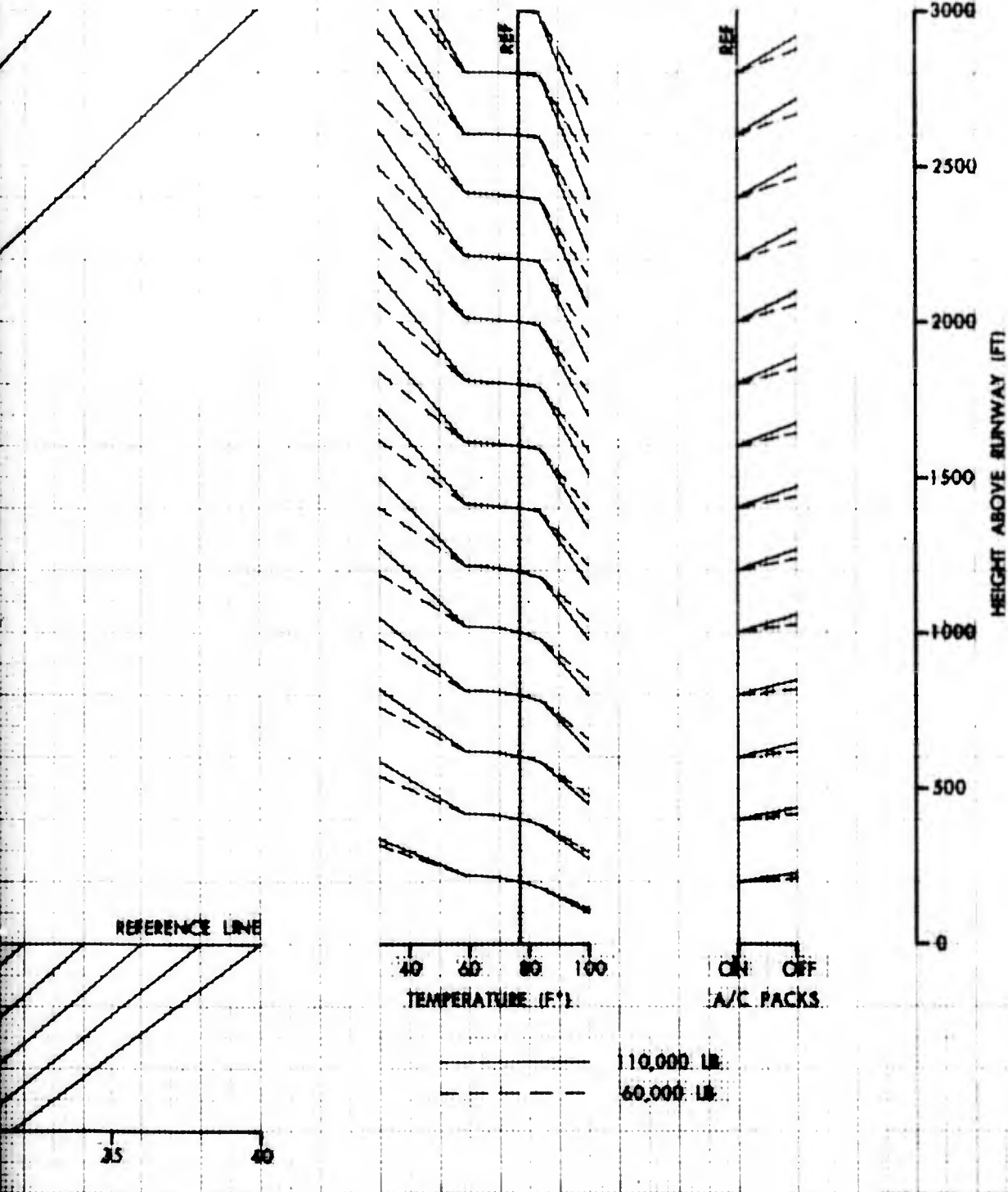
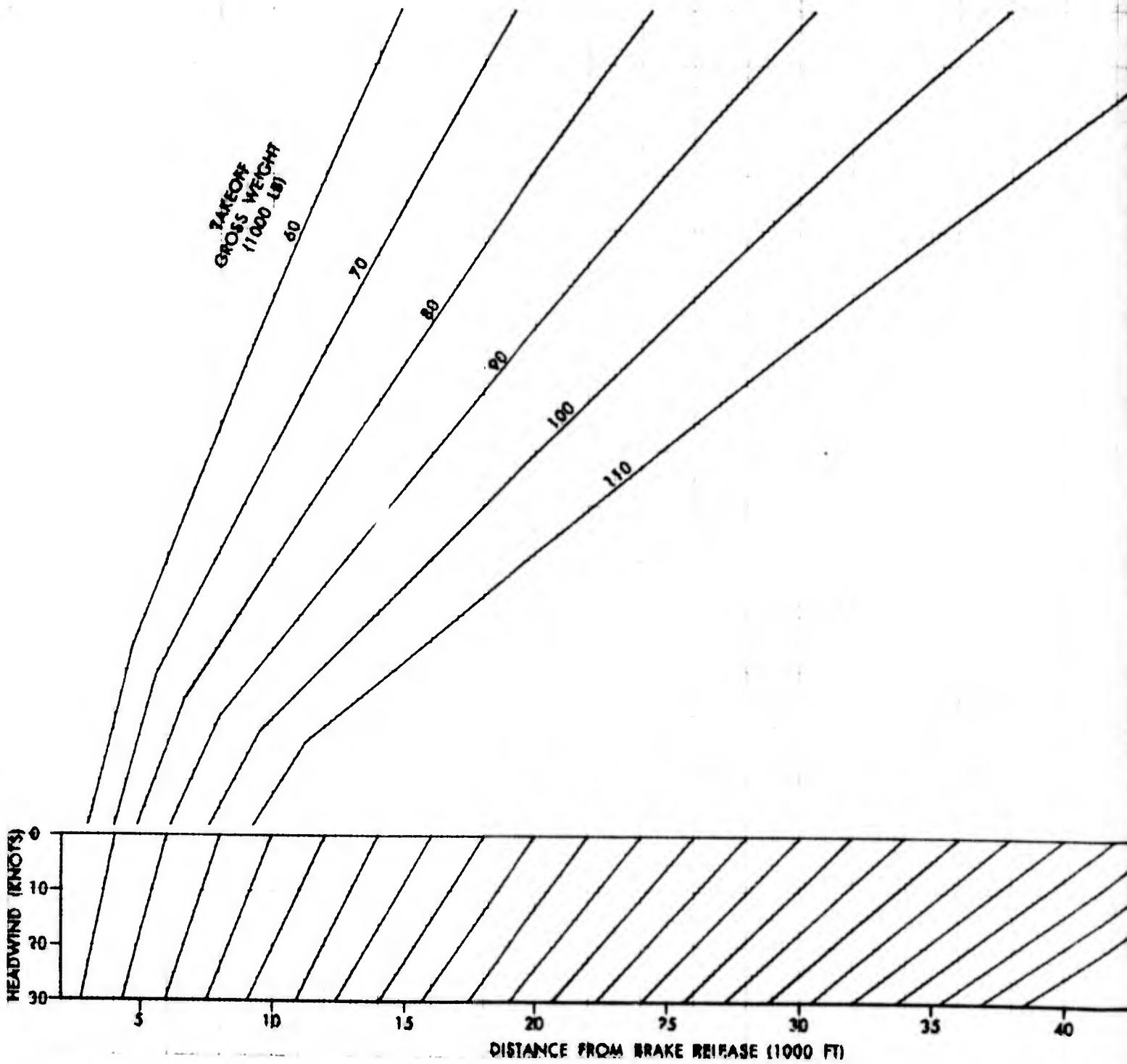


FIGURE 42.

DC-9 SERIES 30
ALL ENGINE FLIGHT PA
6000 FT AIRPORT ALTITUDE
JT8D-7 ENGINES
15° FLAPS
CLIMB AT $V_2 + 10$



DC-9 SERIES 30
 1 ENGINE FLIGHT PATH
 6000 FT AIRPORT ALTITUDE
 JT9D-7 ENGINES
 15° FLAPS
 CLIMB AT $V_2 + 10$

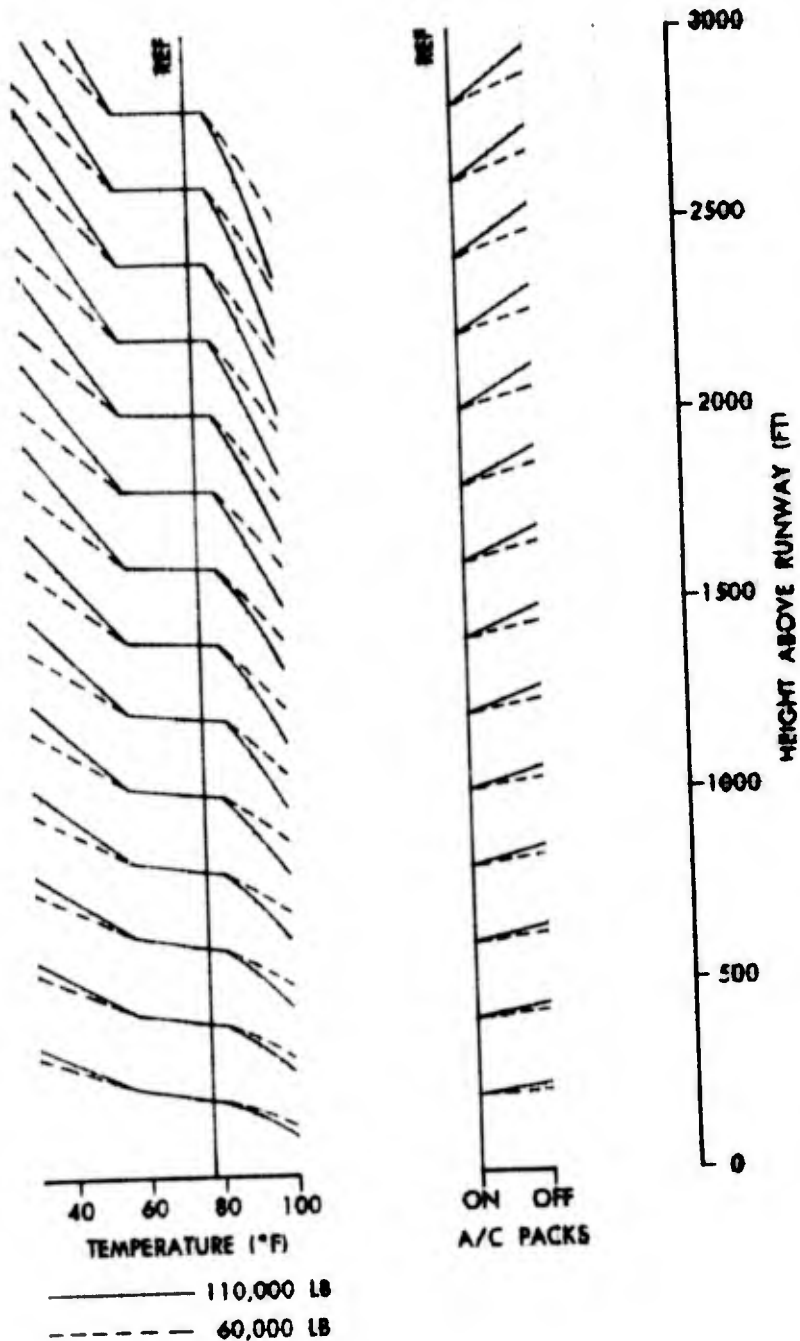


FIGURE 43.

DC-9 SERIES 30
 ALL ENGINE FLIGHT PATH
 8000 FT AIRPORT ALTITUDE
 2x7 ENGINES
 15° FLAPS
 CLIMB AT $V_2 + 10$

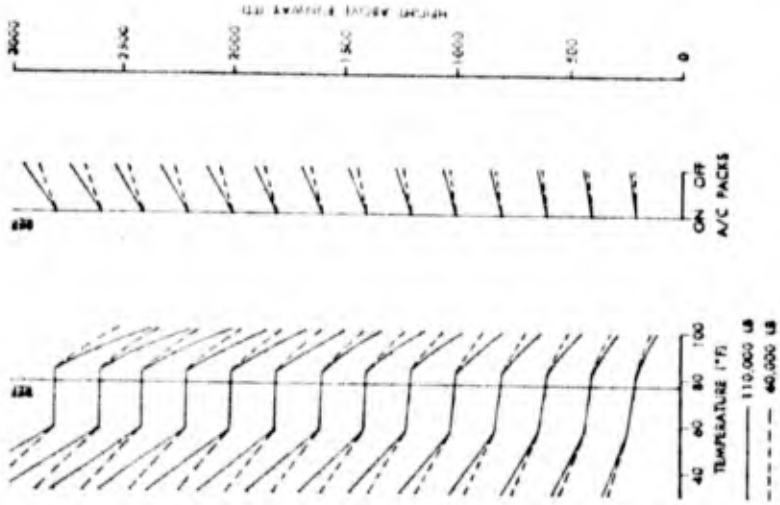
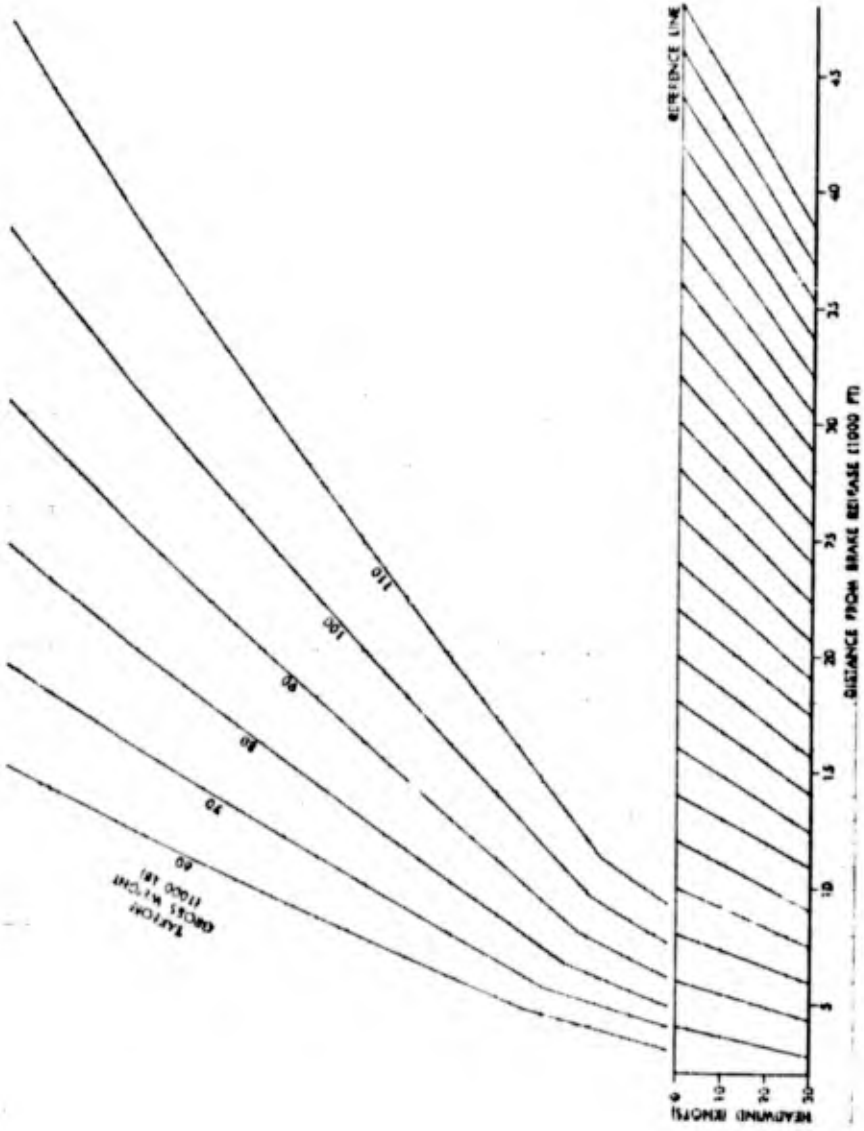


FIGURE 43

LC-130 SERIES 30
 ALL ENGINE FLIGHT PATH
 SEA LEVEL AIRPORT ALTITUDE
 2ND 7 ENGINES
 15° FLAPS
 CLIMB AT $V_2 + 10$ OR 15° PITCH LIMIT

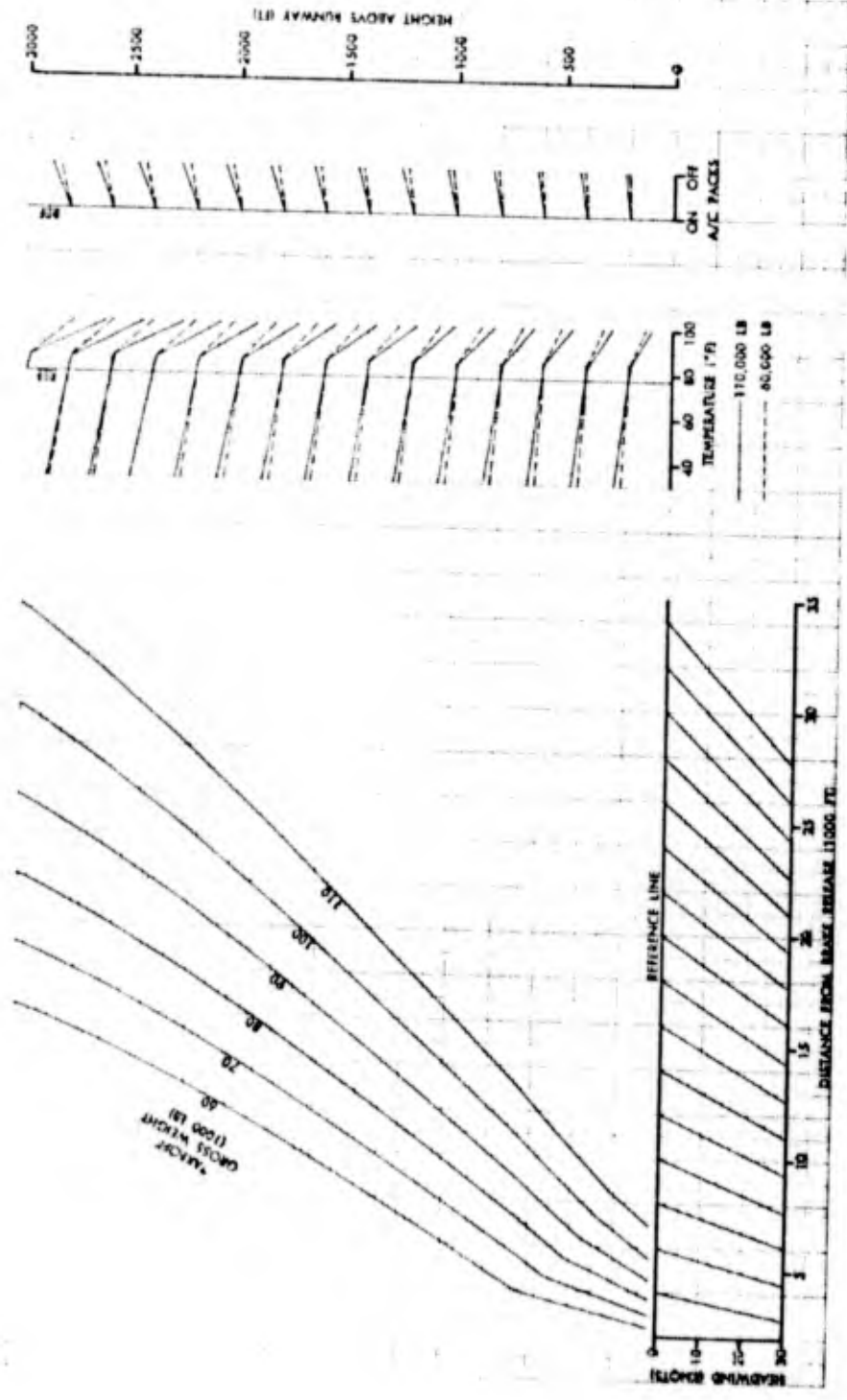
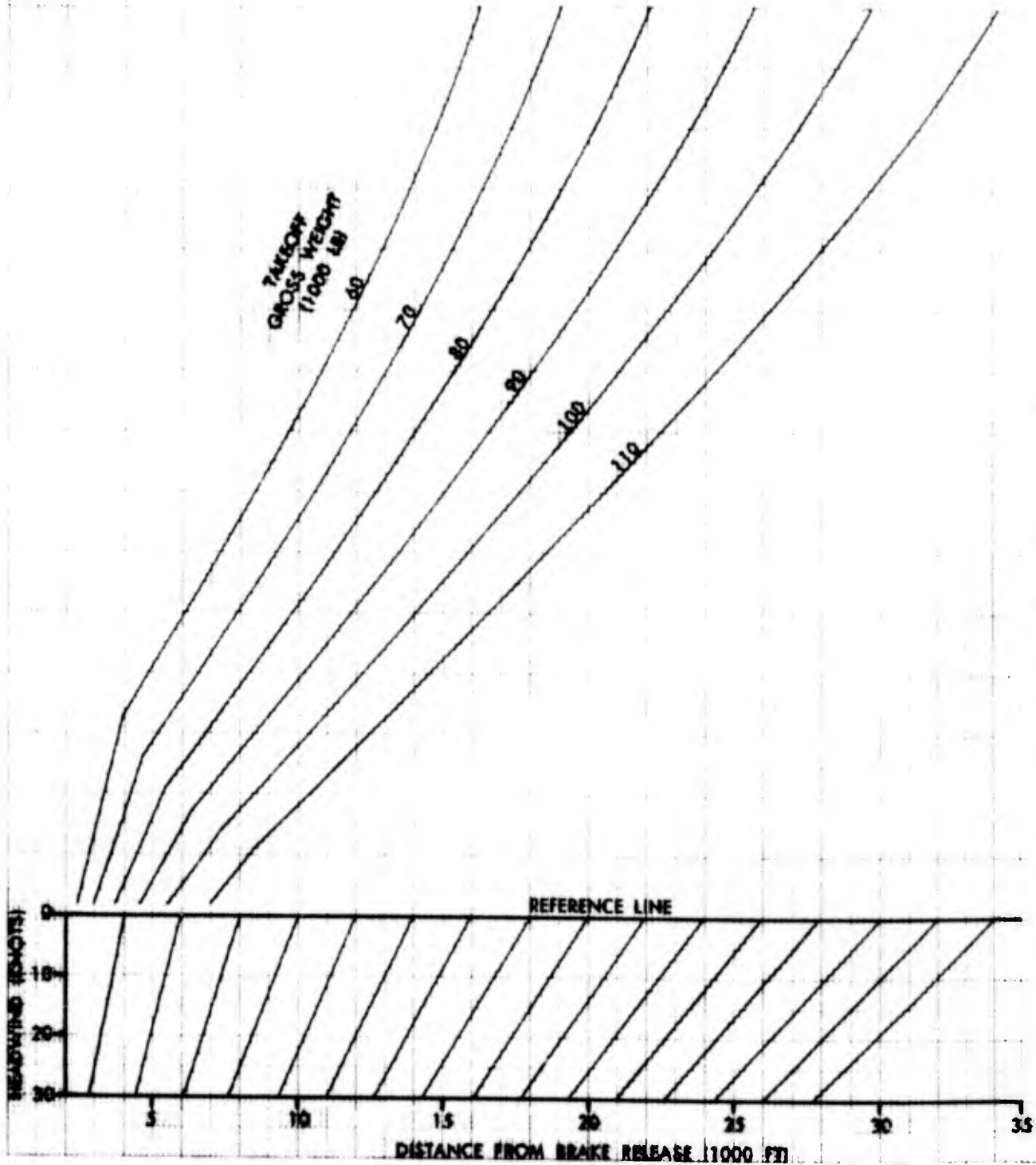
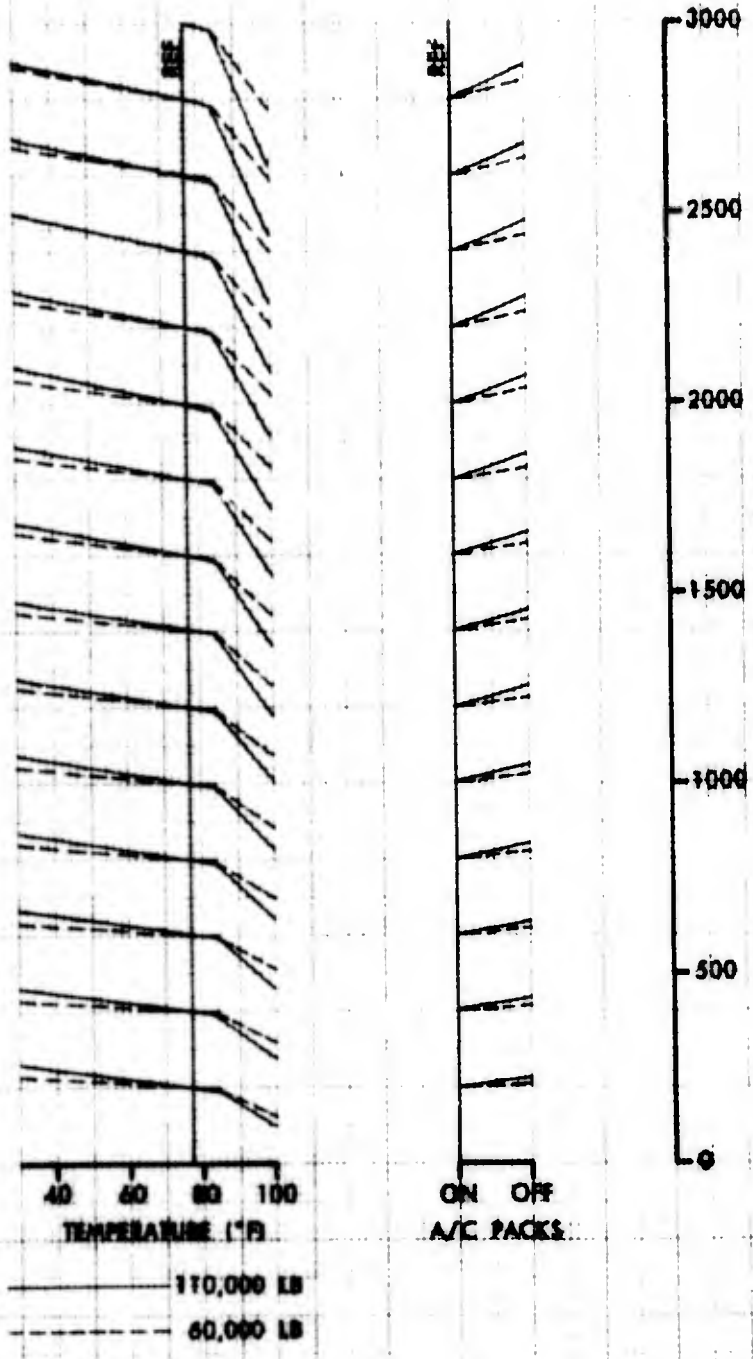


FIGURE 44

DC-9 SERIES 30
ALL ENGINE FLIGHT
SEA LEVEL AIRPORT ALTI
JT8D-7 ENGINES
5° FLAPS
CLIMB AT $V_2 + 10$ OR 15°



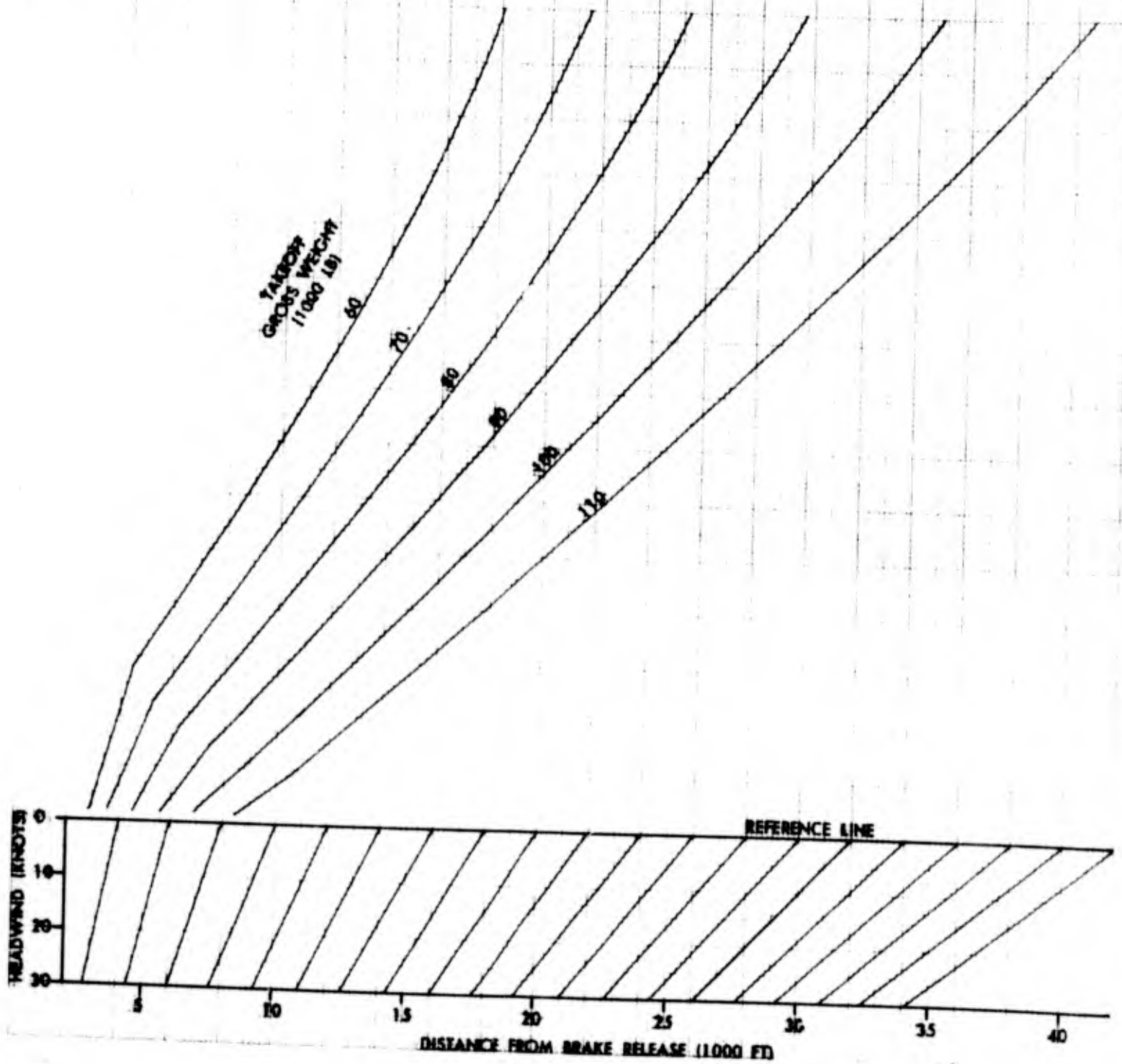
DC-9 SERIES 30
ALL ENGINE FLIGHT PATH
 SEA LEVEL AIRPORT ALTITUDE
 JT8D-7 ENGINES
 5° FLAPS
 AT $V_2 + 10$ OR 15° PITCH LIMIT



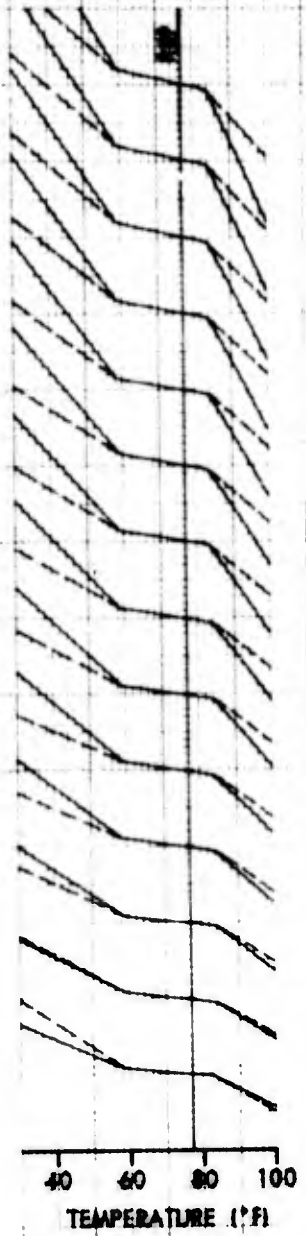
35

FIGURE 44.

DC-9 SERIES 30
 ALL ENGINE FLIGHT PA
 3000 FT AIRPORT ALTITUDE
 JT8D-7 ENGINES
 5° FLAPS
 CLIMB AT $V_2 + 10$ OR 15° PI



DC-9 SERIES 30
 ALL ENGINE FLIGHT PATH
 3000 FT AIRPORT ALTITUDE
 JTD-7 ENGINES
 5° FLAPS
 AT $V_p + 10$ OR 15° PITCH LIMIT



—— 110,000 LB
 - - - 60,000 LB

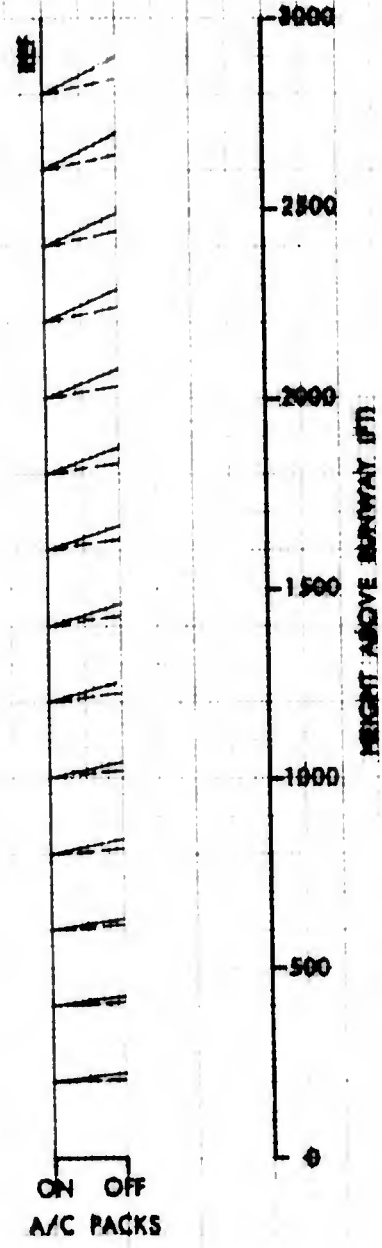


FIGURE 45.

DC-10 SERIES 30
 ALL ENGINES & FLIGHT PATH
 2000 FT AIRPORT ALTITUDE
 2007 ENGINES
 5° FLAPS
 CLIMB AT $V_2 + 10$ OR 15° PITCH LIMIT

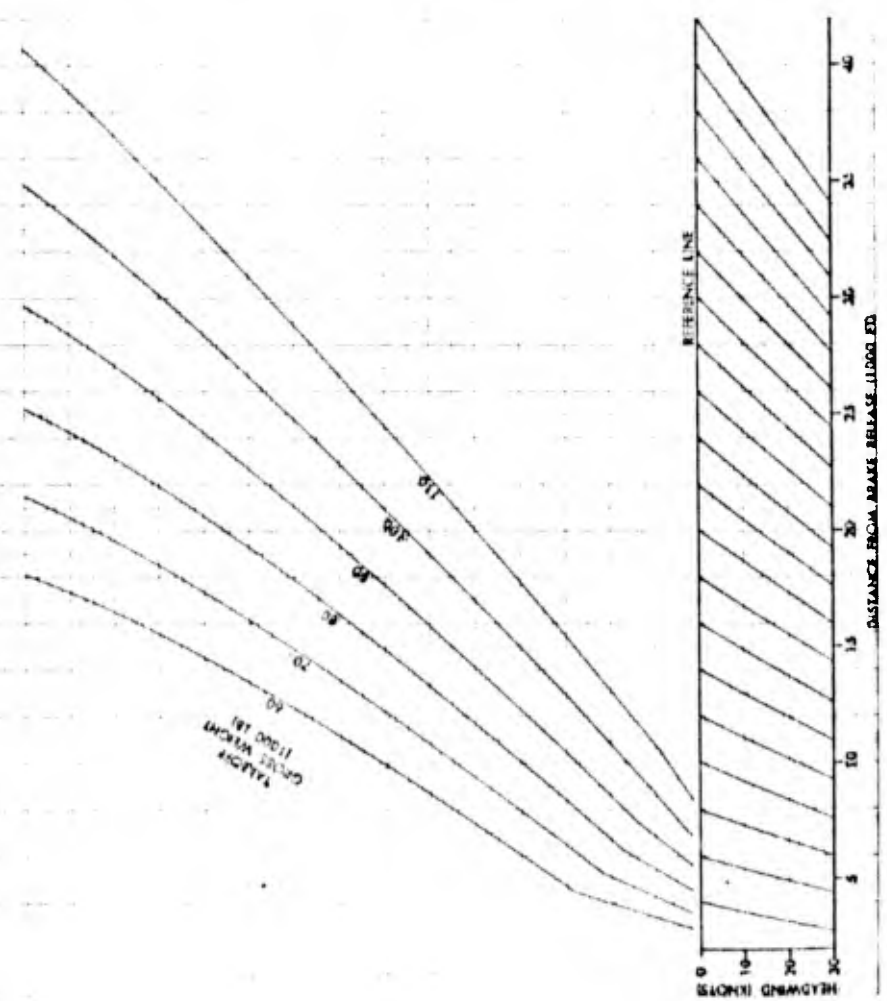
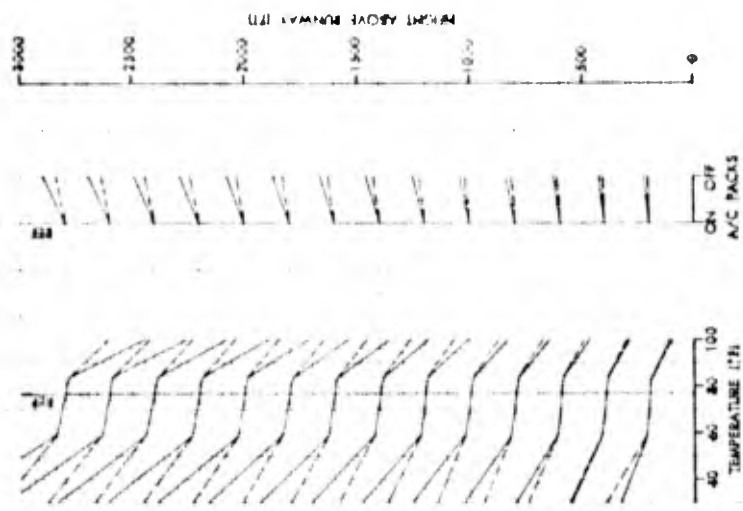
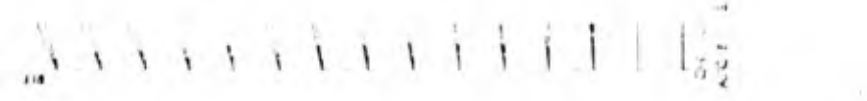
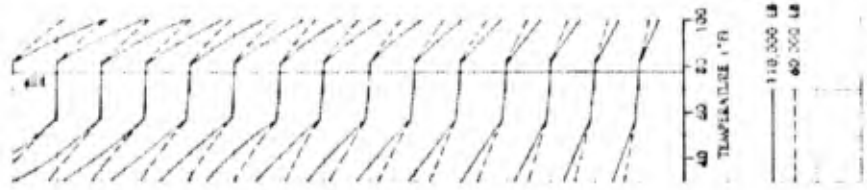
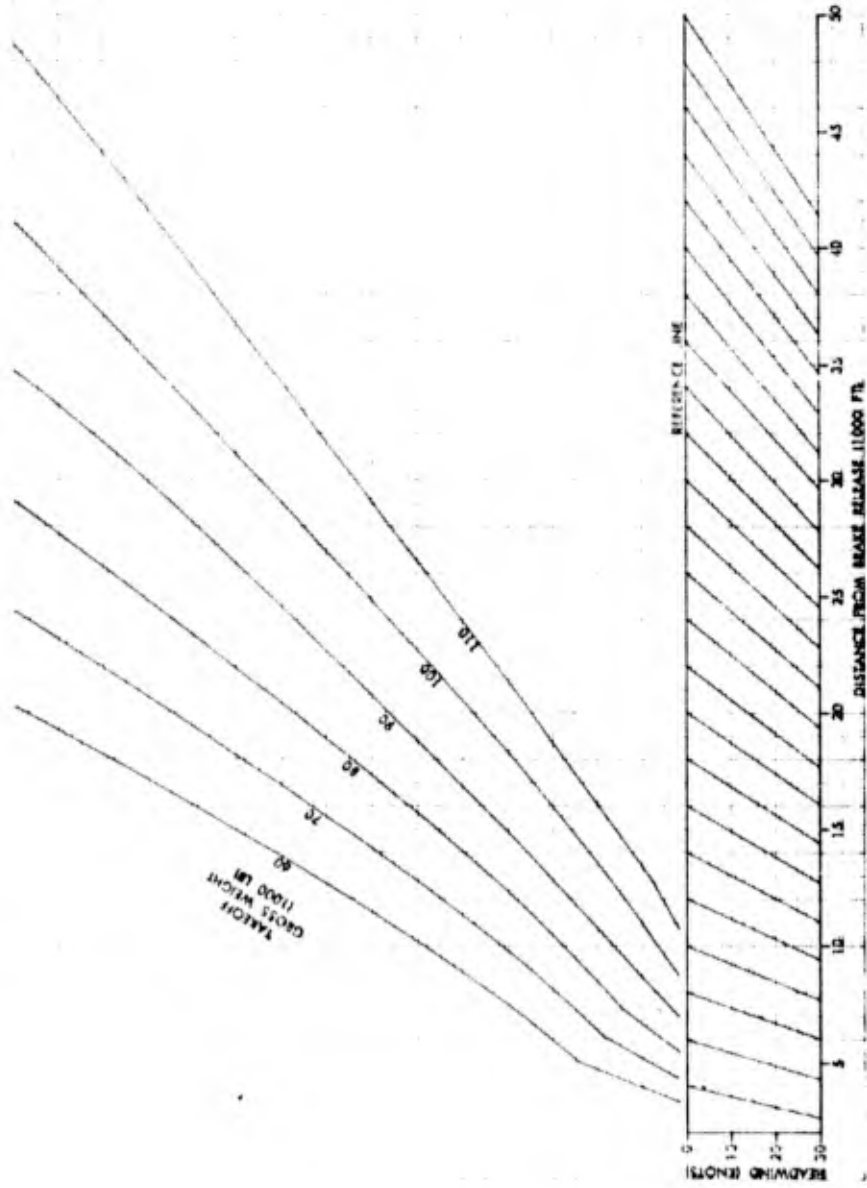


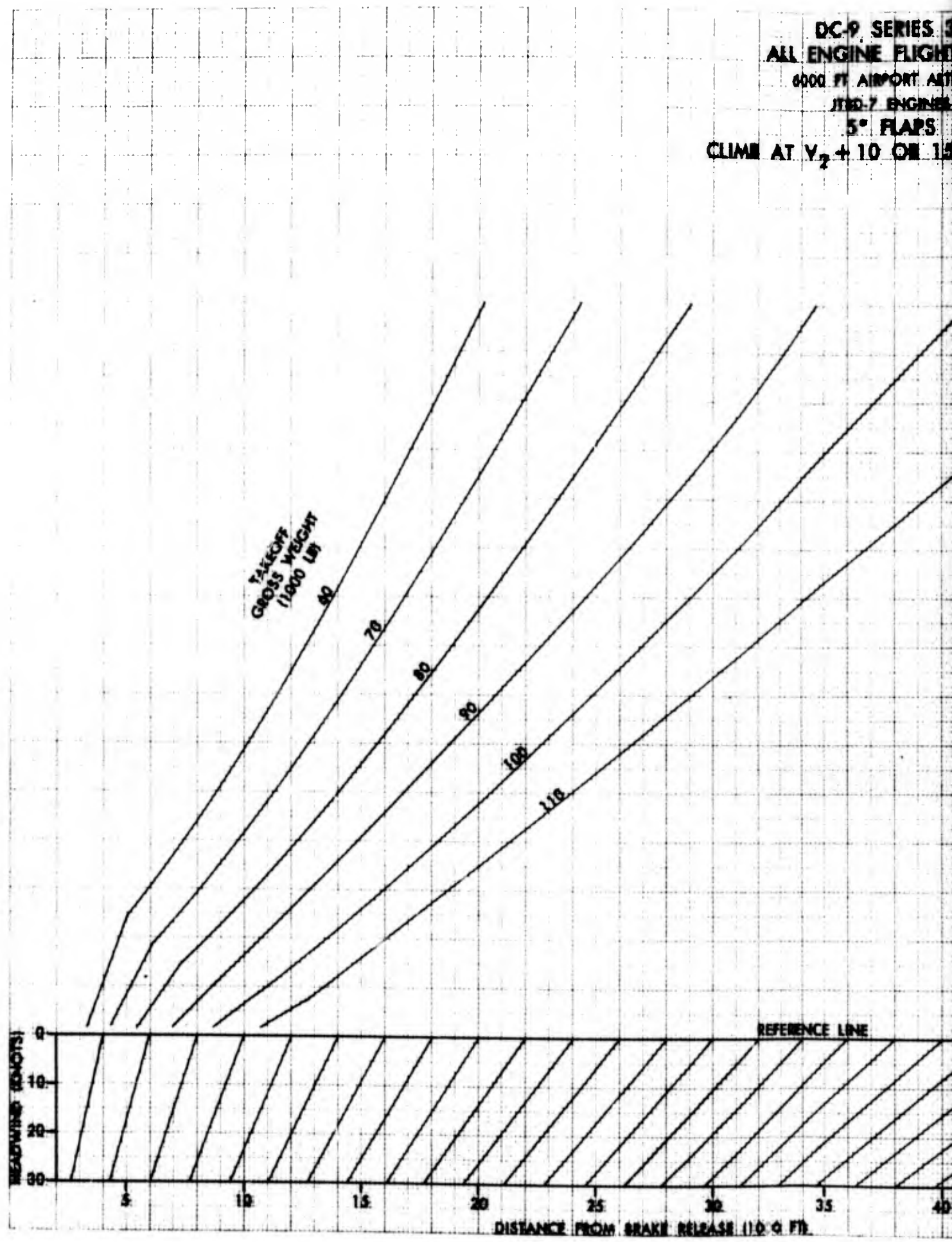
FIGURE 45

DC-9 SERIES 30
 ALL ENGINE FLIGHT PATH
 6000 FT AIRPORT ALTITUDE
 JTD 7 ENGINES
 5° FLAPS
 CLIMB AT $V_2 + 10$ OR 15° PITCH LIMIT



DC-9, SERIES 3
ALL ENGINE FLIGHT
6000 FT AIRPORT ALT
JT8D-7 ENGINES
5° FLAPS

CLIMB AT $V_2 + 10$ OR 15



A

**DC-9, SERIES 30
ALL ENGINE FLIGHT PATH**

6000 FT AIRPORT ALTITUDE

JTBQ-7 ENGINES

5° FLAPS

CLIMB AT $V_2 + 10$ ON 15° PITCH LIMIT

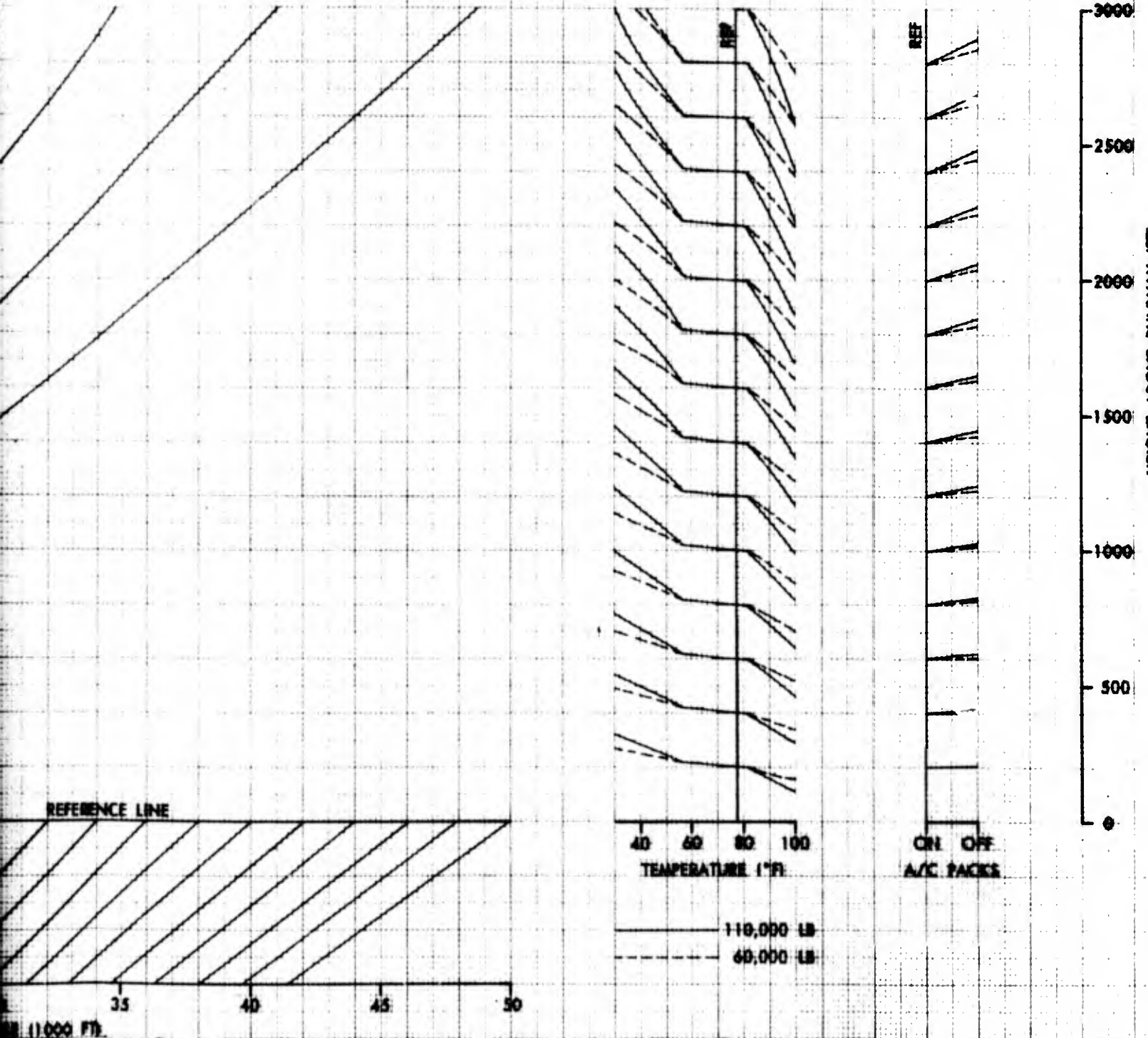
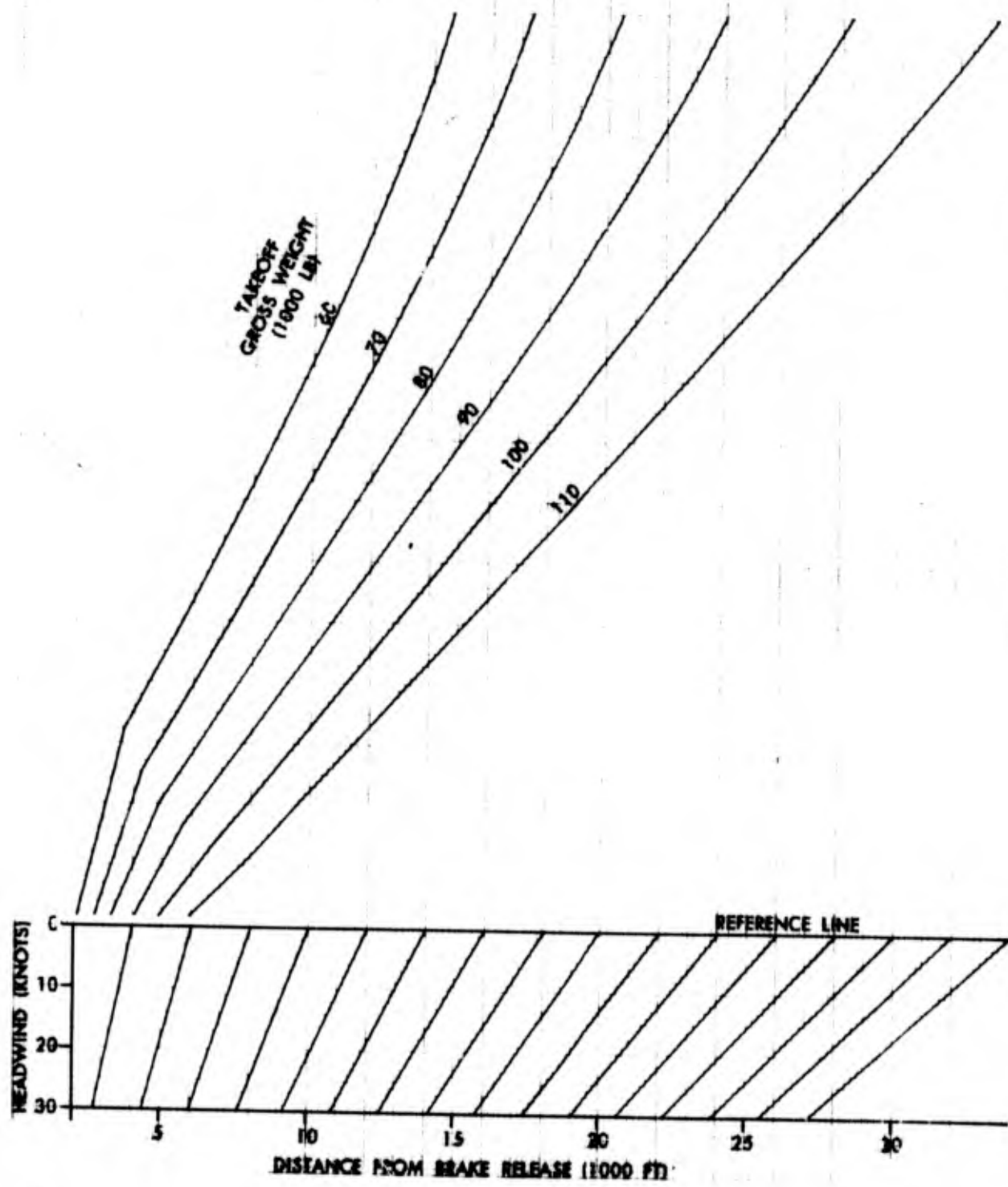


FIGURE 46.

DC-9 SERIES 30
ALL ENGINE FLIGHT PA
 SEA LEVEL AIRPORT ALTITUDE
 JT8D-7 ENGINES
 15° FLAPS
 CLIMB AT $V_2 + 10$ OR 15° PI



DC-9 SERIES 30
 ALL ENGINE FLIGHT PATH
 SEA LEVEL AIRPORT ALTITUDE
 JT8D-7 ENGINES
 15° FLAPS
 AT $V_2 + 10$ OR 15° PITCH LIMIT

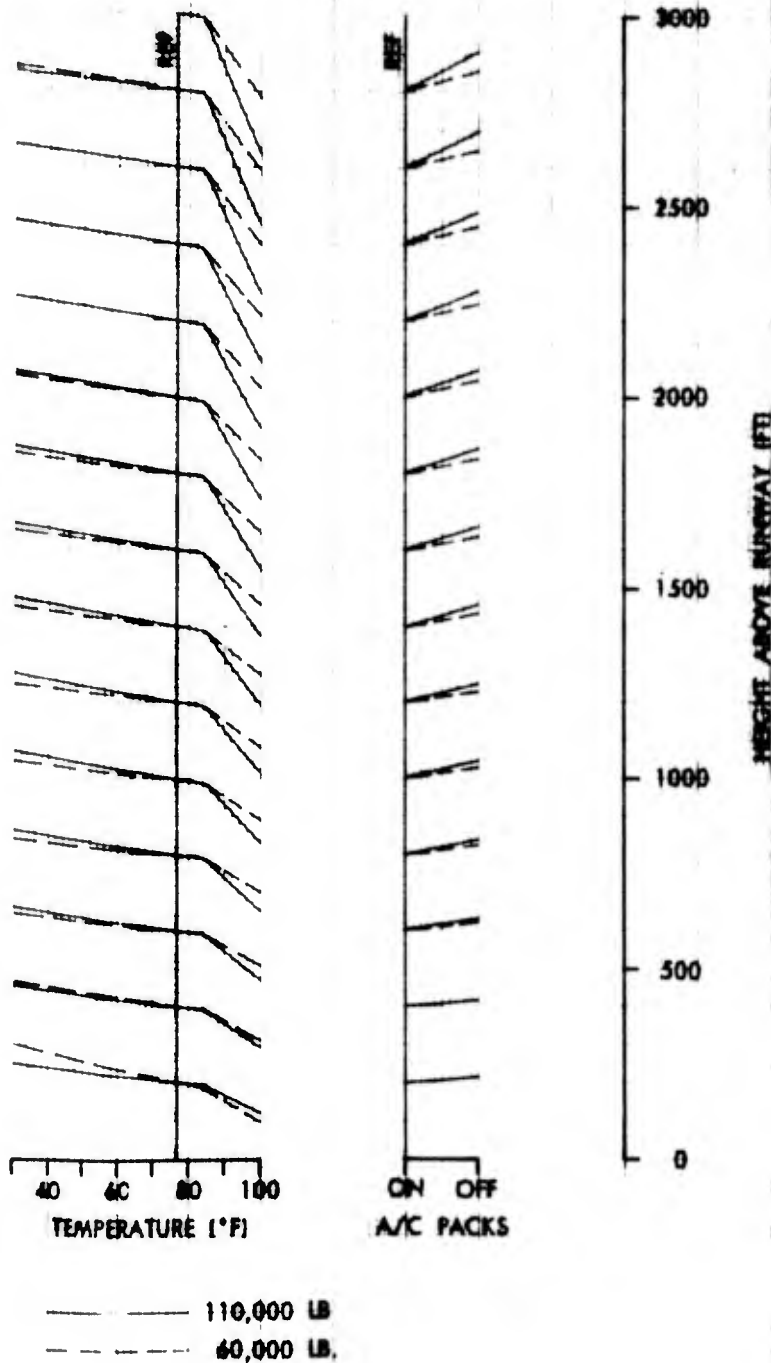


FIGURE 47.

DC-9 SERIES 30
 ALL ENGINE FLIGHT PATH
 SEA LEVEL AIRPORT ALTITUDE
 TWO 7 ENGINES
 15° FLAPS
 CLIMB AT V_{y3} + 10 OR 15° PITCH LIMIT

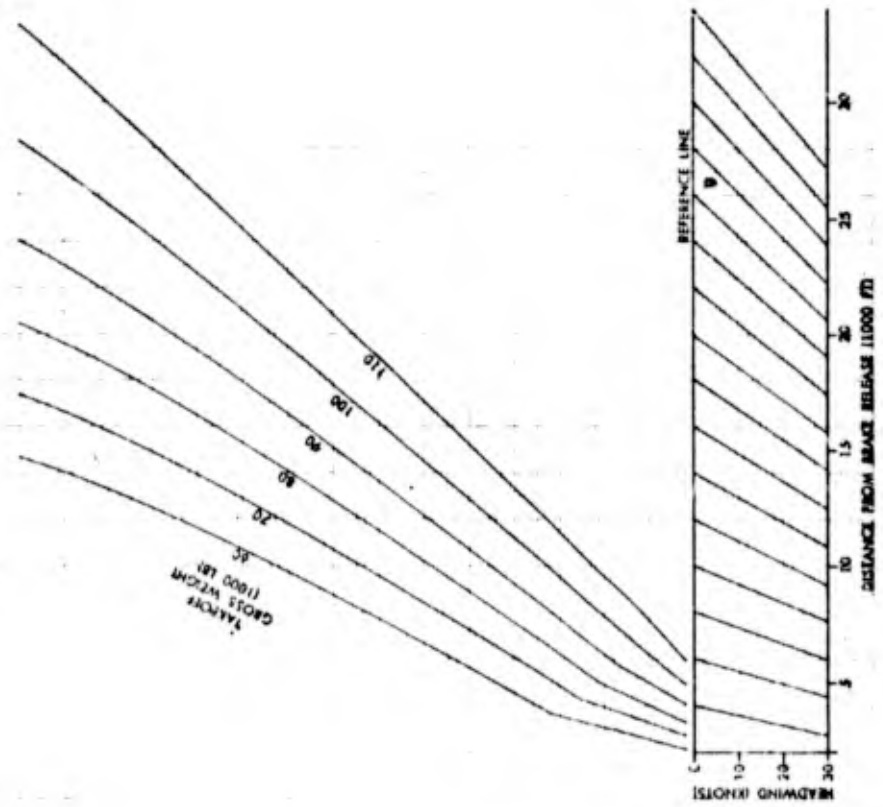
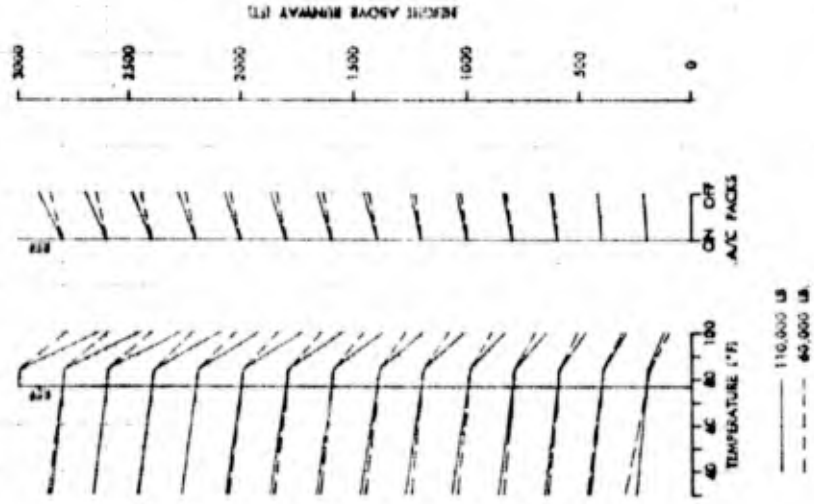


FIGURE 47

DC-8 SERIES 30
 ALL ENGINE FLIGHT PATH
 3900 FT AIRPORT ALTITUDE
 JET-7 ENGINES
 15° FLAPS
 CLIMB AT $V_2 + 10$ OR 15° PITCH LIMIT

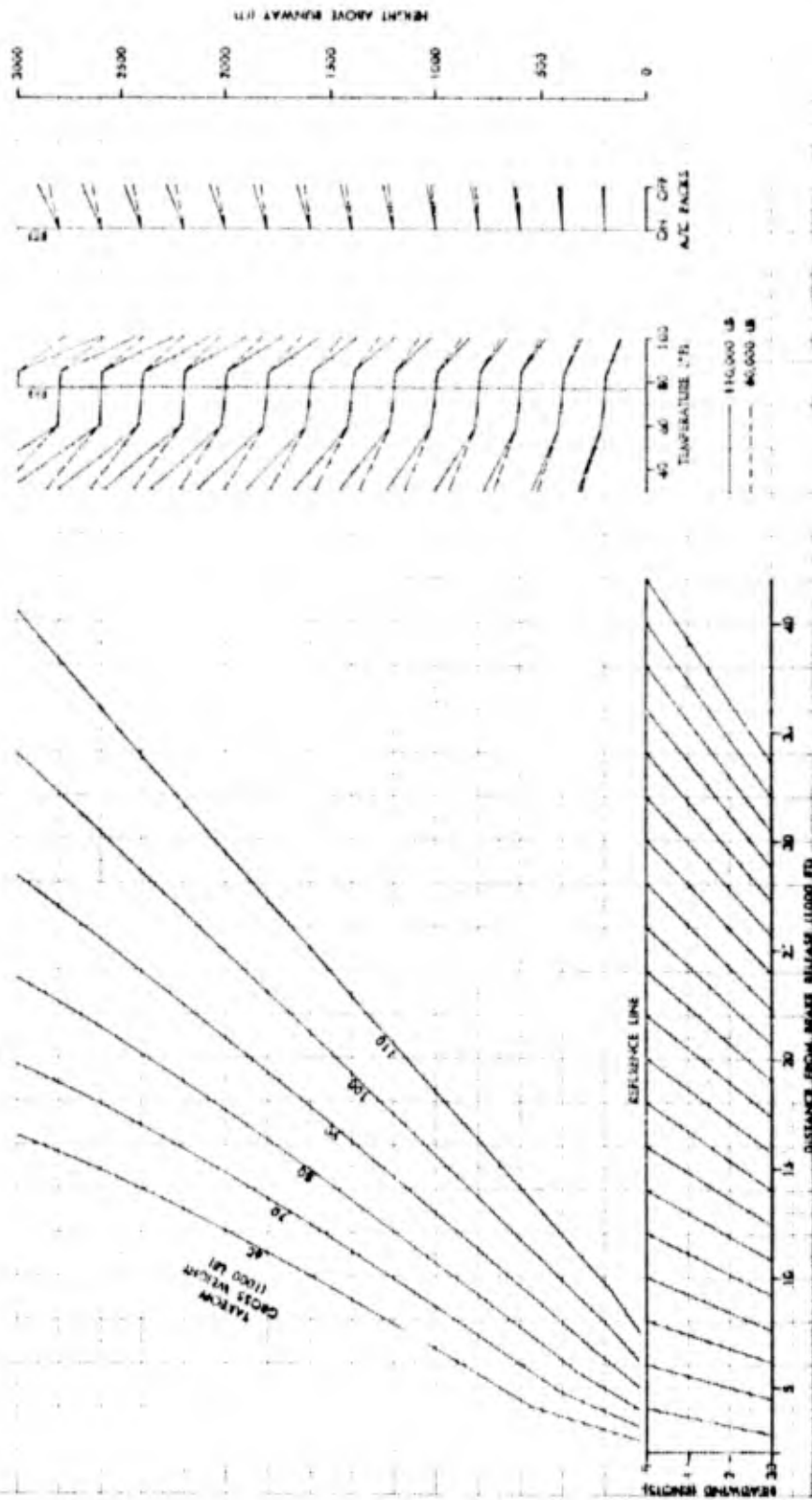


FIGURE 48

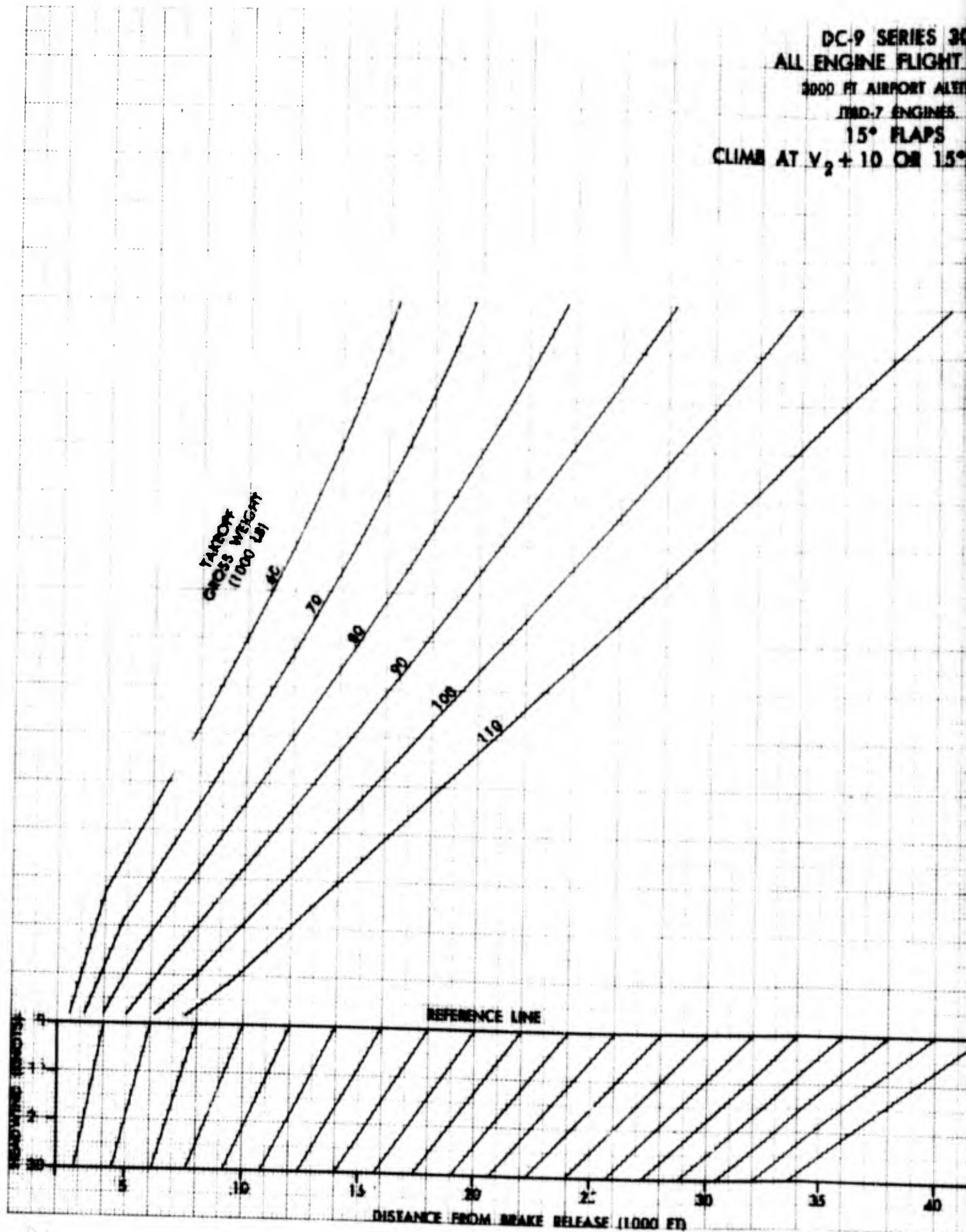
DC-9 SERIES 30
ALL ENGINE FLIGHT

3000 FT AIRPORT ALTITUDE

JTD-7 ENGINES

15° FLAPS

CLIMB AT $V_2 + 10$ OR 15°



DC-9 SERIES 30
ALL ENGINE FLIGHT PATH

3000 FT AIRPORT ALTITUDE

JTD-7 ENGINES

15° FLAPS

MAN AT $V_2 + 10$ OR 15° PITCH LIMIT

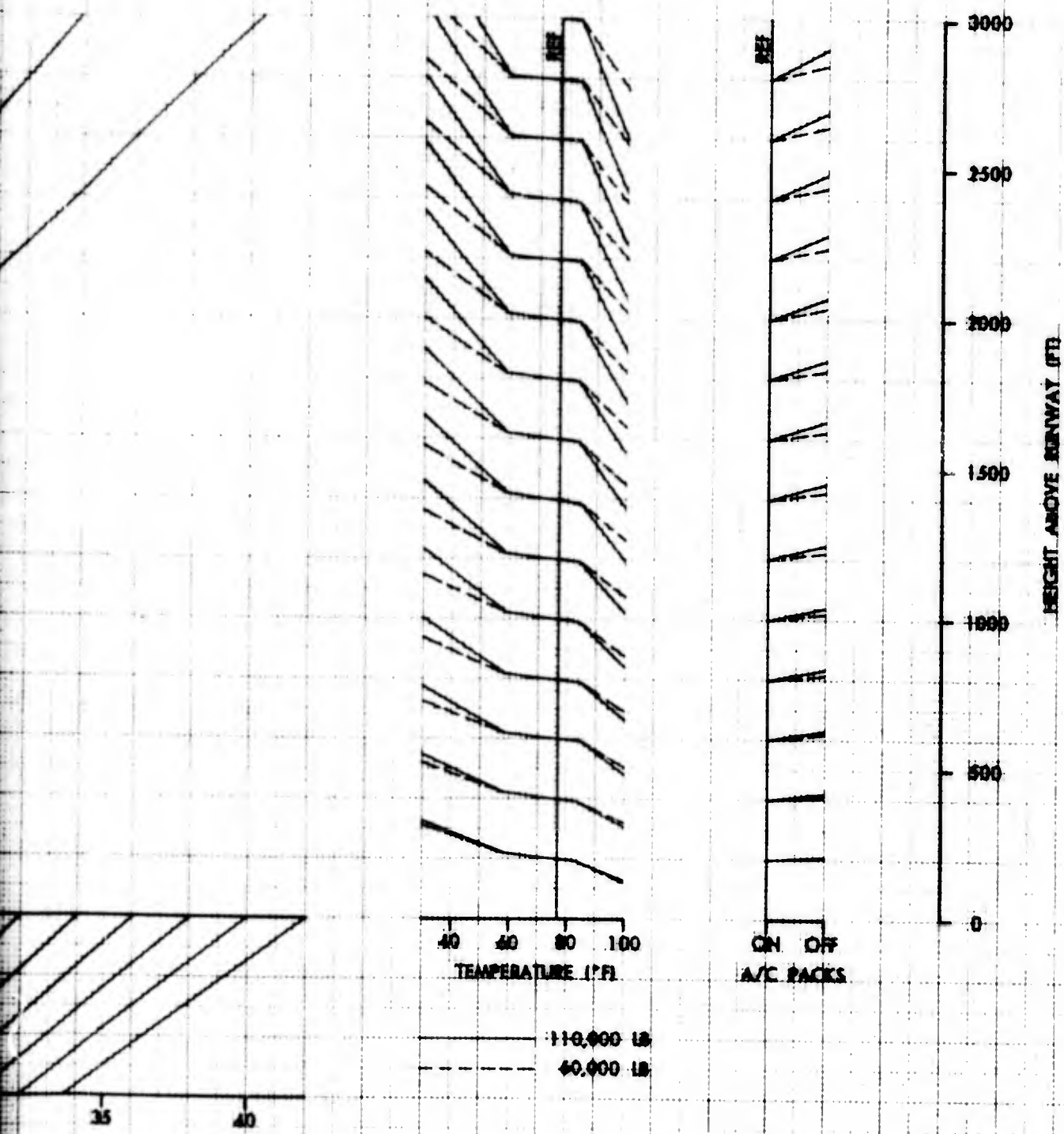
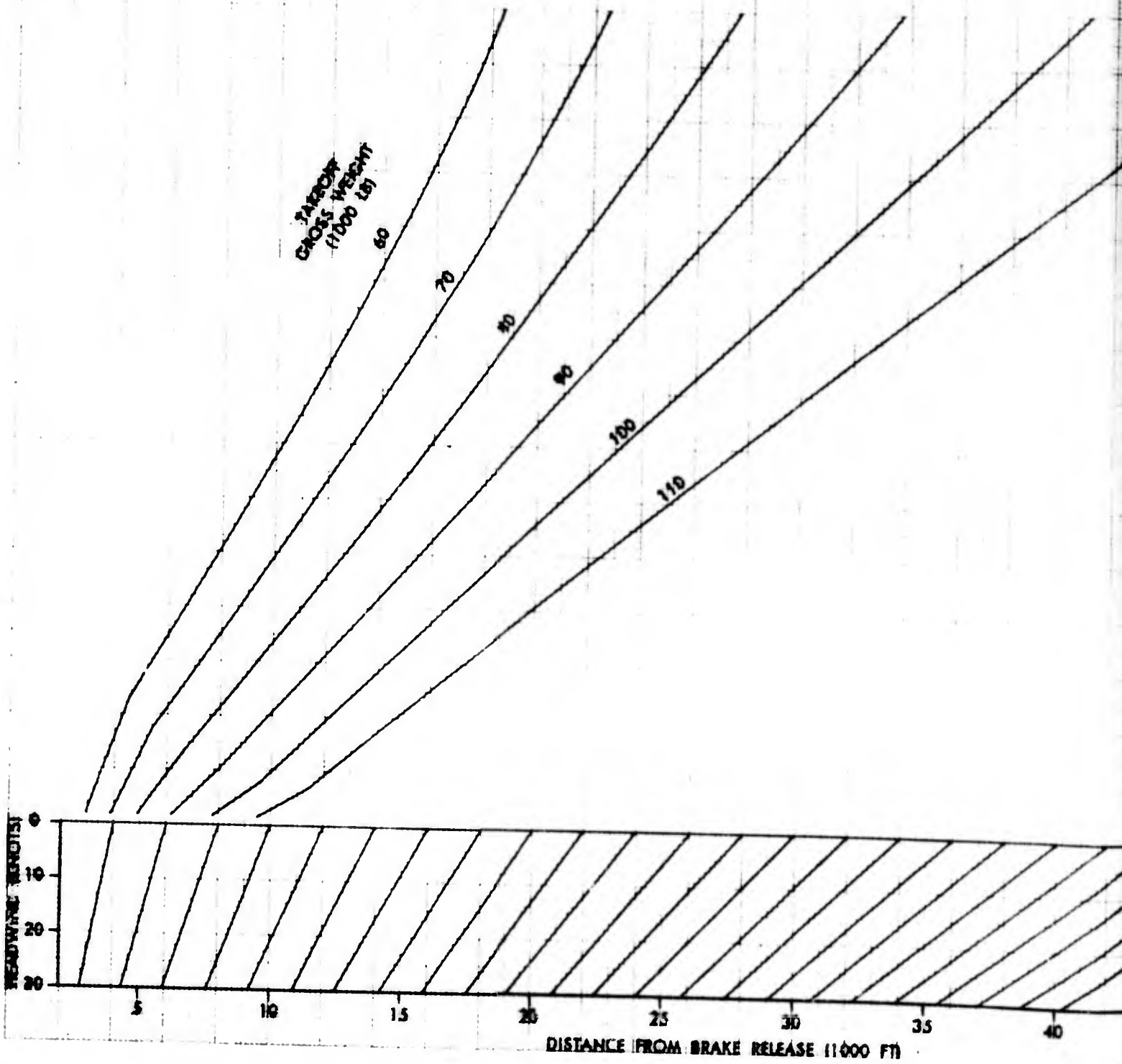


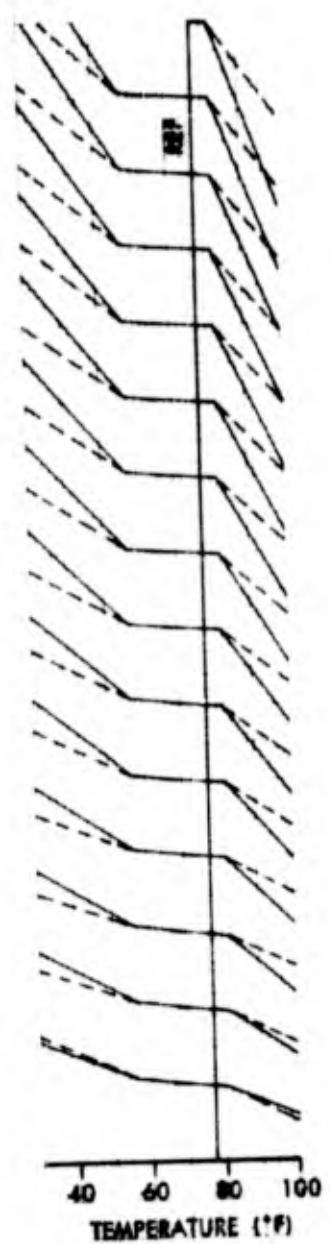
FIGURE 48.

B

DC-9 SERIES 30
ALL ENGINE FLIGHT
6000 FT AIRPORT ALTITUDE
STD-7 ENGINES
15° FLAPS
CLIMB AT $V_2 + 10$ OR 15°



DC-9 SERIES 30
 ALL ENGINE FLIGHT PATH
 8000 FT AIRPORT ALTITUDE
 JT8D-7 ENGINES
 15° FLAPS
 AT $V_2 + 10$ OR 15° PITCH LIMIT



— 110,000 LB
 - - - 60,000 LB

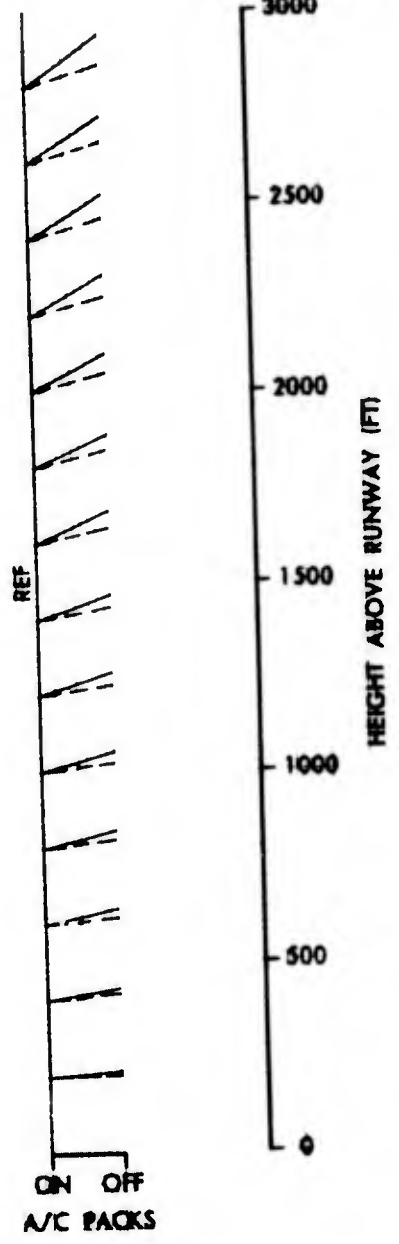


FIGURE 49.

B

DC-9 SERIES 30
 $F_{N/\delta_{AMB}}$ AT CLUT BACK
 STD-7/-9 ENGINES
 FLAPS 15°
 SLATS EXTENDED

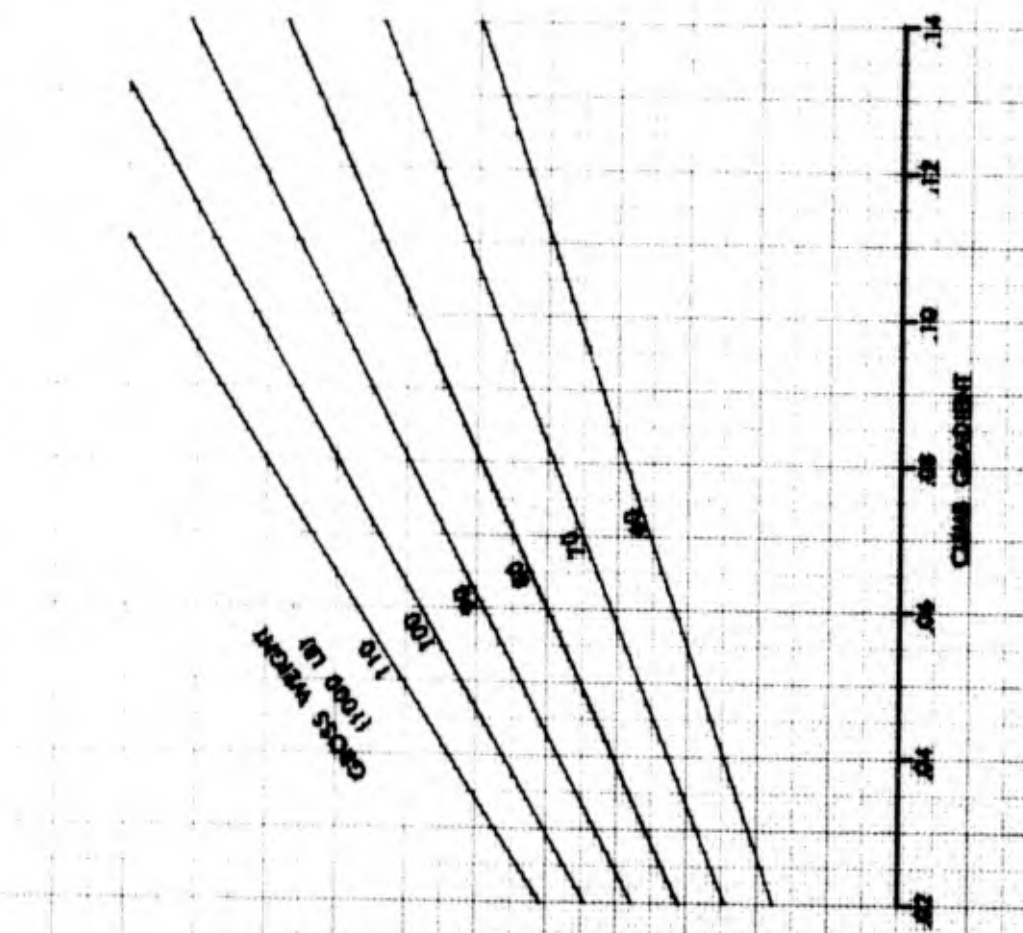
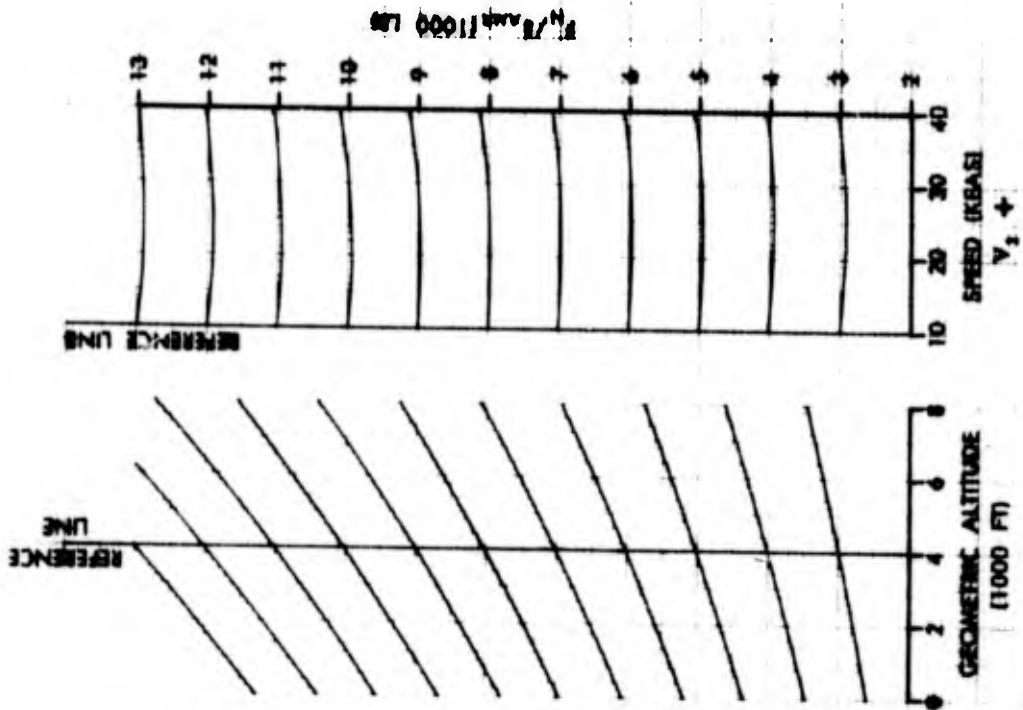


FIGURE 51.

DC-9 SERIES 30
 FUEL AND AIR CUT BACK
 1100-7-9 ENGINES
 FLAPS 5°
 SLATS EXTENDED

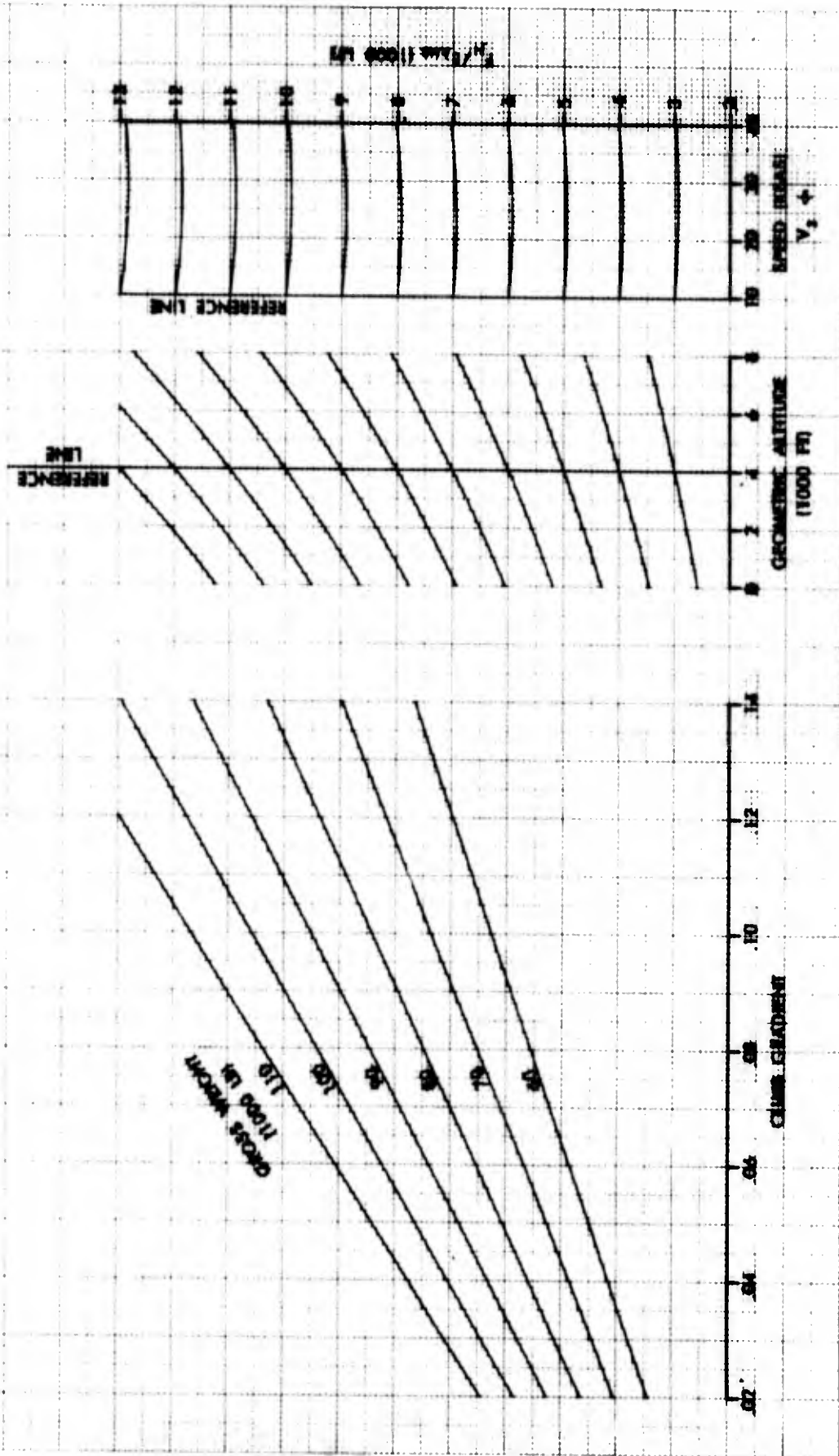
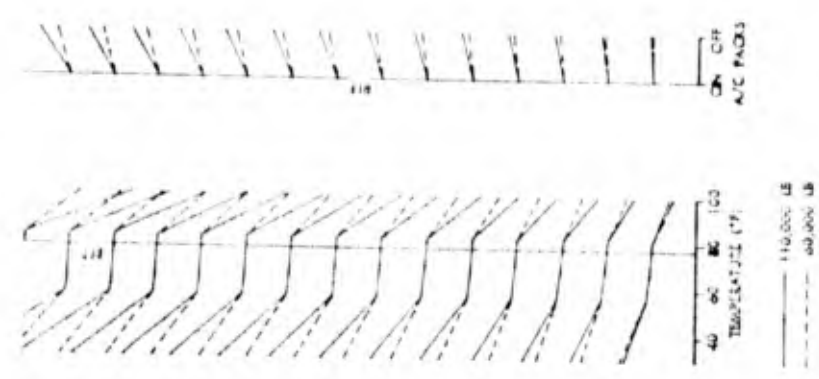
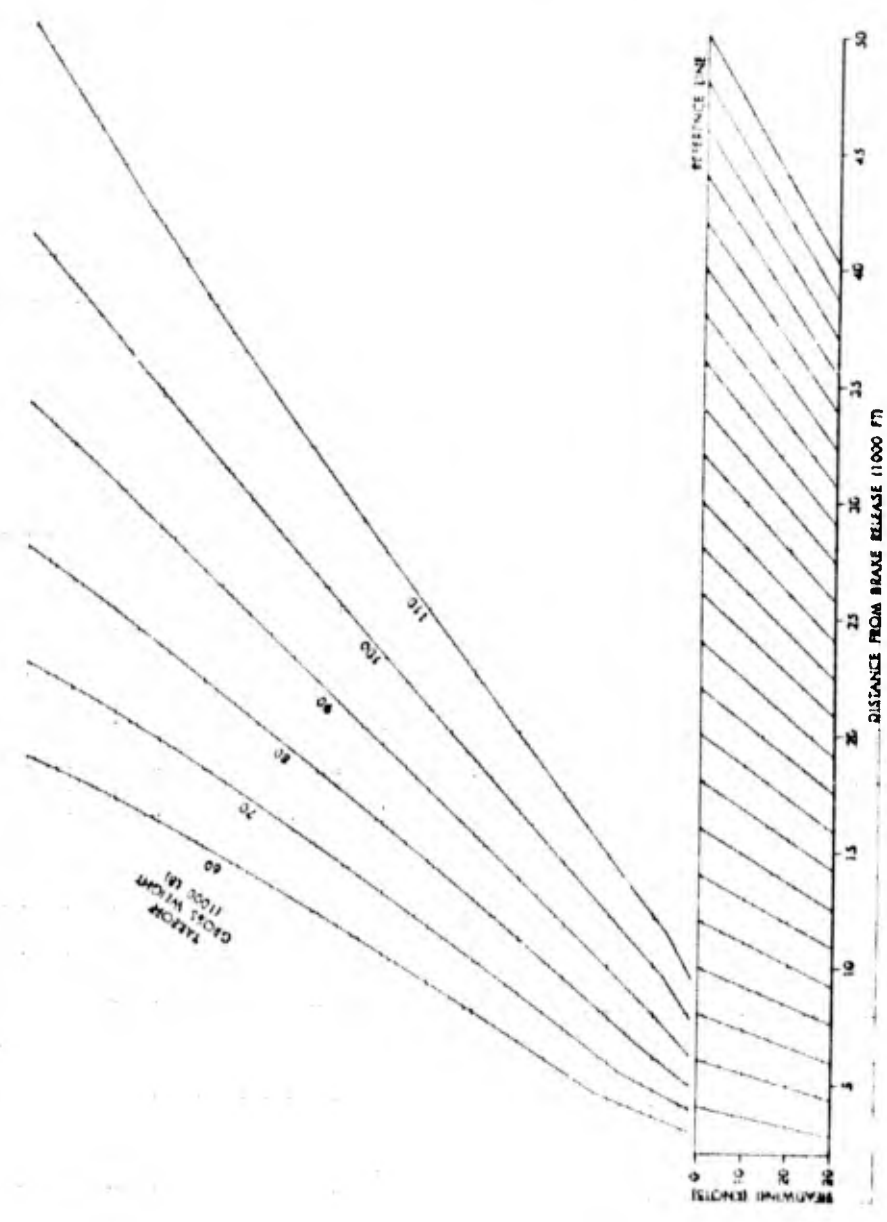


FIGURE 50.

DC-7 SERIES 30
 ALL ENGINE FLIGHT PATH
 6800 FT AIRPORT ALTITUDE
 1827 ENGINES
 15° FLAPS
 CLIMB AT $V_2 + 10$ OR 15° PITCH LIMIT



DC-9 SERIES 30
 F_H/δ_{AMB} AT CUTBACK
 JT8D-7/9 ENGINES
 CLEAN CONFIGURATION
 250 KNOTS IAS

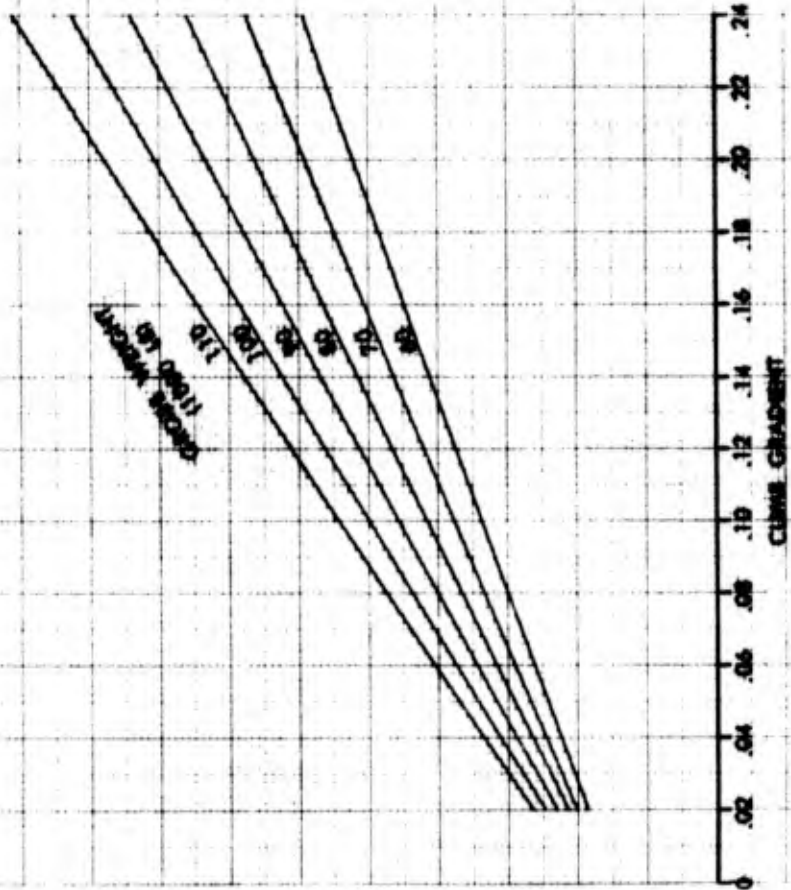
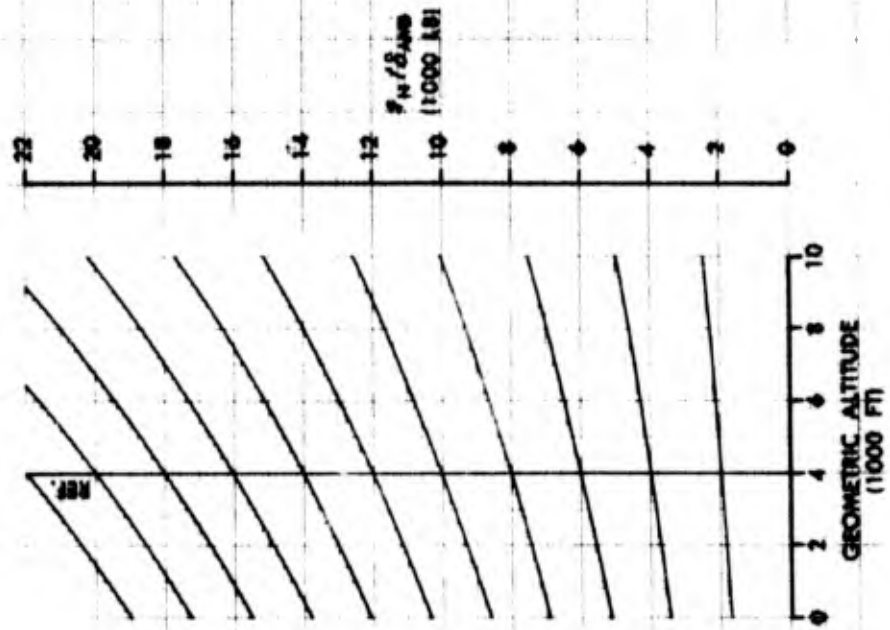


FIGURE 52.

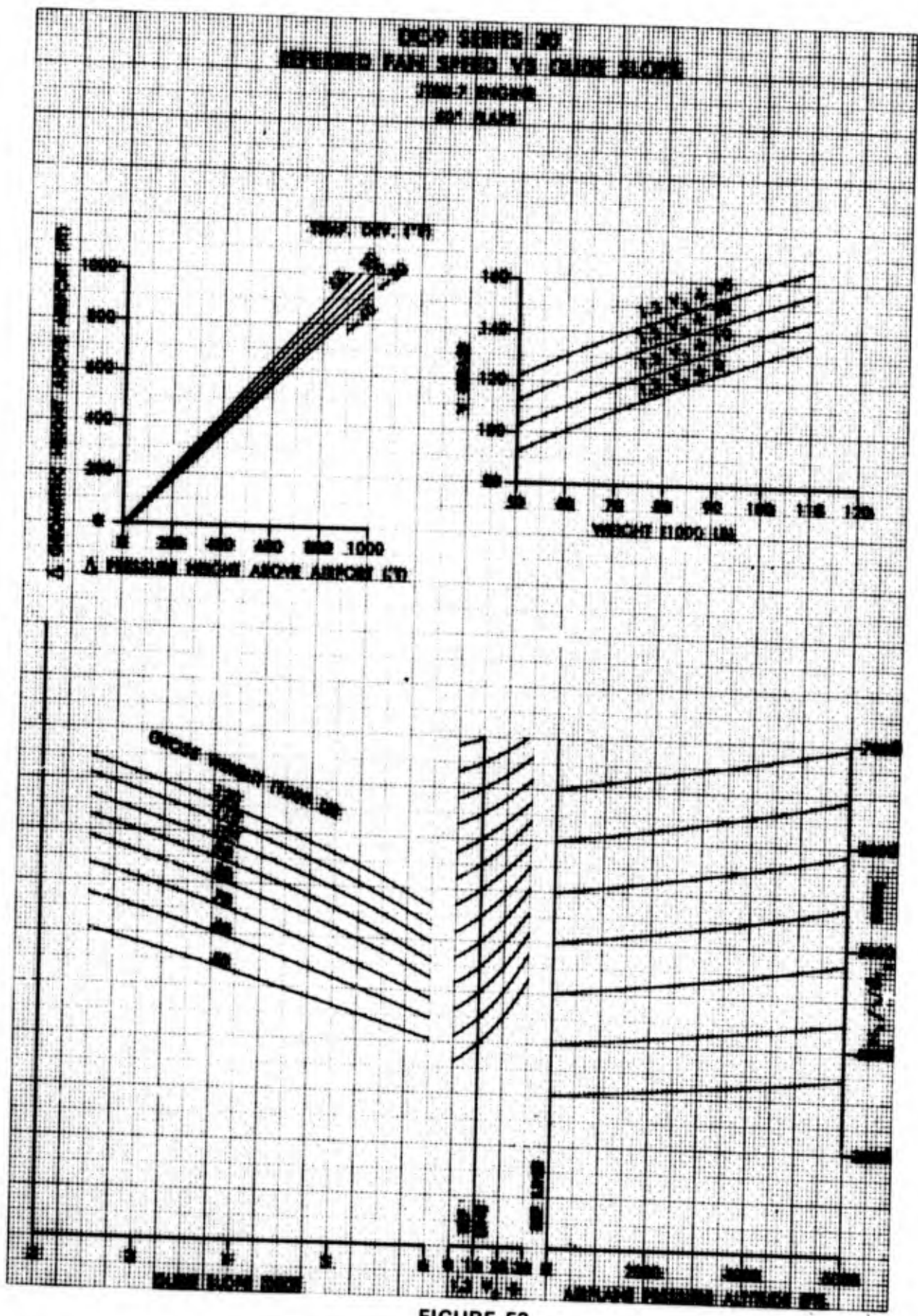


FIGURE 53.

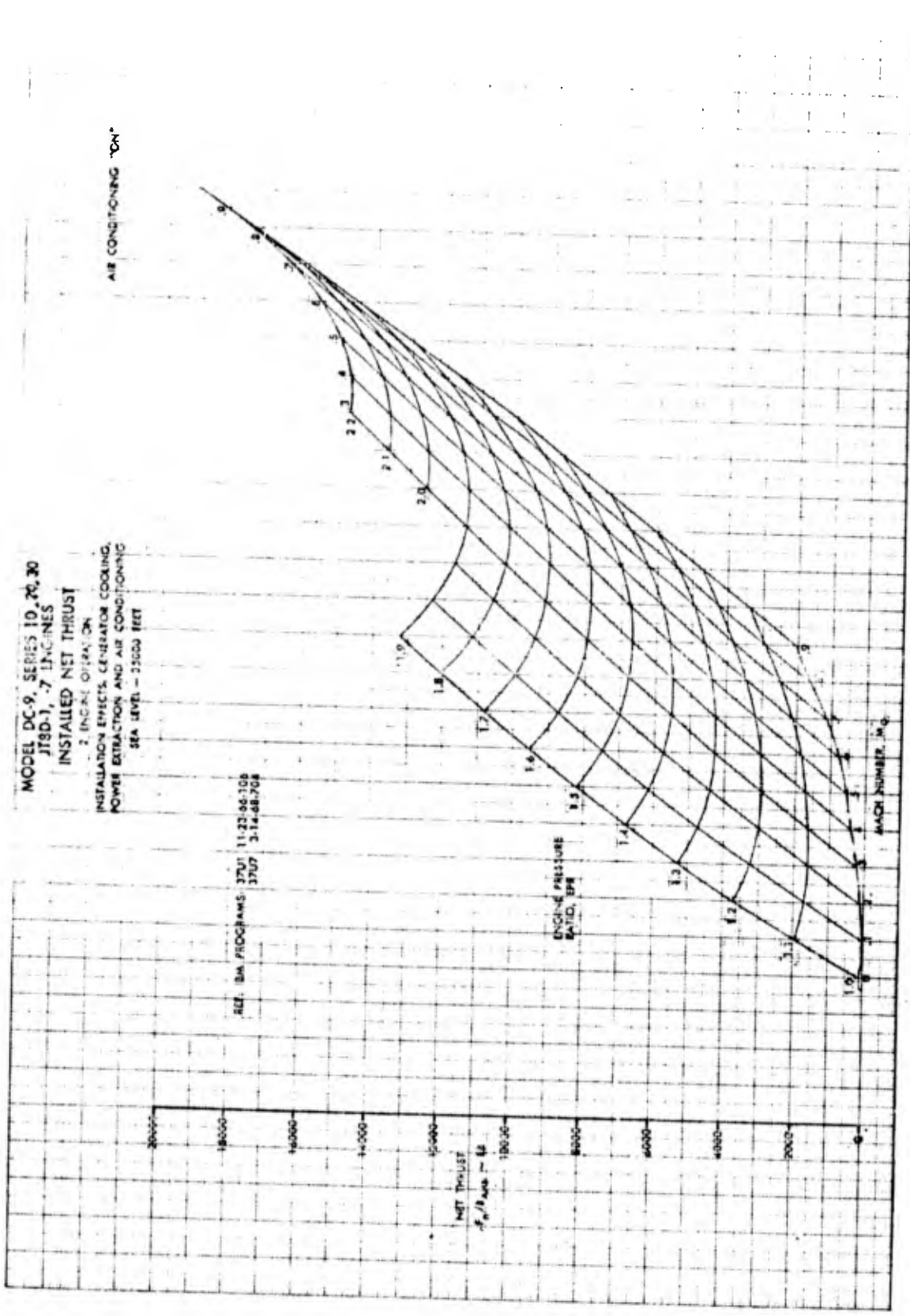
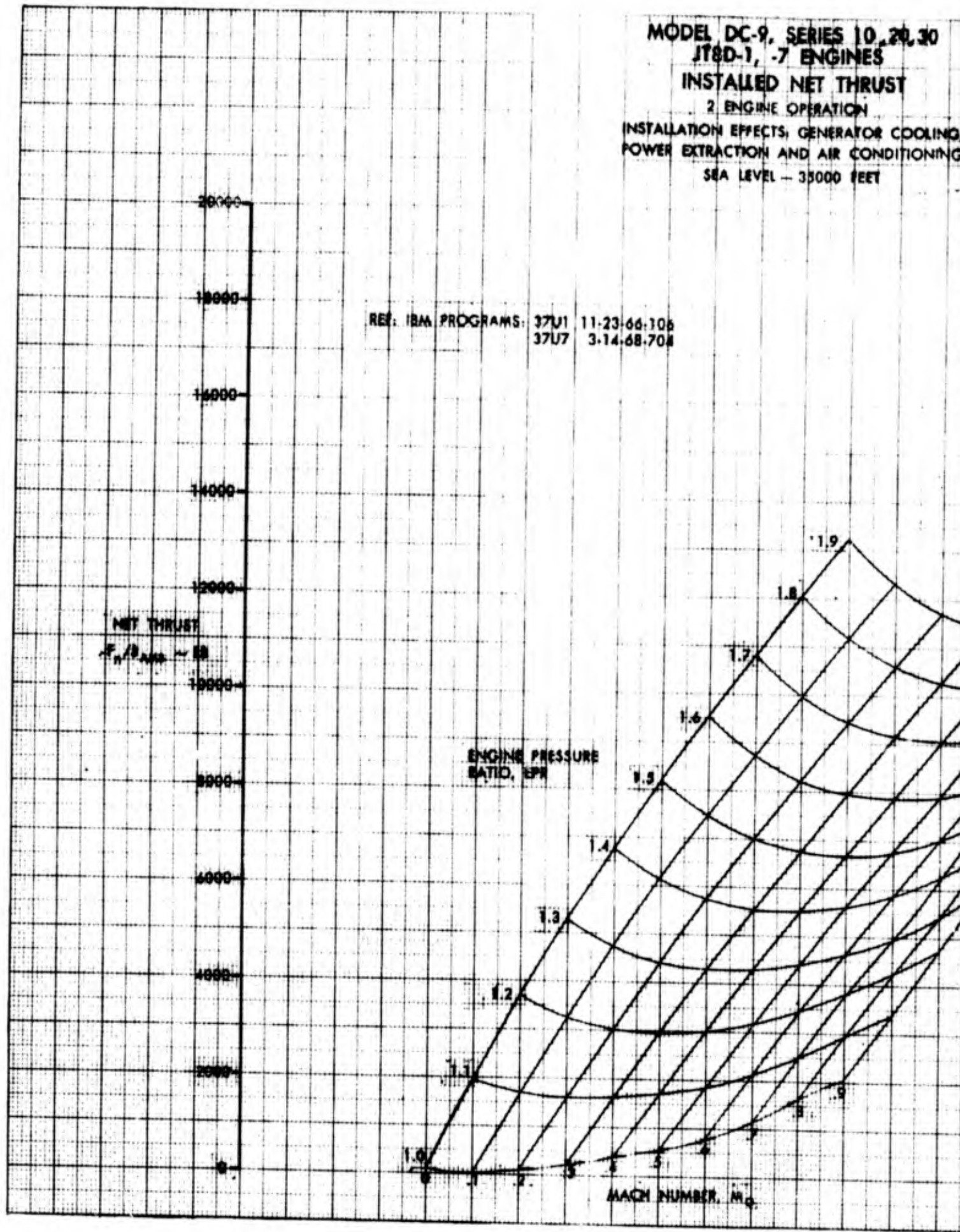


FIGURE 54.

MODEL DC-9, SERIES 10, 20, 30
JT8D-1, -7 ENGINES
INSTALLED NET THRUST
 2 ENGINE OPERATION
 INSTALLATION EFFECTS, GENERATOR COOLING,
 POWER EXTRACTION AND AIR CONDITIONING
 SEA LEVEL - 35000 FEET

REF: IBM PROGRAMS: 37U1 11-23-66-108
 37U7 3-14-68-708



A

SERIES 10, 20, 30
-7 ENGINES
NET THRUST
OPERATION
ELECTRICAL, GENERATOR COOLING,
AND AIR CONDITIONING
ALTITUDE - 35000 FEET

AIR CONDITIONING "ON"

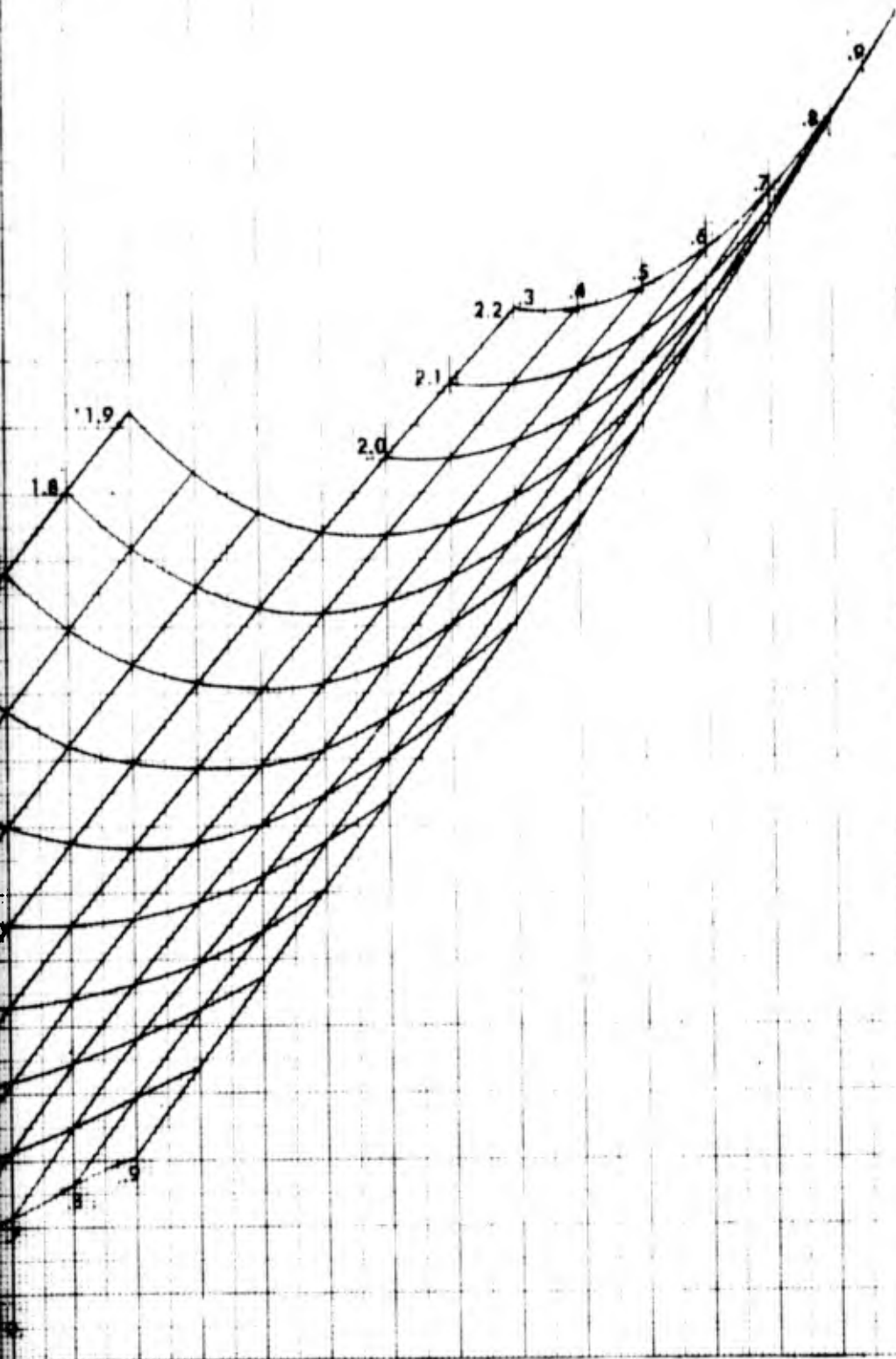


FIGURE 54.

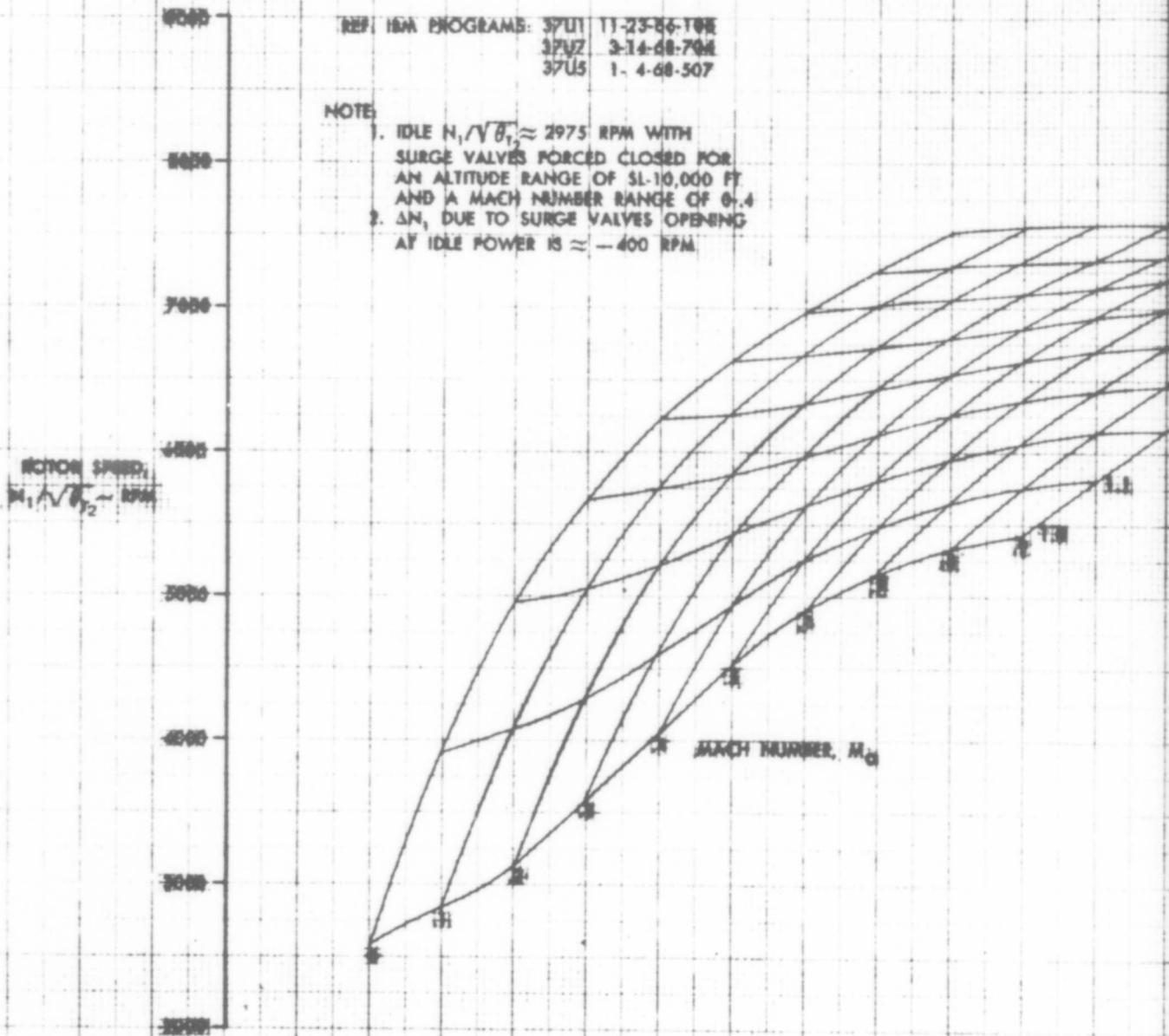
MODEL DC-9 SERIES BY
 JT8D-1-517 ENGINE
 INSTALLED LOW PRESSURE ENGINE SPEED
 2 ENGINE OPERATION
 INSTALLATION EFFECTS, CORRECTION OCCURRING
 POWER EXTRACTION AND AIR CONDENSING
 SEA LEVEL-3,000 FEET

SURGE VALVES CLOSED

REF. IBM PROGRAMS: 37U1 11-23-66-108
 37U2 3-14-68-704
 37U5 1-4-68-507

NOTE:

1. IDLE $N_1/\sqrt{\theta_{t1}} \approx 2975$ RPM WITH SURGE VALVES FORCED CLOSED FOR AN ALTITUDE RANGE OF 51-10,000 FT AND A MACH NUMBER RANGE OF 0.4
2. ΔN_1 DUE TO SURGE VALVES OPENING AT IDLE POWER IS ≈ -400 RPM



P

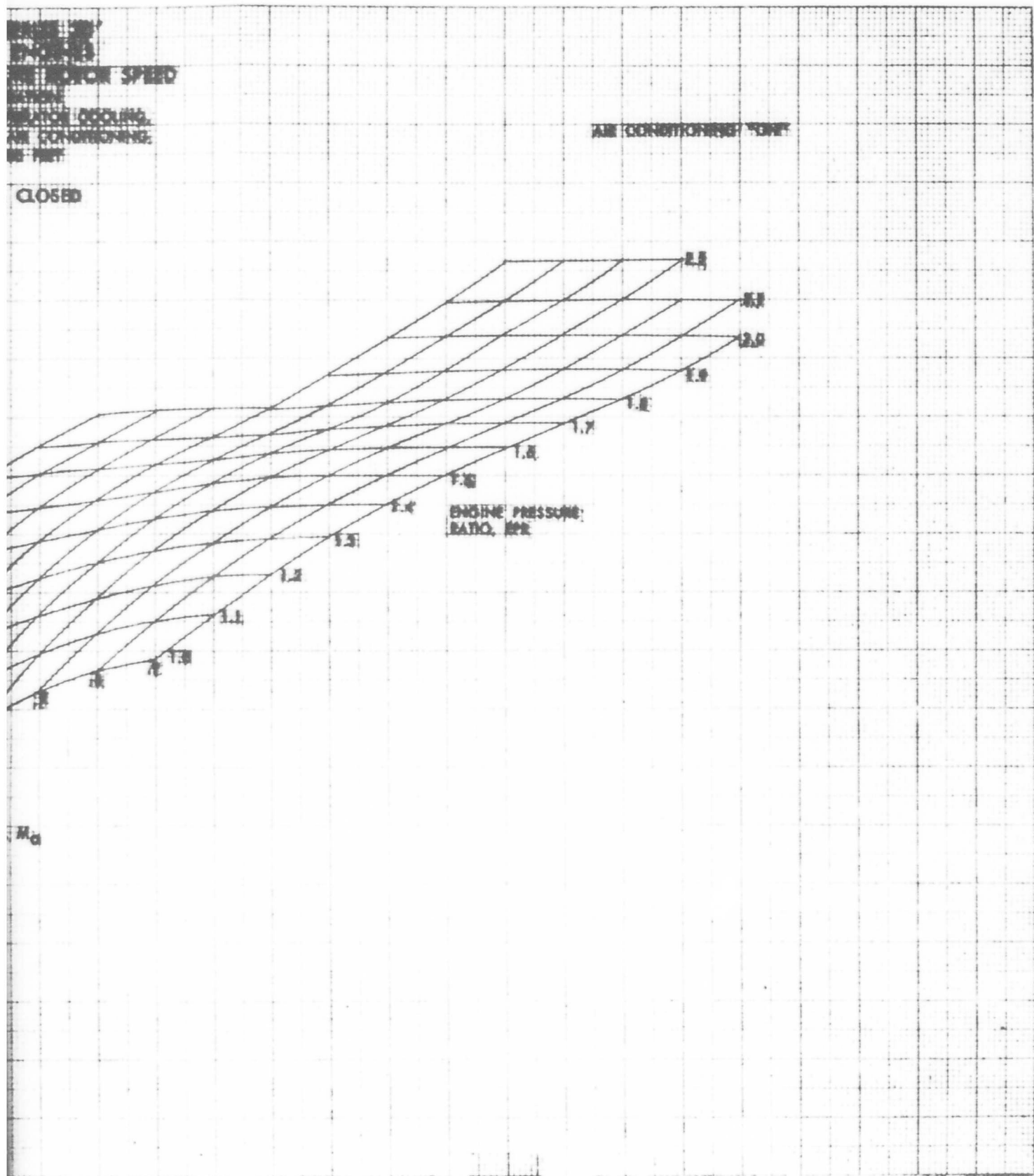
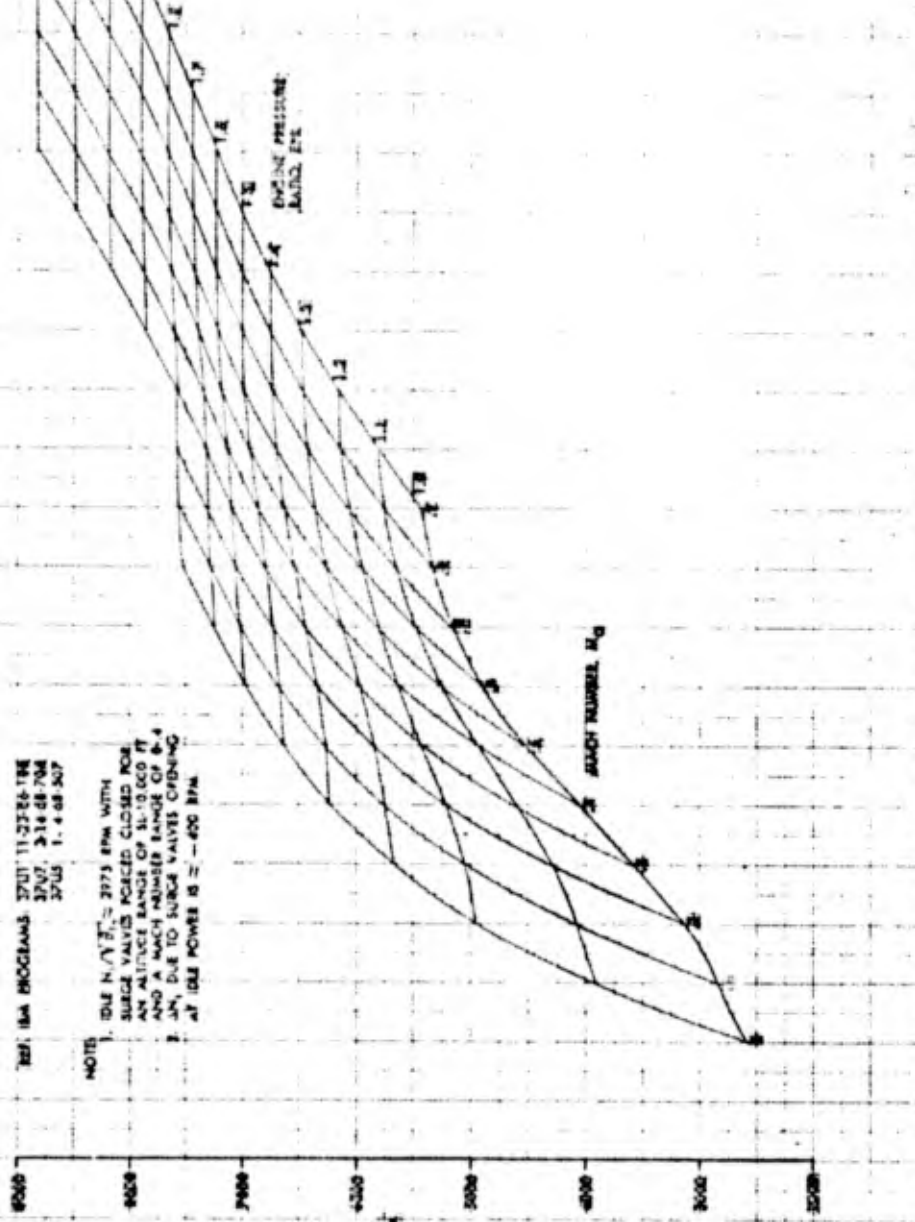


FIGURE 55.

B

MODEL DC-9 SERIES
 JTD-1-3-7 EN
 INSTALLED LOW PRESSURE WATER SPEED
 12 ENGINE GENERATOR
 INSTALLATION EFFECTS ON WATER PUMP NO.
 POWER EXTRACTION AND AIR CONSUMPTION
 SEA LEVEL-3500 FT
 SURGE VALVES CLOSED
 AIR CONSUMPTION (GPM)



REF: IMA PROGRAMS 3701 11-2726-188
 3707 314 28-704
 3705 1-4 28-507

NOTE:
 1. IDLE N/A \approx 2975 RPM WITH
 SURGE VALVES FORCED CLOSED FOR
 AN ALTITUDE RANGE OF 31-10,000 FT
 AND A MACH NUMBER RANGE OF 0.4
 2. UN. DUE TO SURGE VALVES OPENING
 AT IDLE POWER IS \approx -600 RPM.

ENGINE SPEED
 RPM

2.6 DC-9-30 WITH JT8D-9 ENGINES

2.6.1 Aircraft Description

The aircraft description is contained in Section 2.5.1. The JT8D-9 engine is flat rated to 84°F, is rated at 14,500 pounds, and the bypass ratio is 1.03. The takeoff EPR setting is 2.0, decreasing as the aircraft attains forward speed.

2.6.2 Acoustic Data

Figures 56 and 57 present the EPNL and A-weighted sound level curves for the JT8D-9 engines. Plots are shown for seven power settings in terms of referred thrust ranging from 2000 pounds, the thrust for a steep glide slope approach, to the takeoff thrust of 12,500 pounds. The curves are based on Douglas-funded flyover noise tests utilizing a DC-9-15 aircraft with JT8D-9 engines and using up-to-date data acquisition, data processing, and space positioning techniques, which were essentially the same as those used for the DC-10-40 noise certification test described in Reference 2.

2.6.3 Performance Data

Figures 58 through 69 present the takeoff flight-path data for 5 and 15-deg flaps with and without a 15-deg pitch limit for the various runway altitudes. The data from these curves combined with the data from the curves of Figures 70, 71, and 72, the cutback charts, and data from Figures 56 and 57, the noise-level curves, will provide the aircraft noise levels. The cutback charts are identical for the JT8D-7 and -9 engines but are included for both writeups for the sake of convenience.

Figure 73 provides the referred fan speed for approach and Figures 74 and 75 present curves relating thrust, fan speed, and EPR for various Mach numbers.

1/22/74

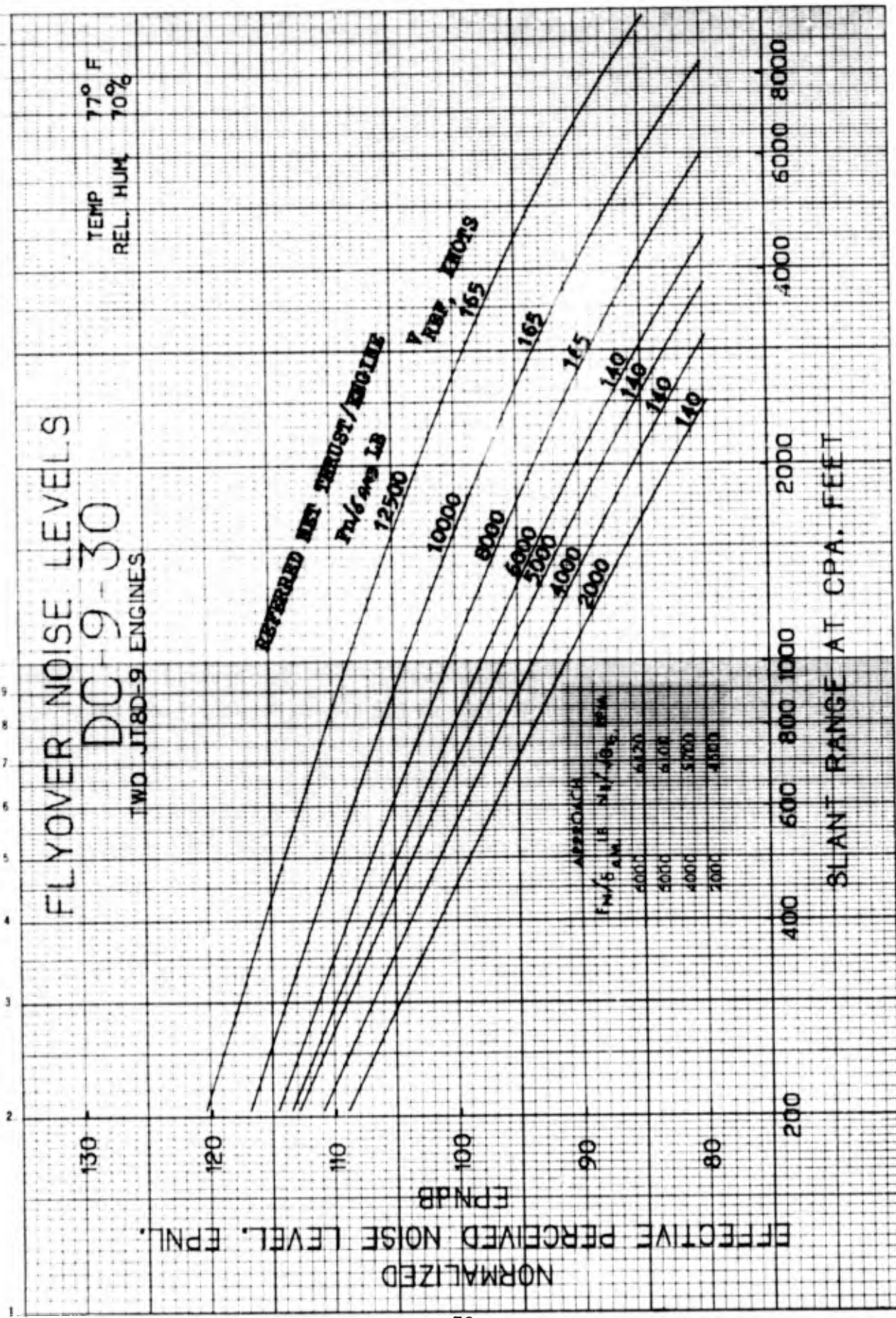


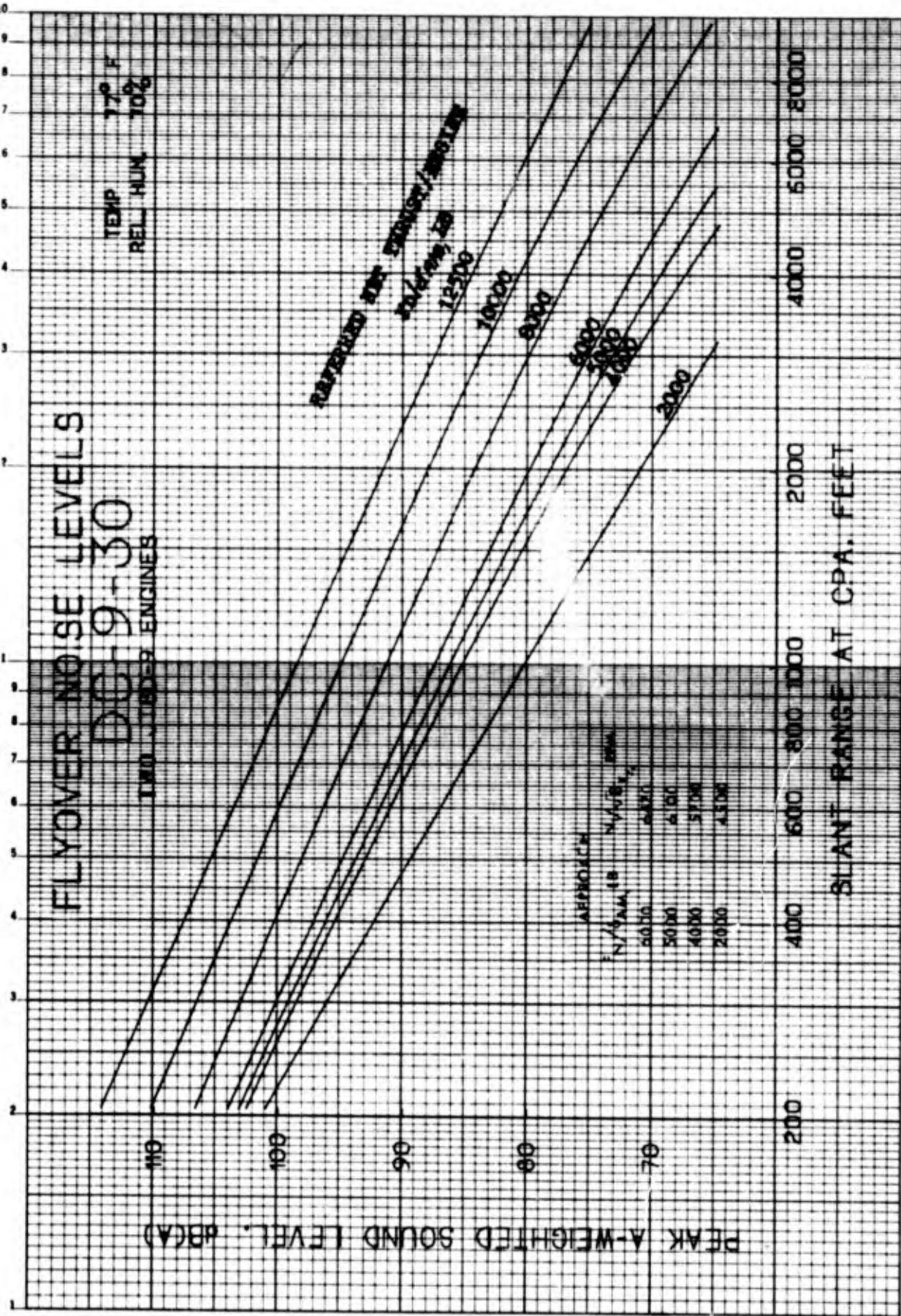
FIGURE 56.

1/22/74

FLYOVER NOISE LEVELS DC-9-30 TWO JET ENGINES

TEMP 17° F
REL HUM 10%

PEAK A-WEIGHTED SOUND LEVEL, (PWL)



SLANT RANGE AT CPA, FEET

FIGURE 57.

DC-9 SERIES 30
 ALL ENGINE FLIGHT PATH
 18A LEVEL AIRPORT ALTITUDE
 JET-P ENGINES
 5° FLAPS
 CLIMB AT $V_2 + 10$

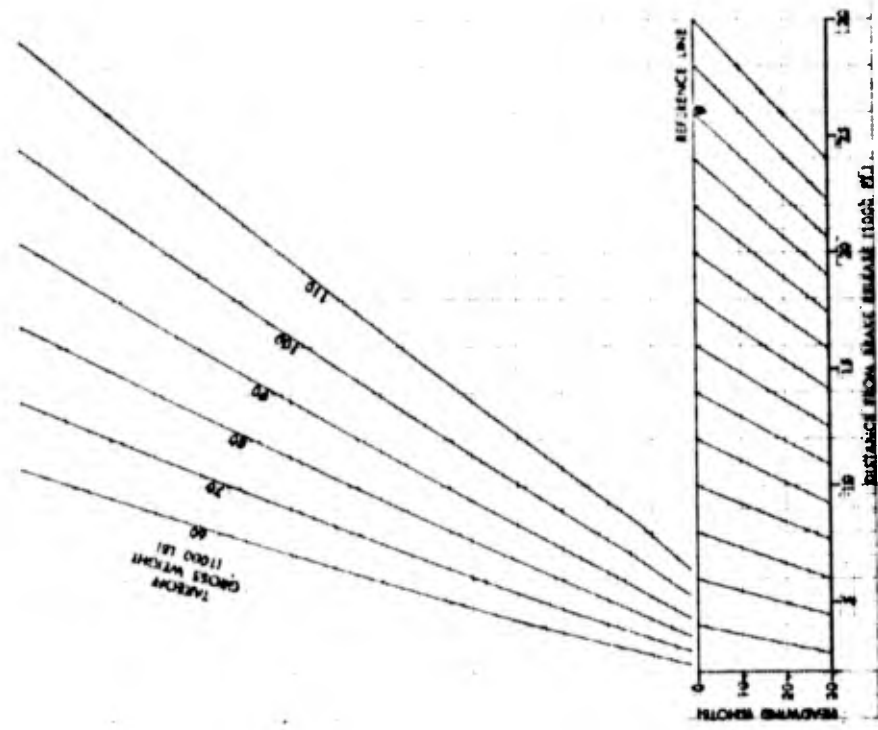
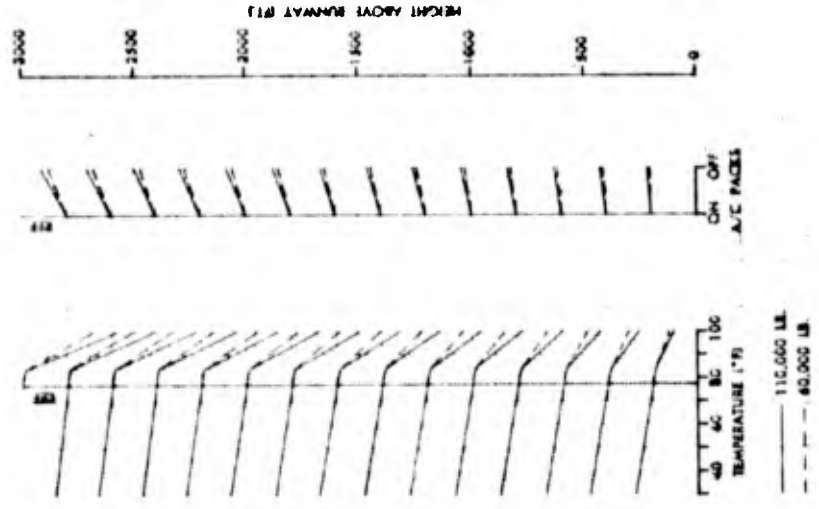
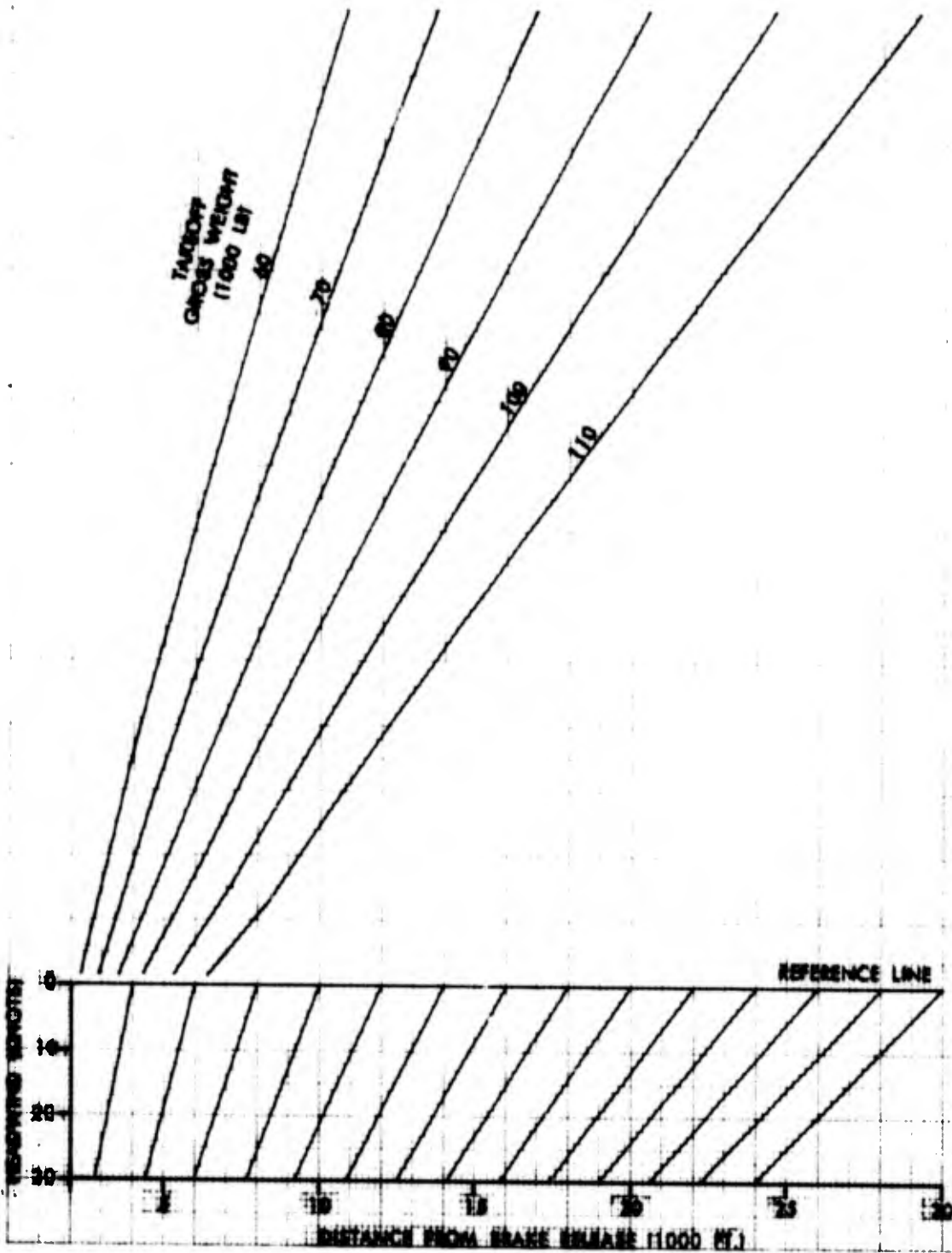
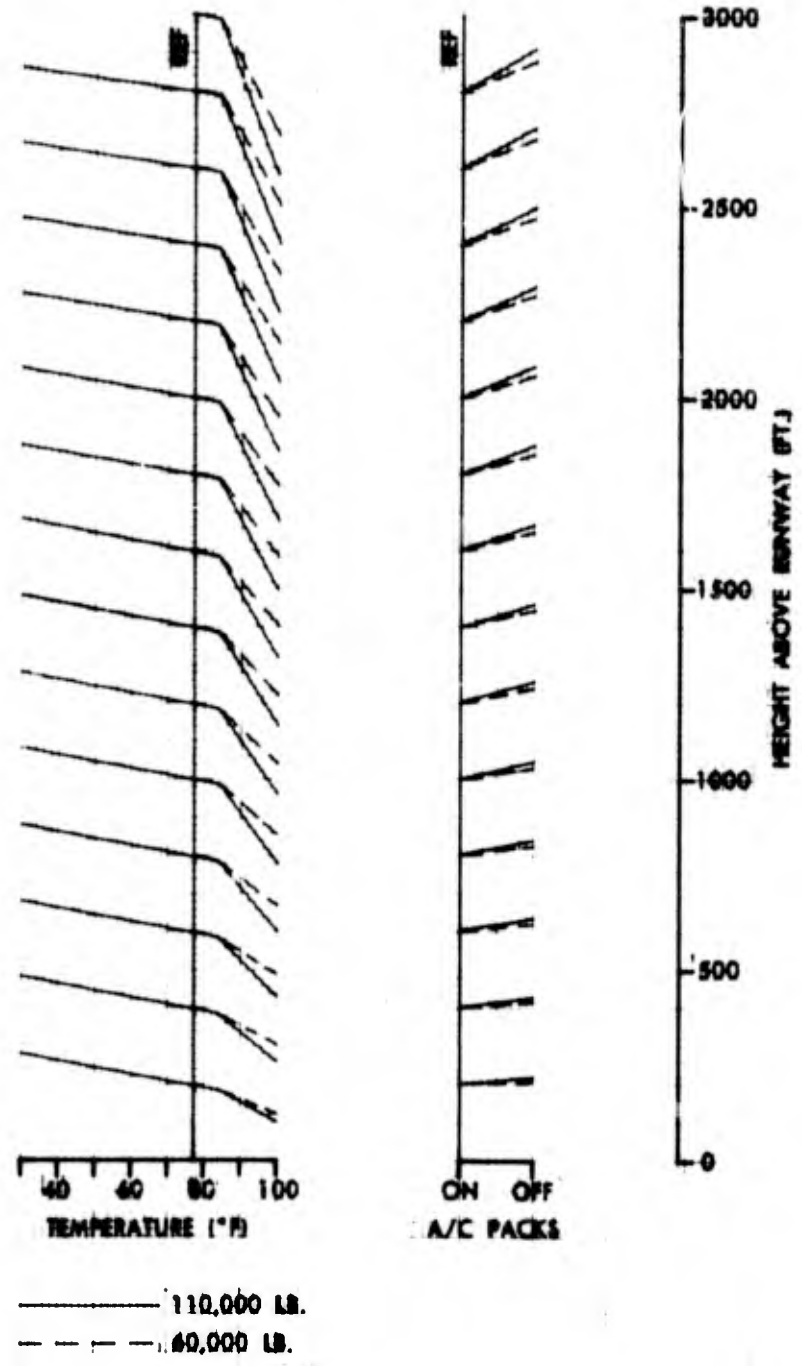


FIGURE 58.

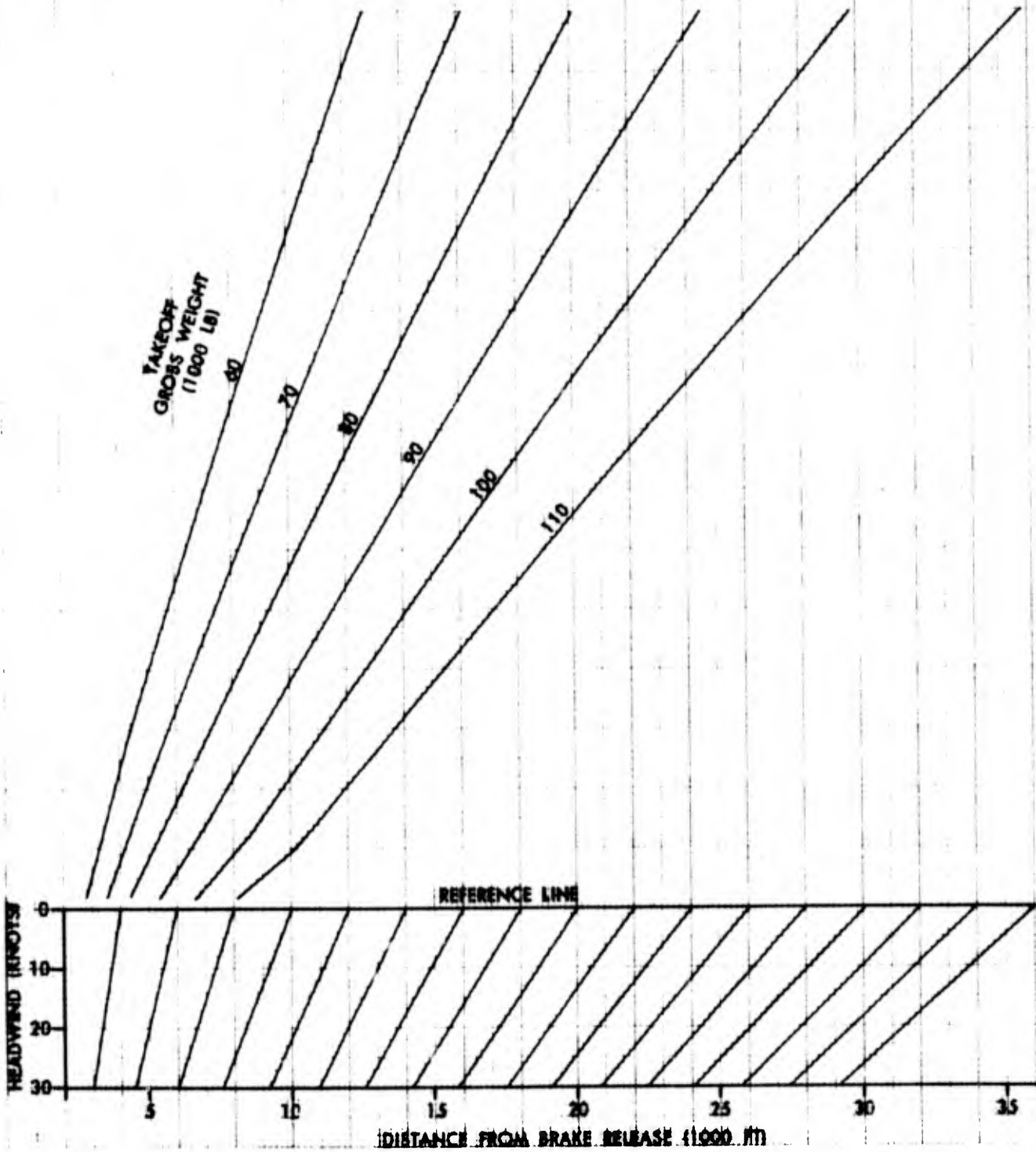
DC-9 SERIES 30
ALL ENGINE FLIGHT PA
SEA LEVEL AIRPORT ALTITUDE
JTD-2 ENGINES
5° FLAPS
CLIMB AT $V_2 + 10$



DC-9 SERIES 30
ALL ENGINE FLIGHT PATH
 SEA LEVEL AIRPORT ALTITUDE
 J18D-9 ENGINES
 5° FLAPS
 CLIMB AT $V_2 + 10$



DC-9 SERIES 30
ALL ENGINE FLIGHT PATH
3000 FT AIRPORT ALTITUDE
JT8D-9 ENGINES
5° FLAPS
CLIMB AT $V_2 + 10$



DC-9 SERIES 30
 ALL ENGINE FLIGHT PATH
 3000 FT AIRPORT ALTITUDE
 JT8D-9 ENGINES
 5° FLAPS
 CLIMB AT $V_2 + 10$

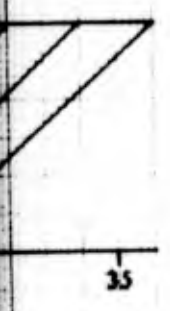
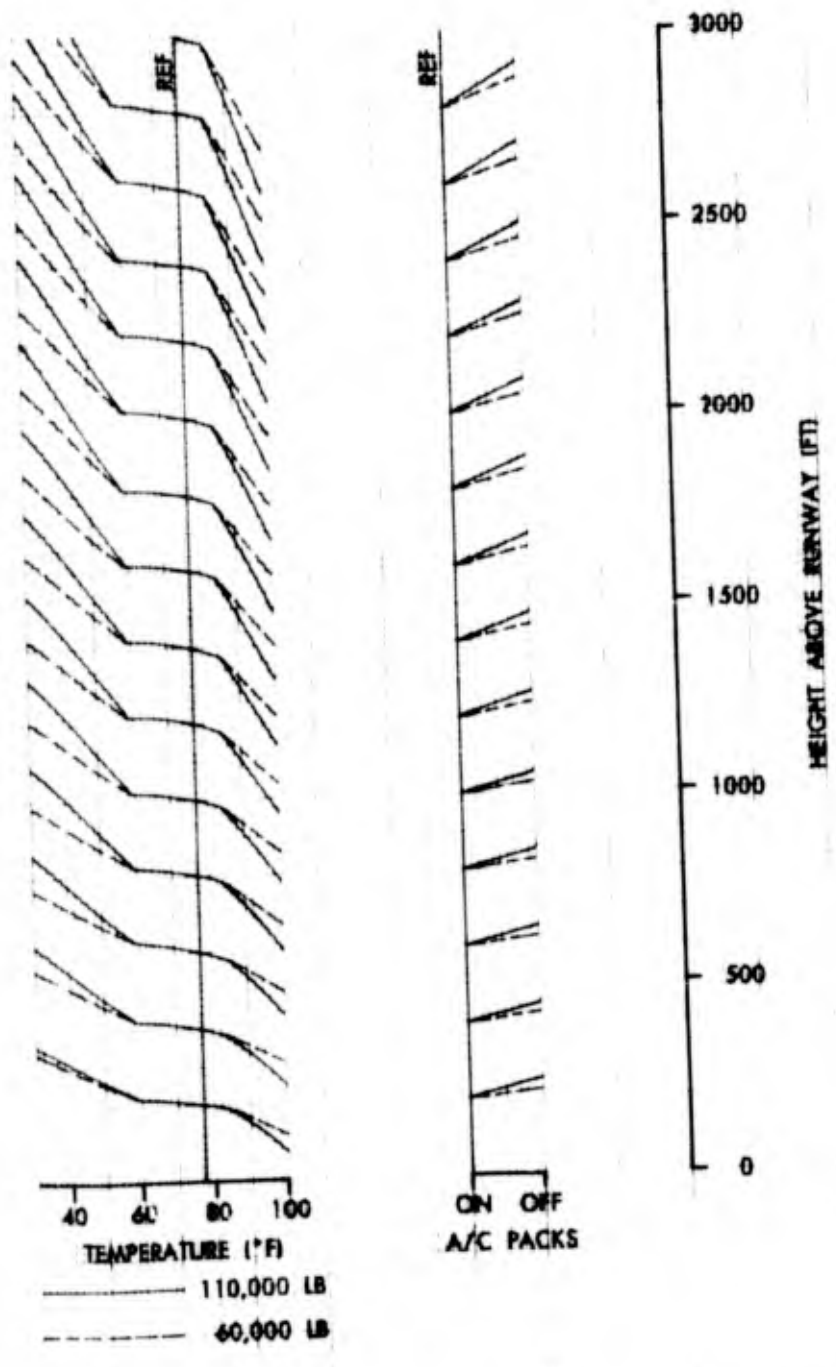


FIGURE 59.

DC-9 SERIES 30
 ALL ENGINE FLIGHT PATH
 3000 FT AIRPORT ALTITUDE
 4100-9 ENGINES
 5° FLAPS
 CLIMB AT $V_2 + 10$

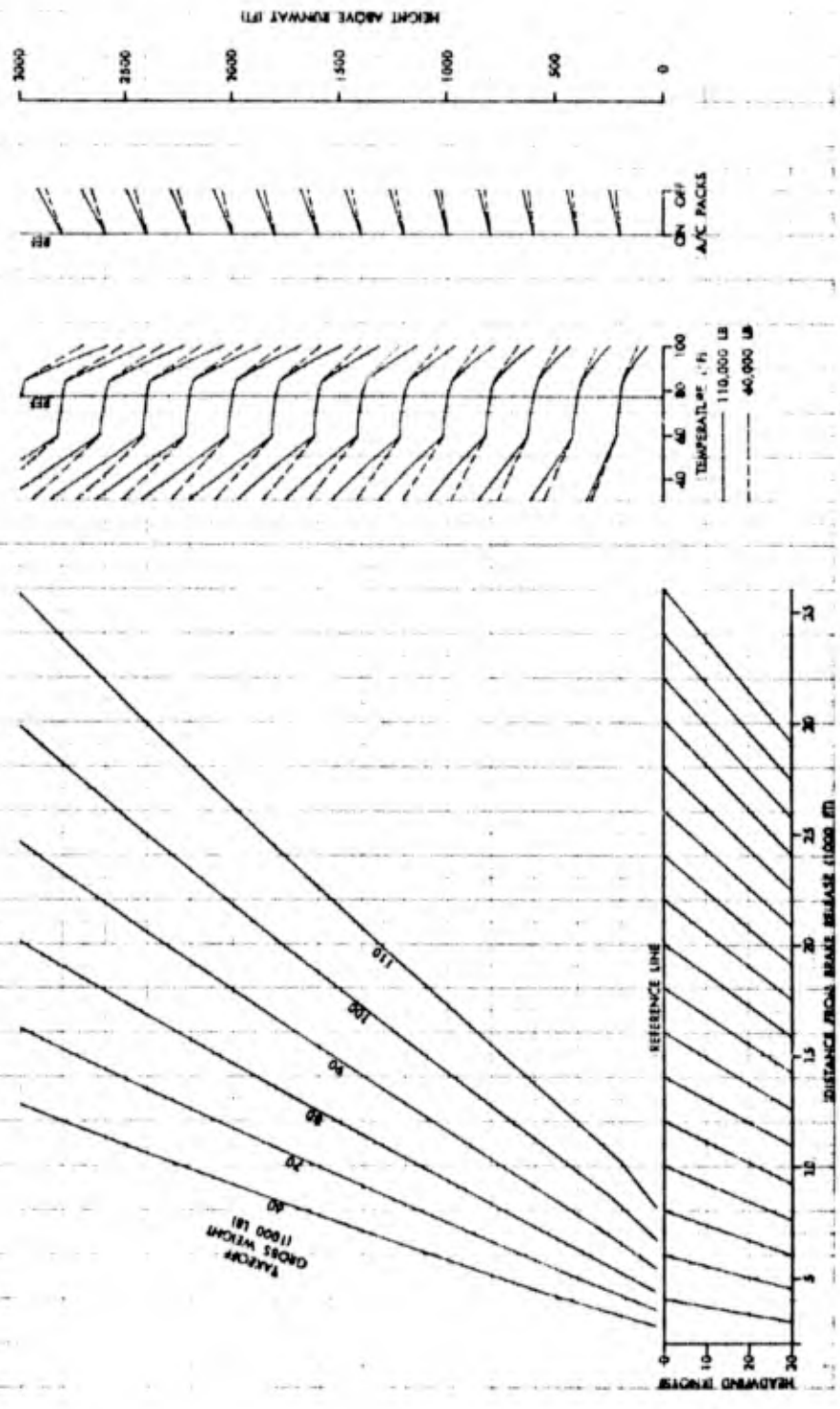


FIGURE 59

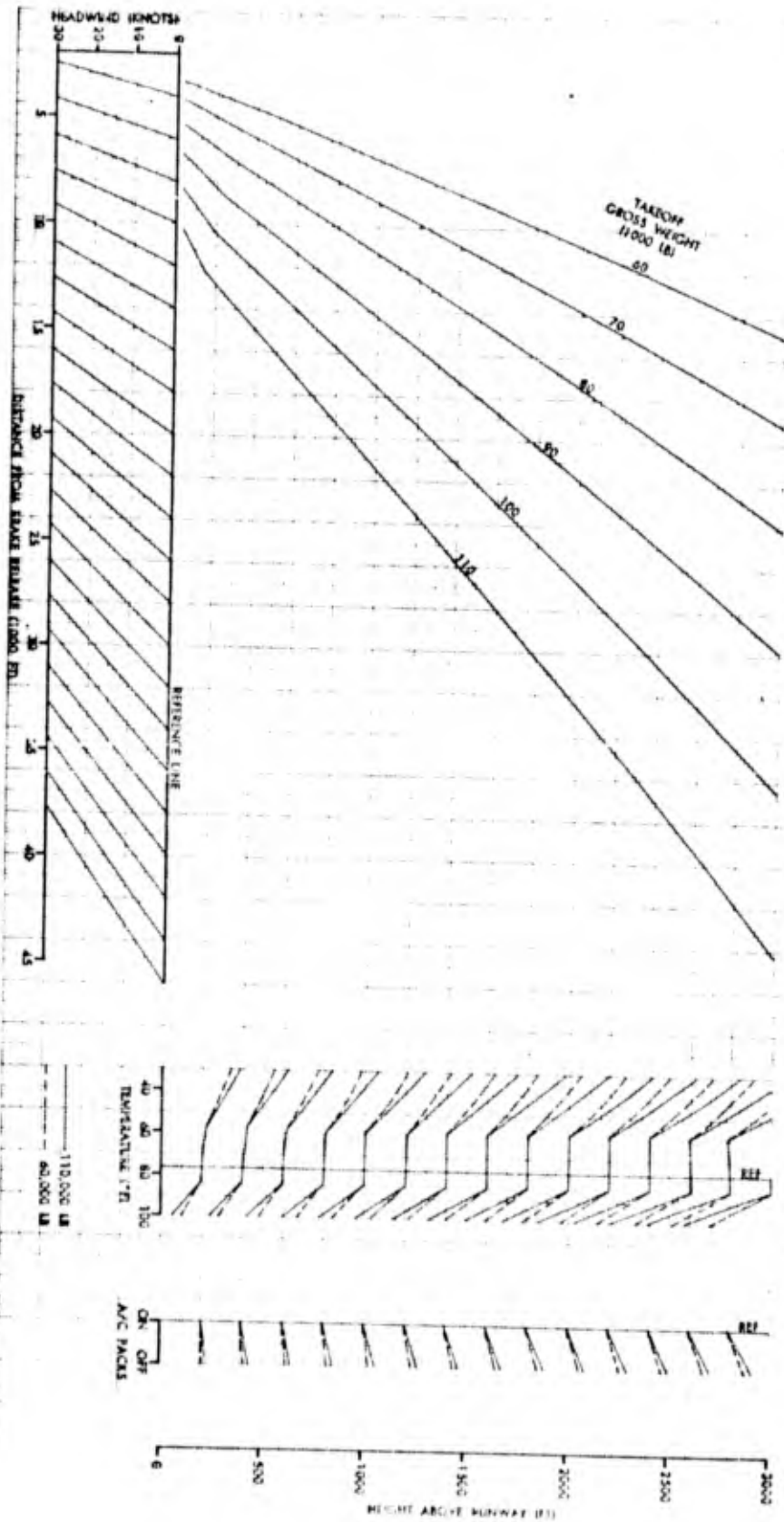
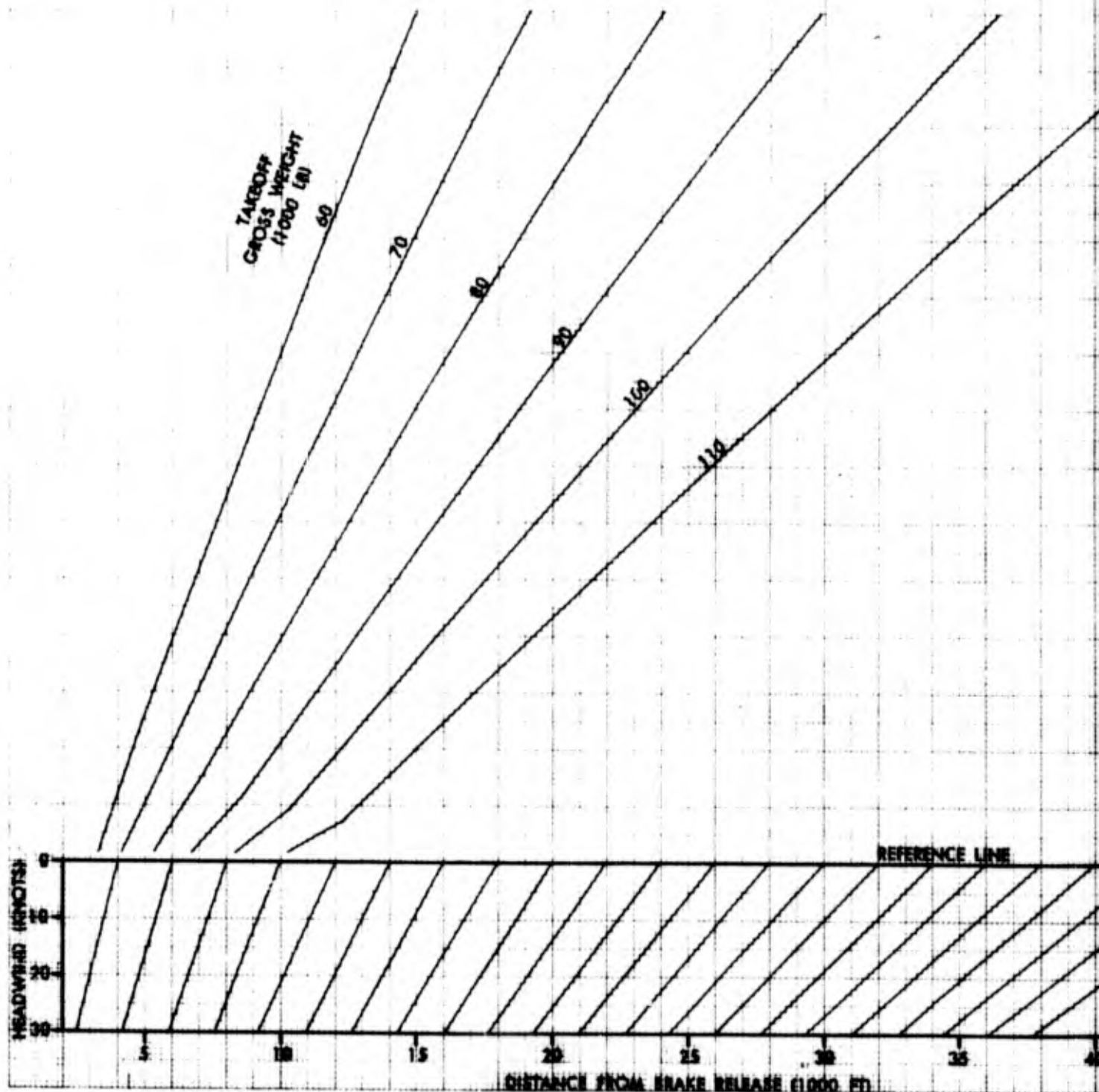


FIGURE 60

DC-9 SERIES
ALL ENGINE FLIGHT
6000 FT AIRPORT ALTITUDE
JT8D-9 ENGINE
5° FLAPS
CLIMB AT V_2



DC-9 SERIES 30
ALL ENGINE FLIGHT PATH
 6000 FT AIRPORT ALTITUDE
 JT8D-9 ENGINES
 5° FLAPS
 CLIMB AT $V_2 + 10$

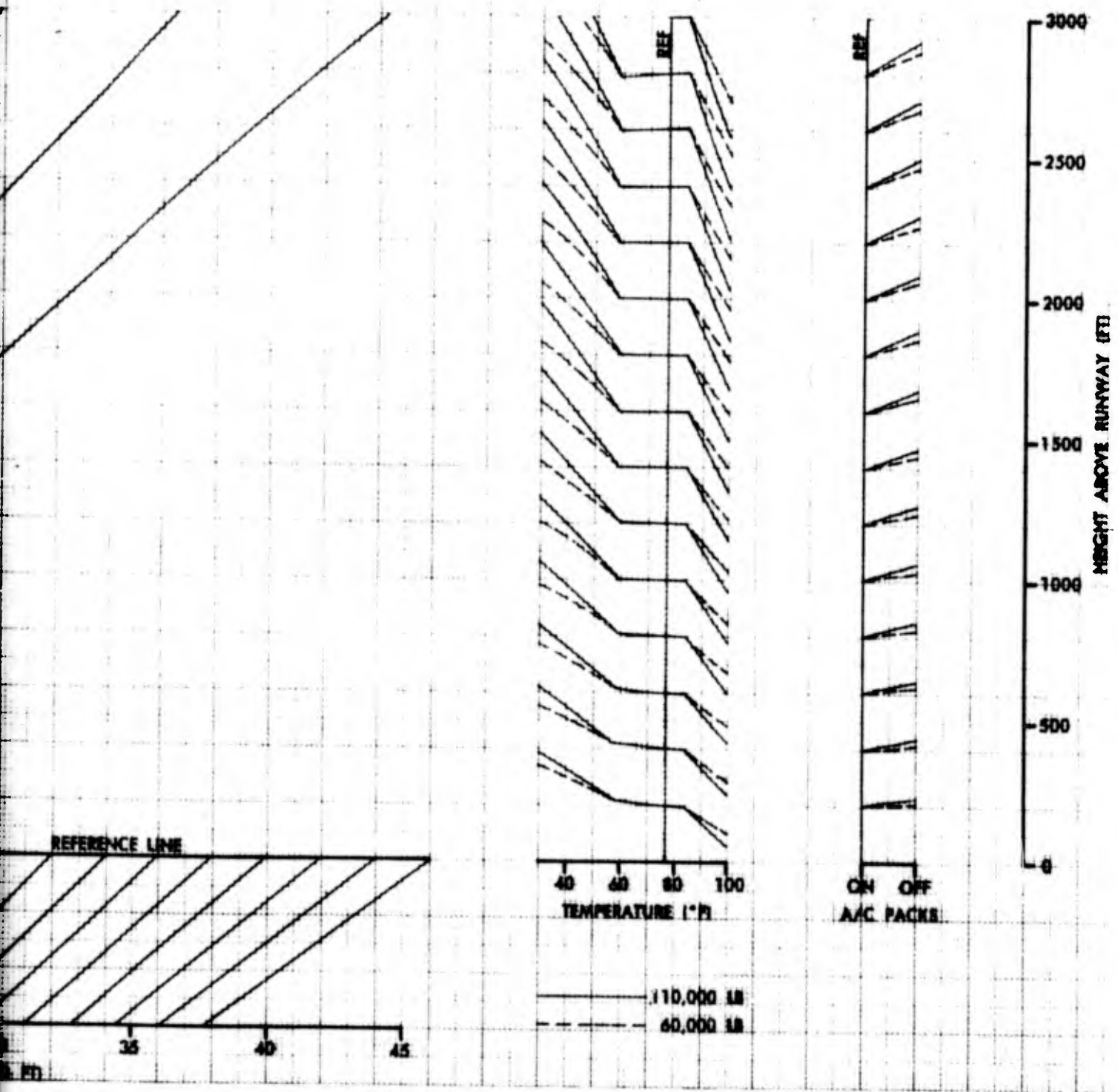
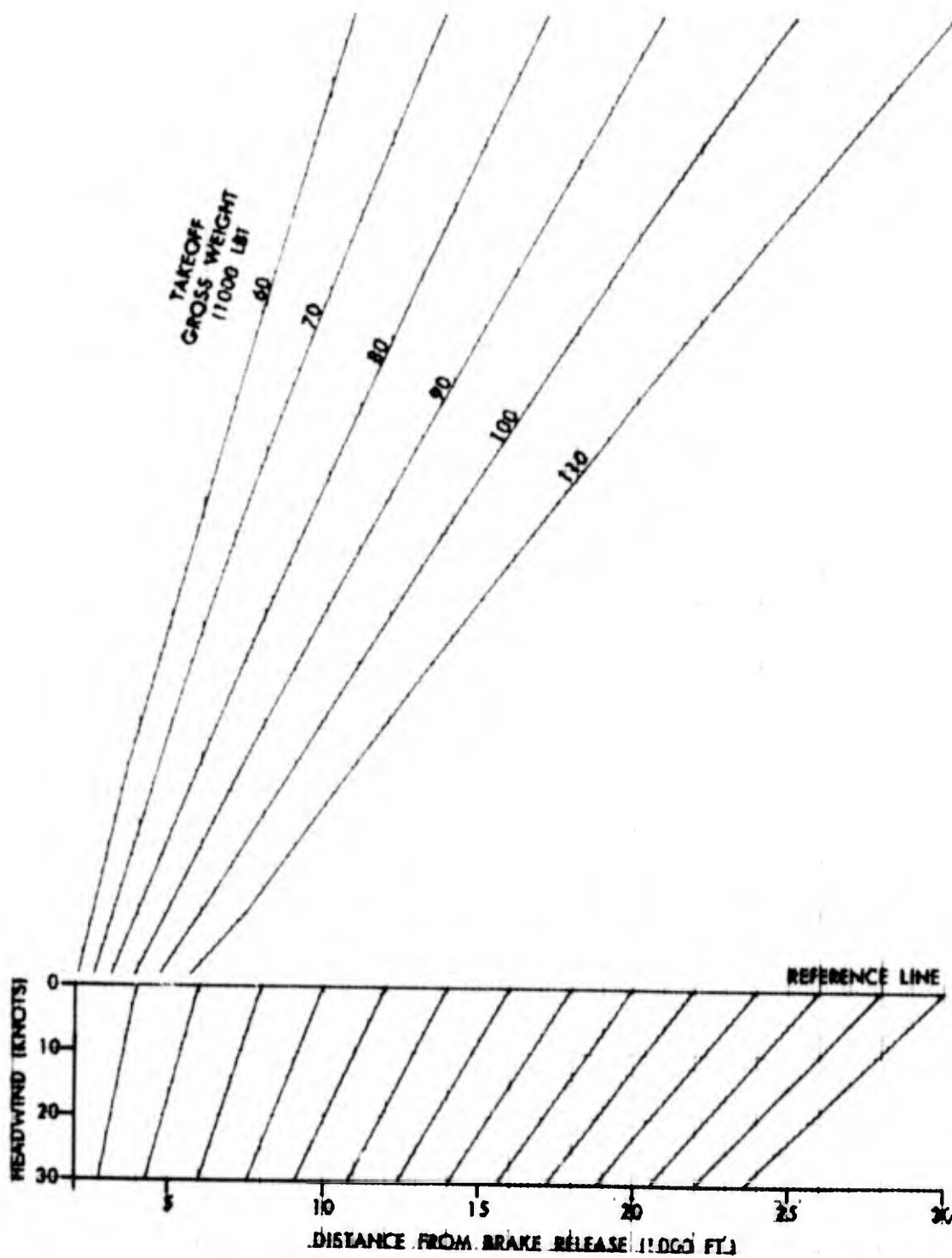
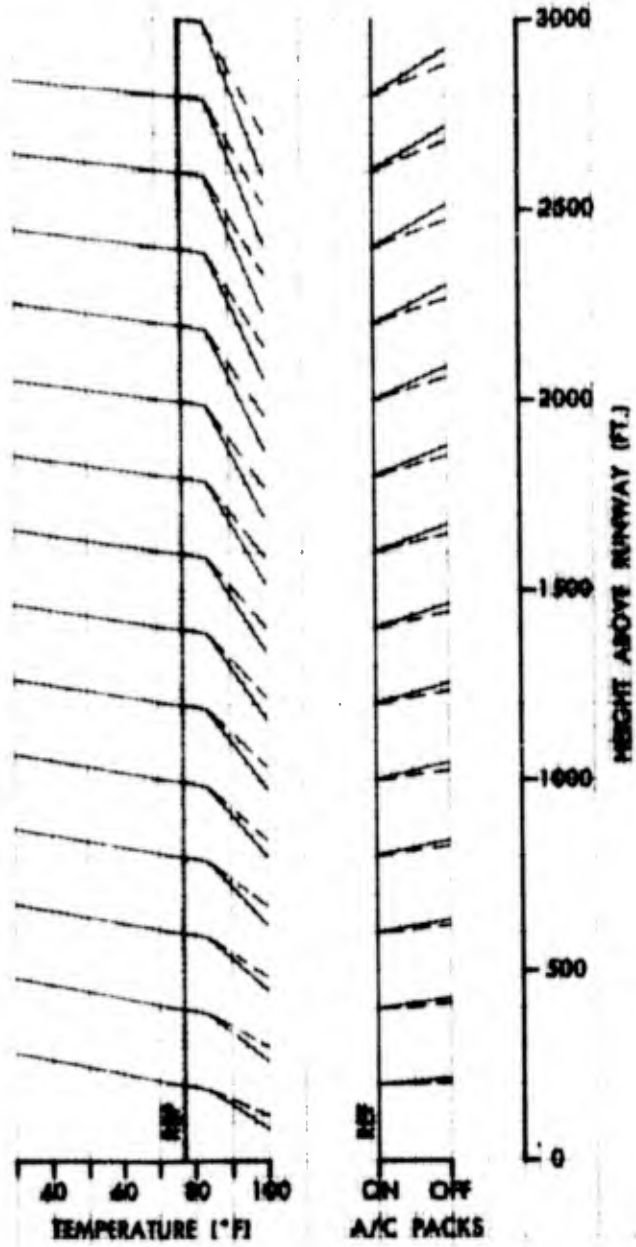


FIGURE 60.

DC-9 SERIES 30
 ALL ENGINE FLIGHT PAT
 SEA LEVEL AIRPORT ALTITUDE
 TWO 9 ENGINES
 FLAPS 15°
 CLIMB AT $V_2 + 10$

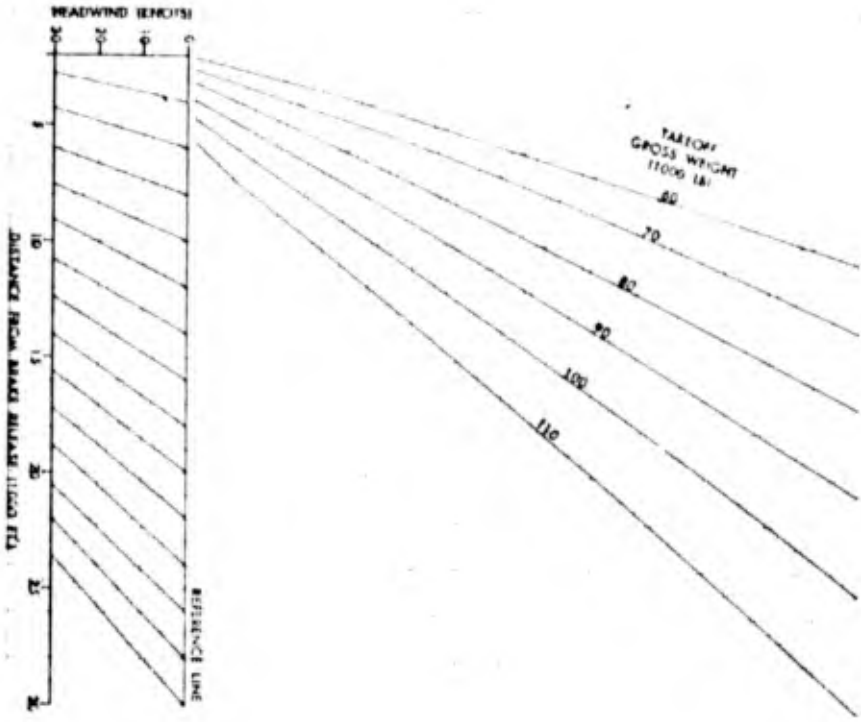


DC-9 SERIES 30
ALL ENGINE FLIGHT PATH
SEA LEVEL AIRPORT ALTITUDE
TWO-2 ENGINES
FLAPS 15°
CLIMB AT $V_2 + 10$

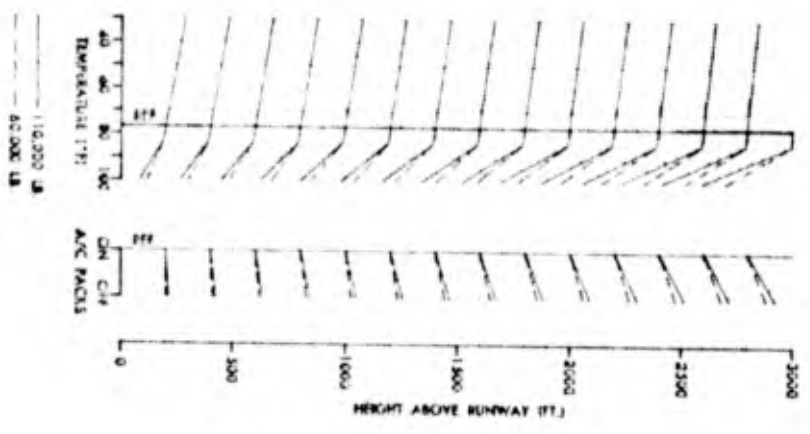


——— 110,000 LB.
 - - - 60,000 LB.

FIGURE 61.



DC-9 SERIES 30
 ALL ENGINE FLIGHT PATH
 SEA LEVEL AIRPORT ALTITUDE
 2 IDG ENGINES
 FLAPS 15°
 CLIMB AT $V_2 + 10$



DC 9 SERIES 30
 ALL ENGINE FLIGHT PATH
 3000 FT. RWY. ALTITUDE
 2/80 / ENGINE
 1" MAPS
 S11-48-117 V3 # 13

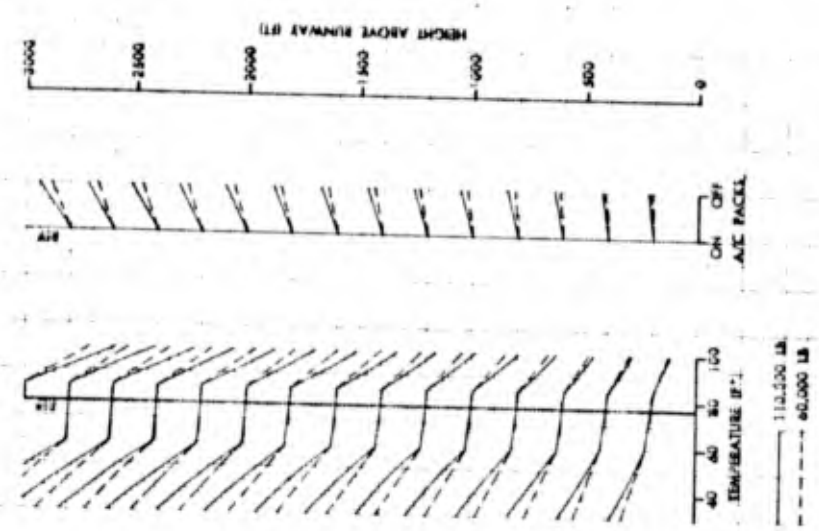
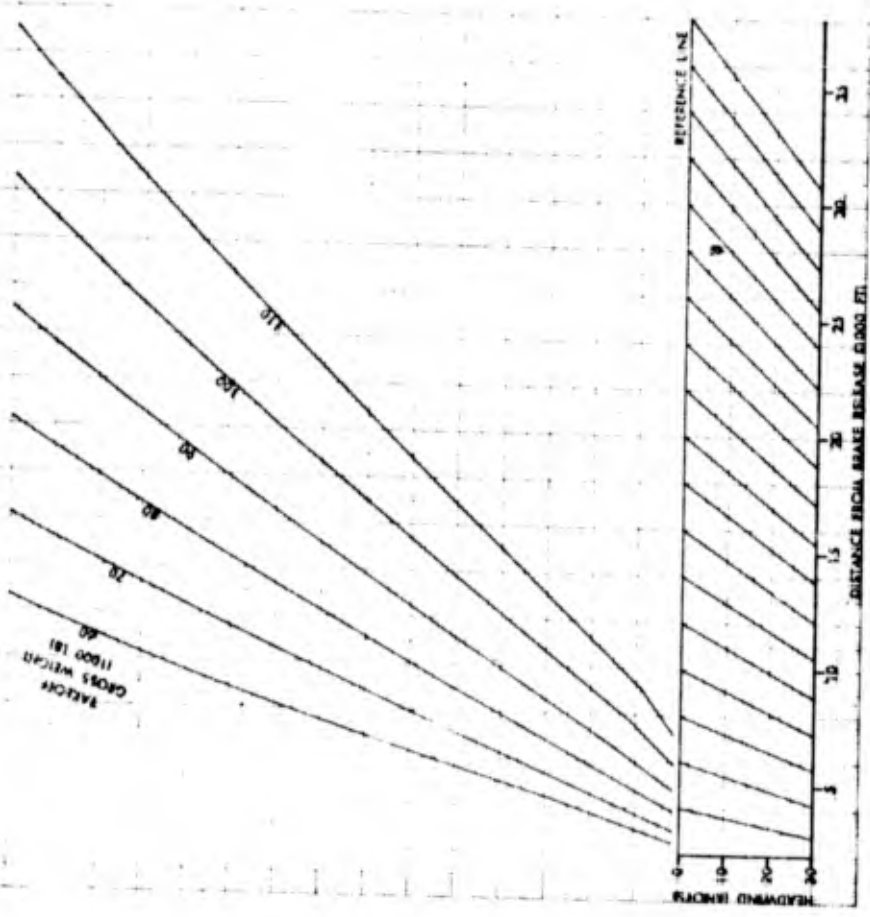
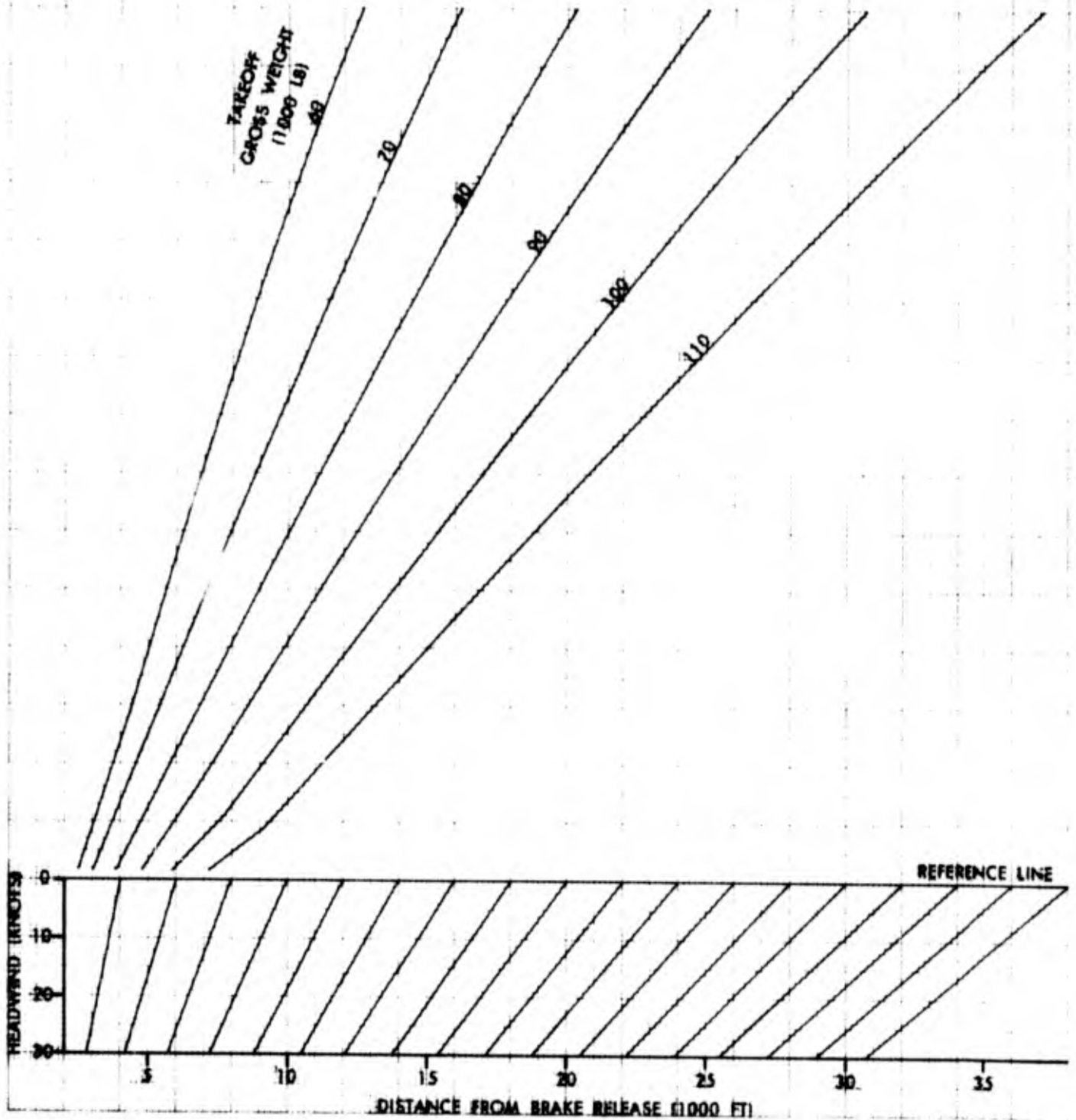


FIGURE 62

DC-9 SERIES 30
ALL ENGINE FLIGHT PA
3000 FT RUNWAY ALTITUDE
JT80-9 ENGINE
15° FLAPS
CLIMB AT $V_2 + 10$



R

DC-9 SERIES 30
 1 ENGINE FLIGHT PATH
 3000 FT RUNWAY ALTITUDE
 JT80-9 ENGINE
 15° FLAPS
 CLIMB AT $V_2 + 10$

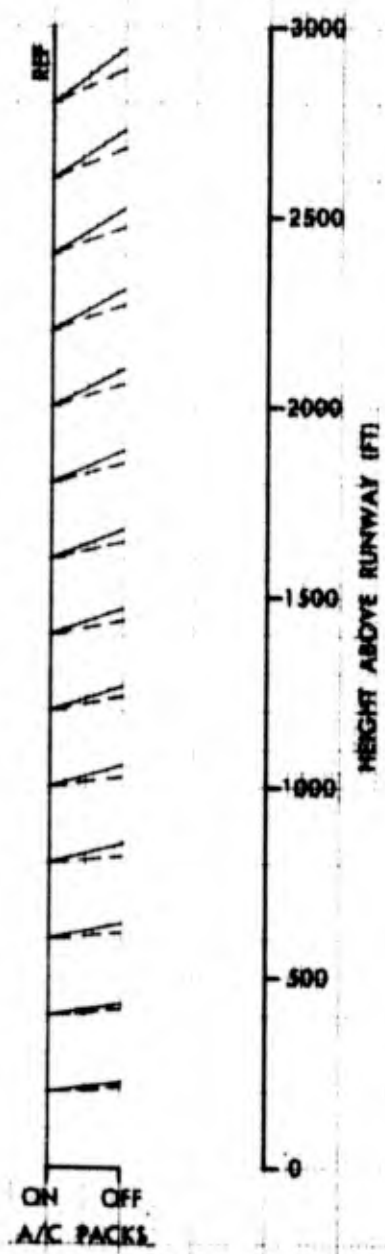
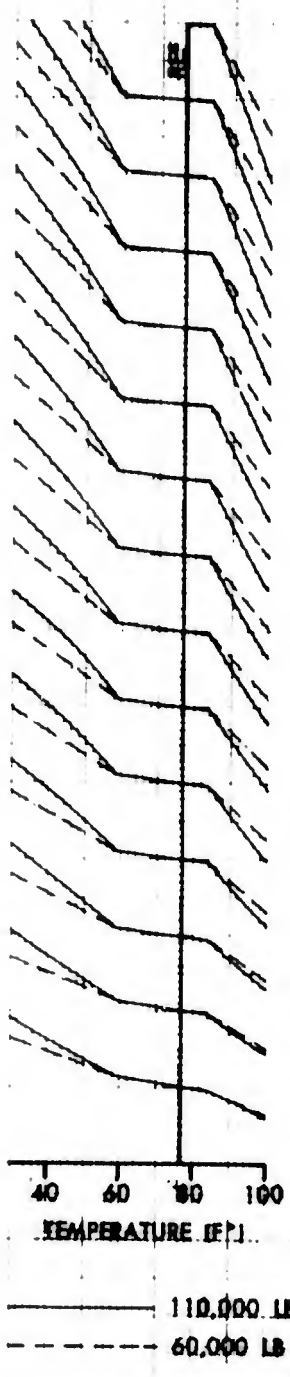
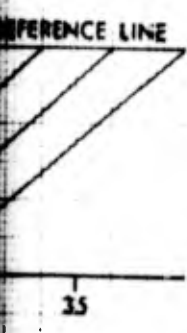
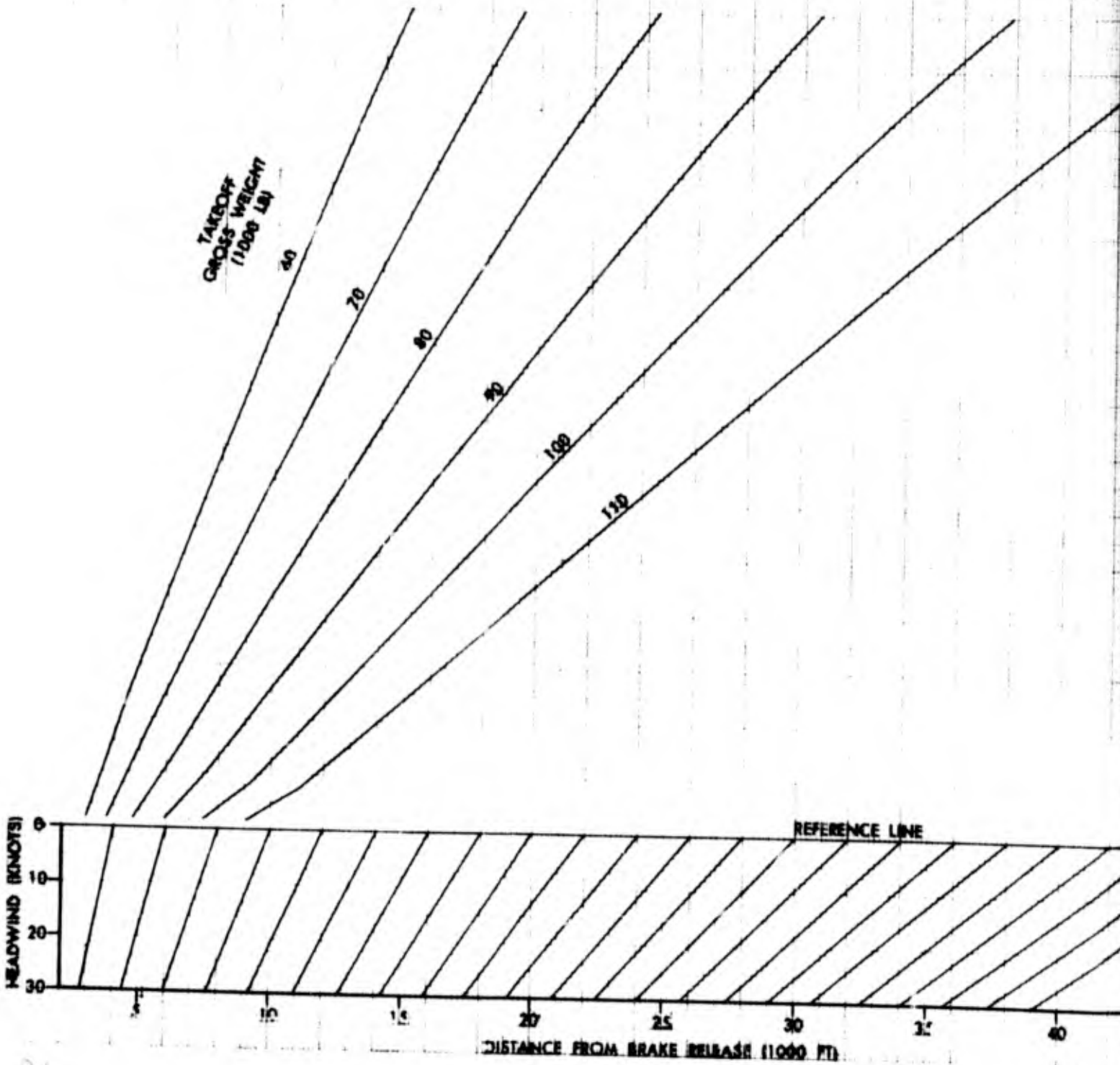


FIGURE 62.

DC-9 SERIES 30
ALL ENGINE FLIGHT
6000 FT AIRPORT ALTITUDE
JT8D-9 ENGINES
15° FLAPS
CLIMB AT $V_2 + 10$



8

DC-9 SERIES 30
 ALL ENGINE FLIGHT PATH
 4000 FT AIRPORT ALTITUDE
 JT8D-9 ENGINES
 15° FLAPS
 CLIMB AT $V_2 + 10$

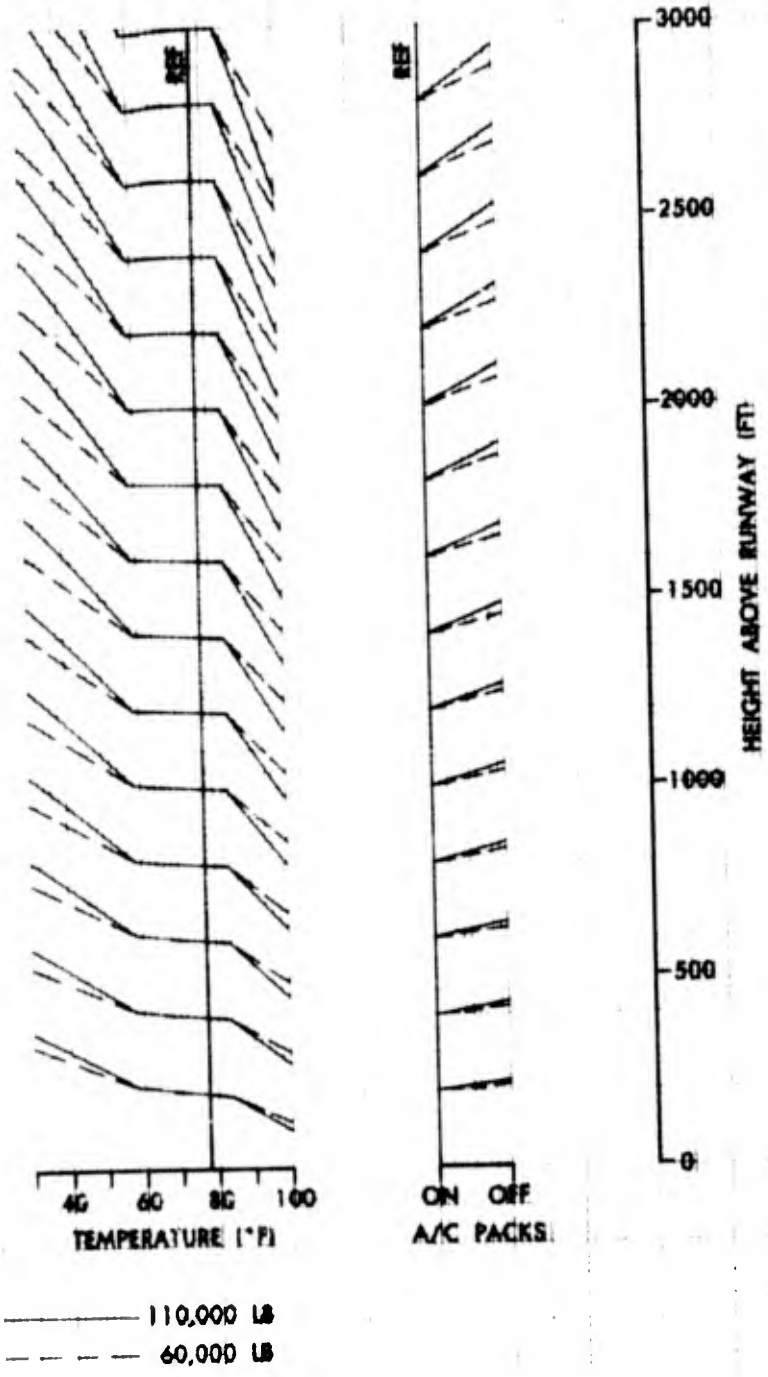


FIGURE 63.

DC-9 SERIES 30
 ALL ENGINE-1 FLIGHT PATH
 6000 FT AIRPORT ALTITUDE
 J32-P ENGINES
 15° FLAPS
 CLIMB AT $V_2 + 10$

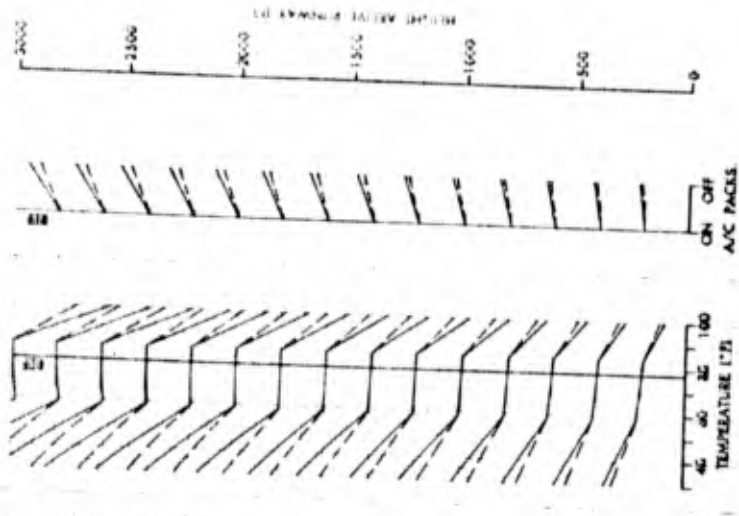
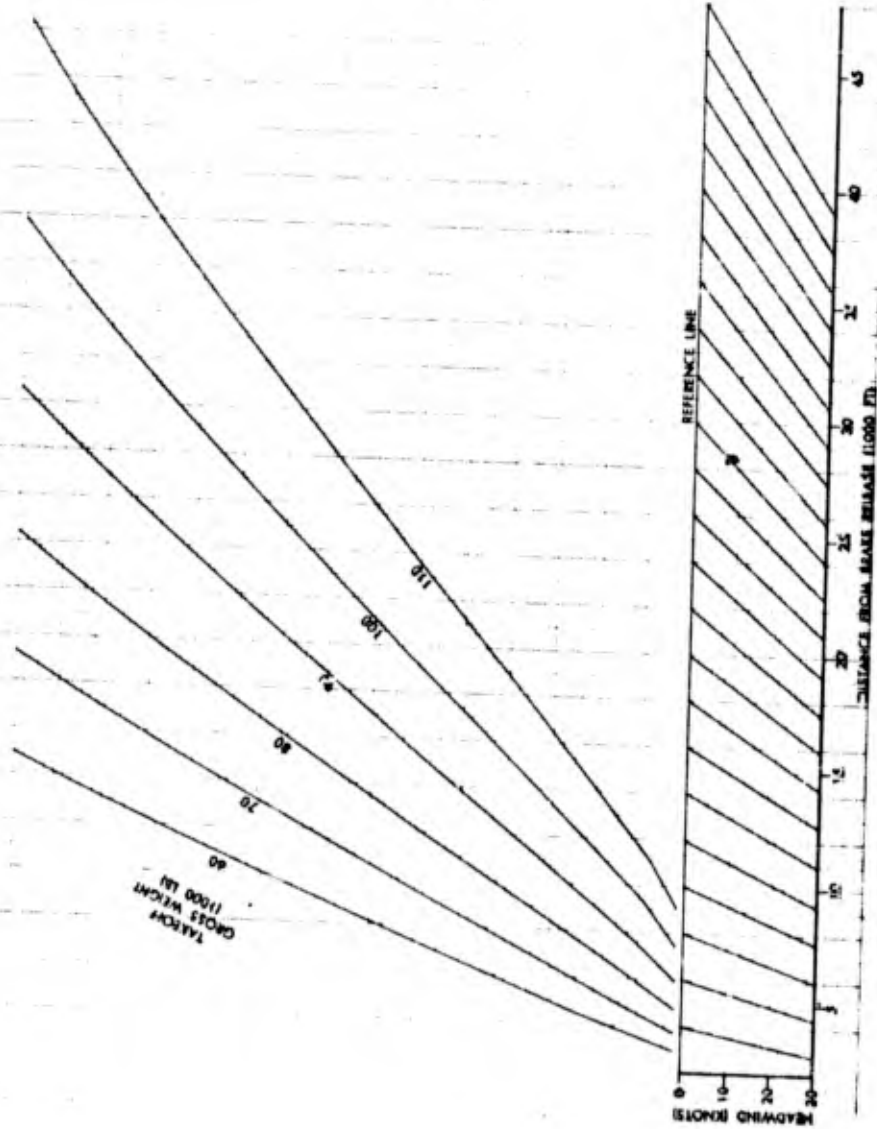
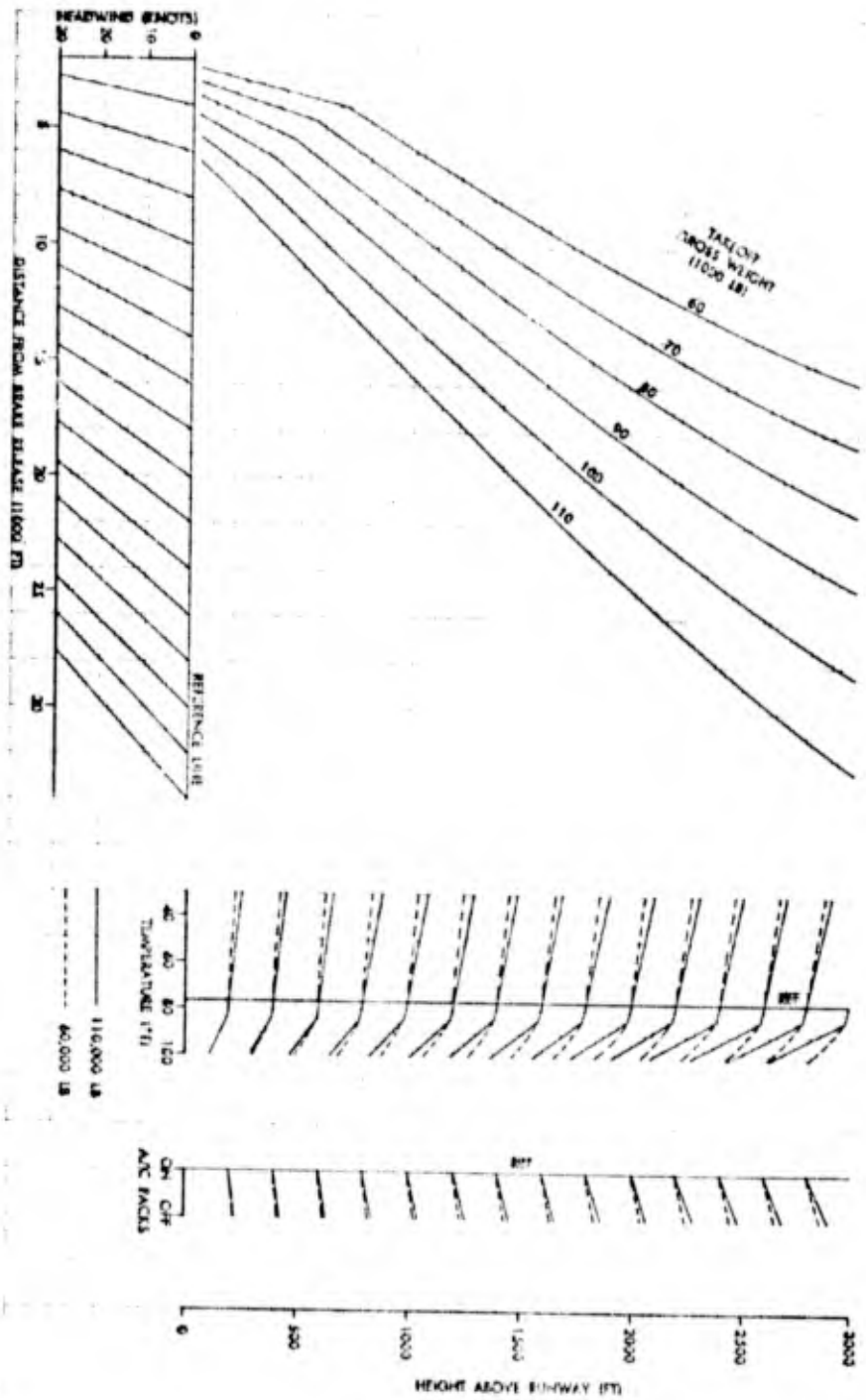


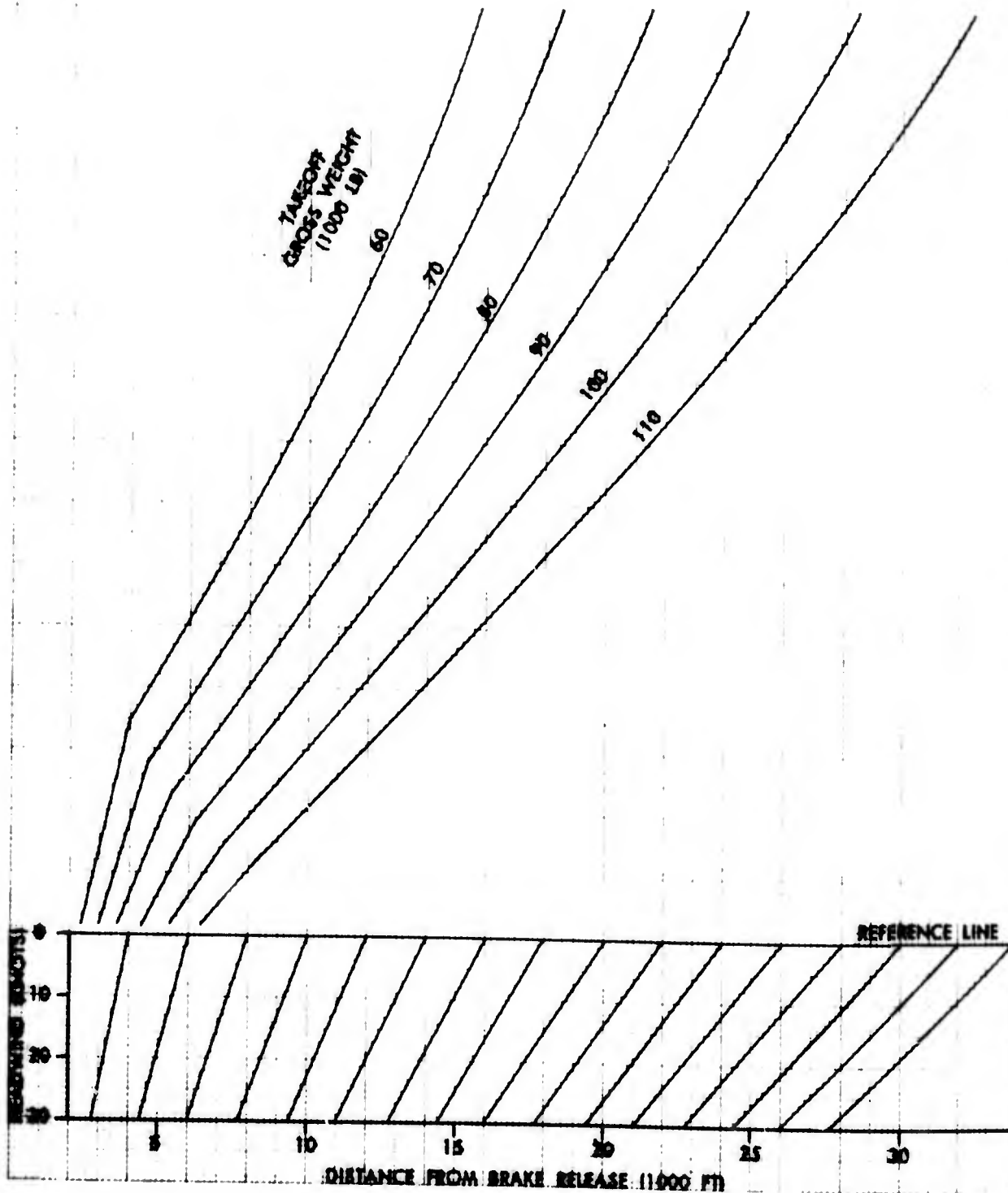
FIGURE 63



DC9 SERIES 30
 ALL ENGINE FLIGHT PATH
 SEA LEVEL AIRPORT ALTITUDE
 7100 9 ENGINES
 5° FLAPS
 CLIMB AT $V_2 + 10$ OR 15° PITCH LIMIT

FIGURE 64

DC-9 SERIES 30
ALL ENGINE FLIGHT
SEA LEVEL AIRPORT ALTITUDE
STD-9 ENGINES
5° FLAPS
CLIMB AT $V_2 + 10$ OR 15°



28

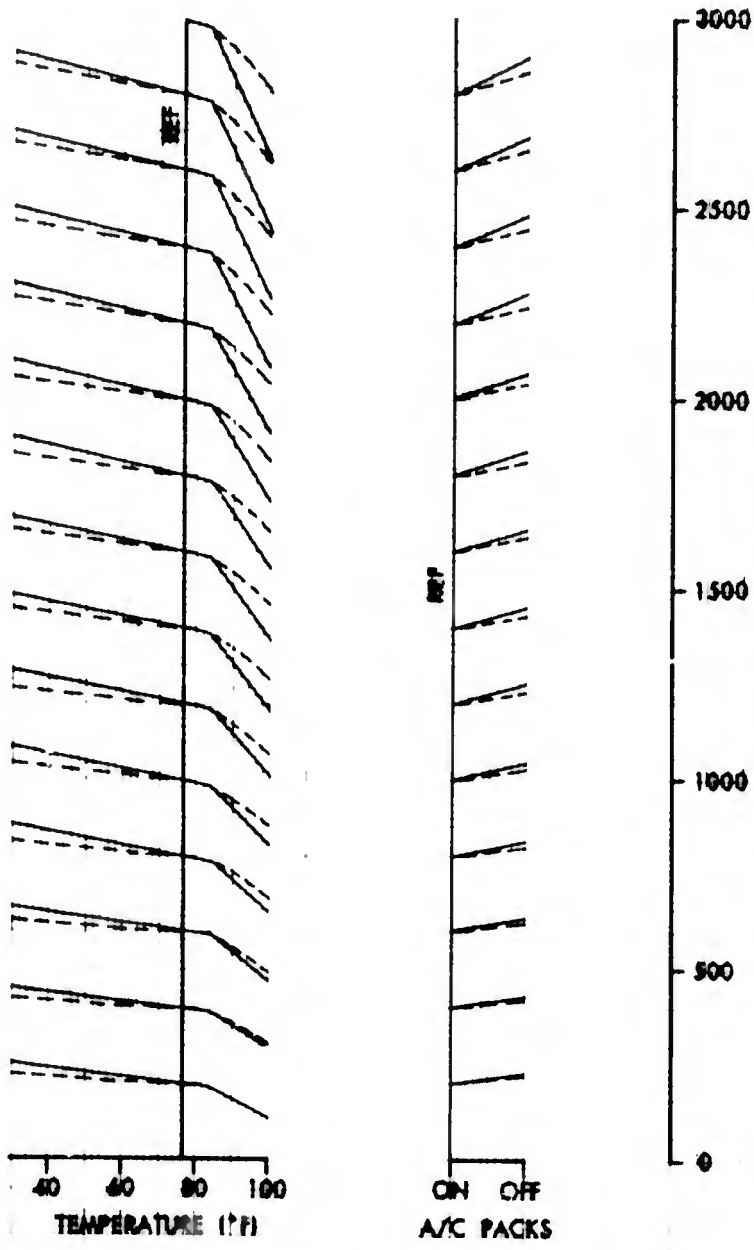
DC-9 SERIES 30
ALL ENGINE FLIGHT PATH

SEA LEVEL AIRPORT ALTITUDE

STD-9 ENGINES

5° FLAPS

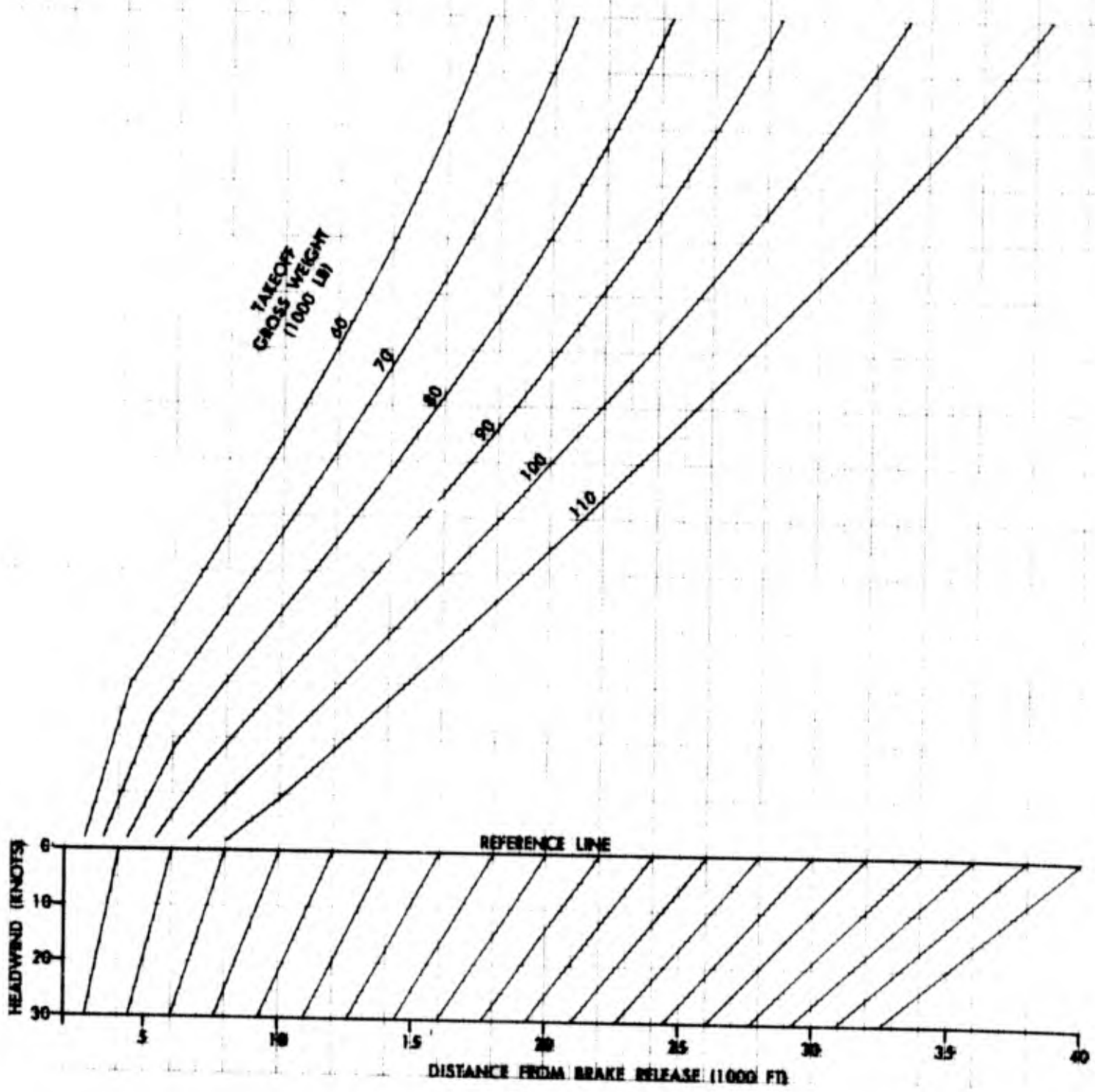
LIMIT AT $V_2 + 10$ OR 1.5° PITCH LIMIT



————— 110,000 LB
- - - - - 60,000 LB

FIGURE 64.

DC-9 SERIES 30
ALL ENGINE FLIGHT PATH
3000 FT AIRPORT ALTITUDE
JT8D-9 ENGINES
5° FLAPS
CLIMB AT $V_2 + 10$ OR 15° PITCH



DC-9 SERIES 30
 ALL ENGINE FLIGHT PATH
 3000 FT AIRPORT ALTITUDE
 JT8D-9 ENGINES
 5° FLAPS
 AT $V_2 + 10$ OR 15° PITCH LIMIT

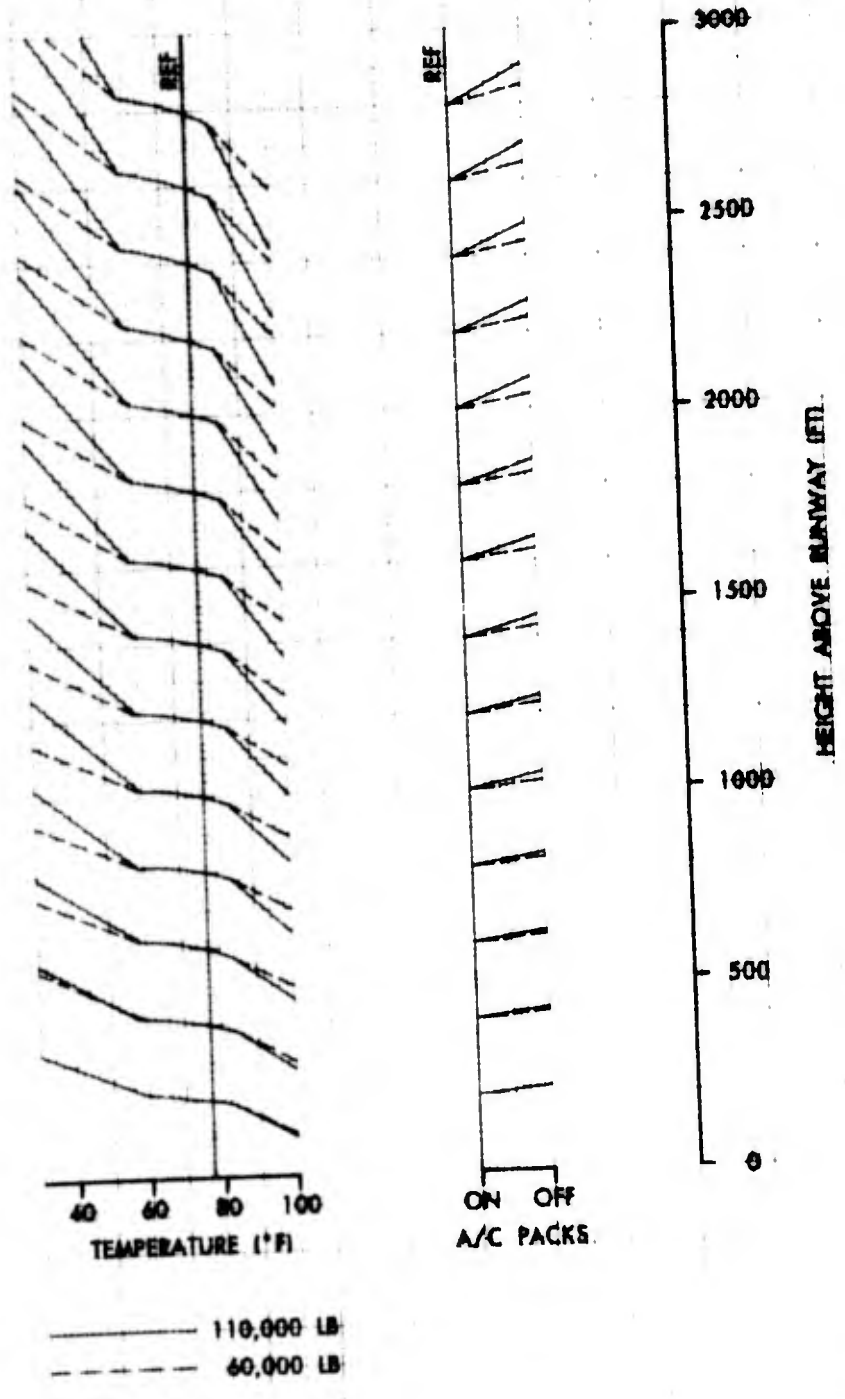
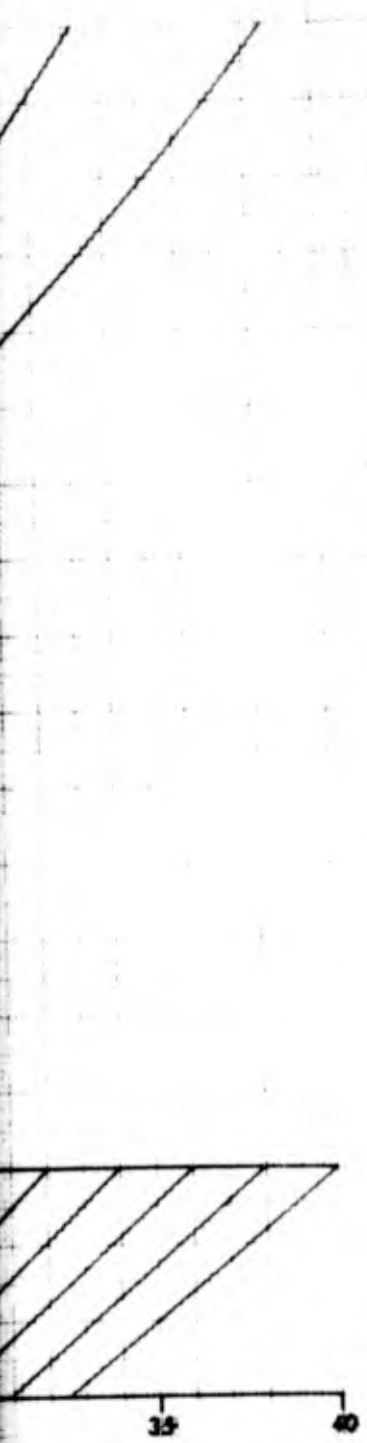
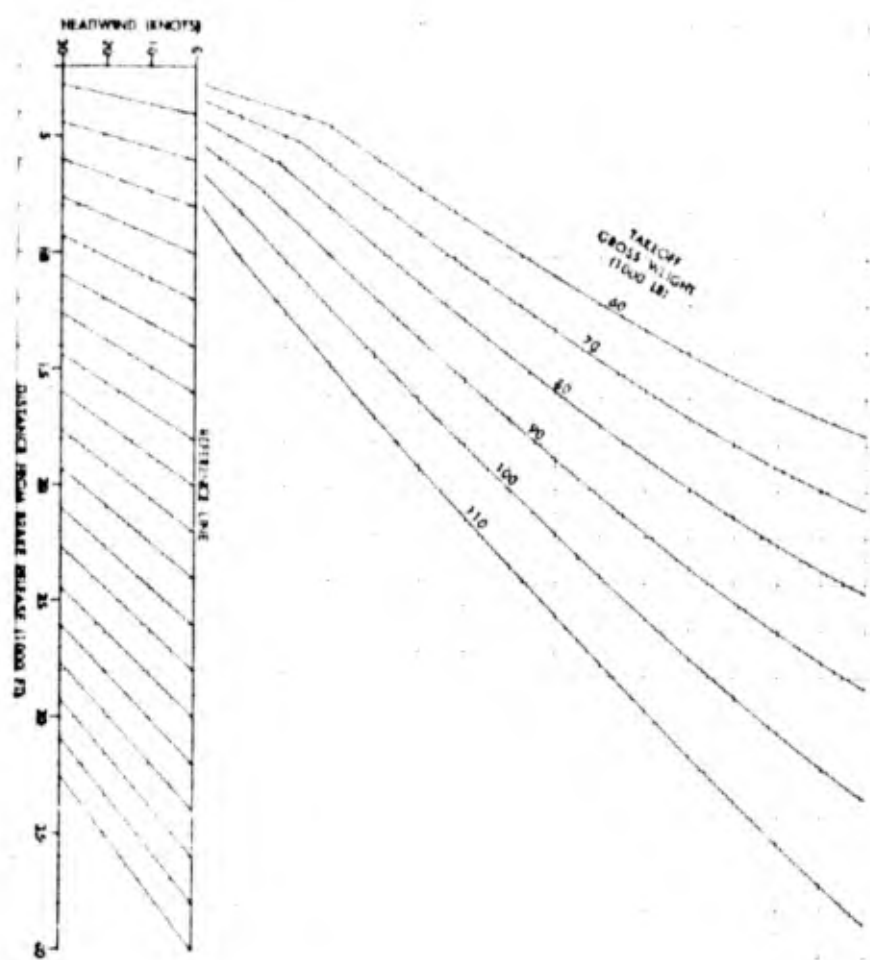


FIGURE 65



TC-9 SERIES 30
 ALL ENGINE FLIGHT PATH
 2000 FT AIRPORT ALTITUDE
 J1D9 ENGINE
 3° FLAPS
 CLIMB AT $V_2 + 10$ OR 13° PITCH LIMIT

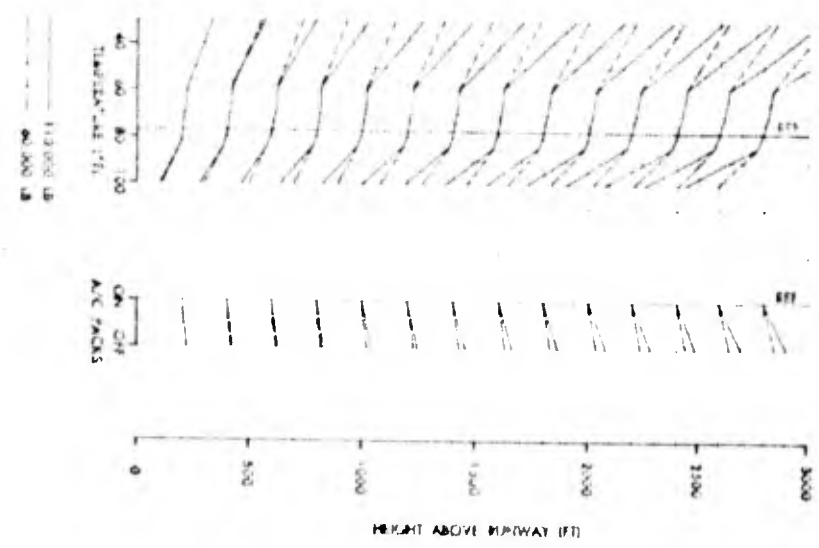
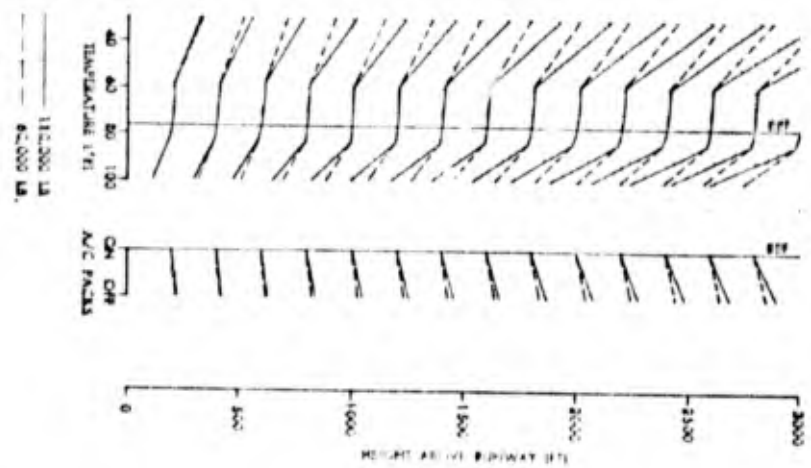
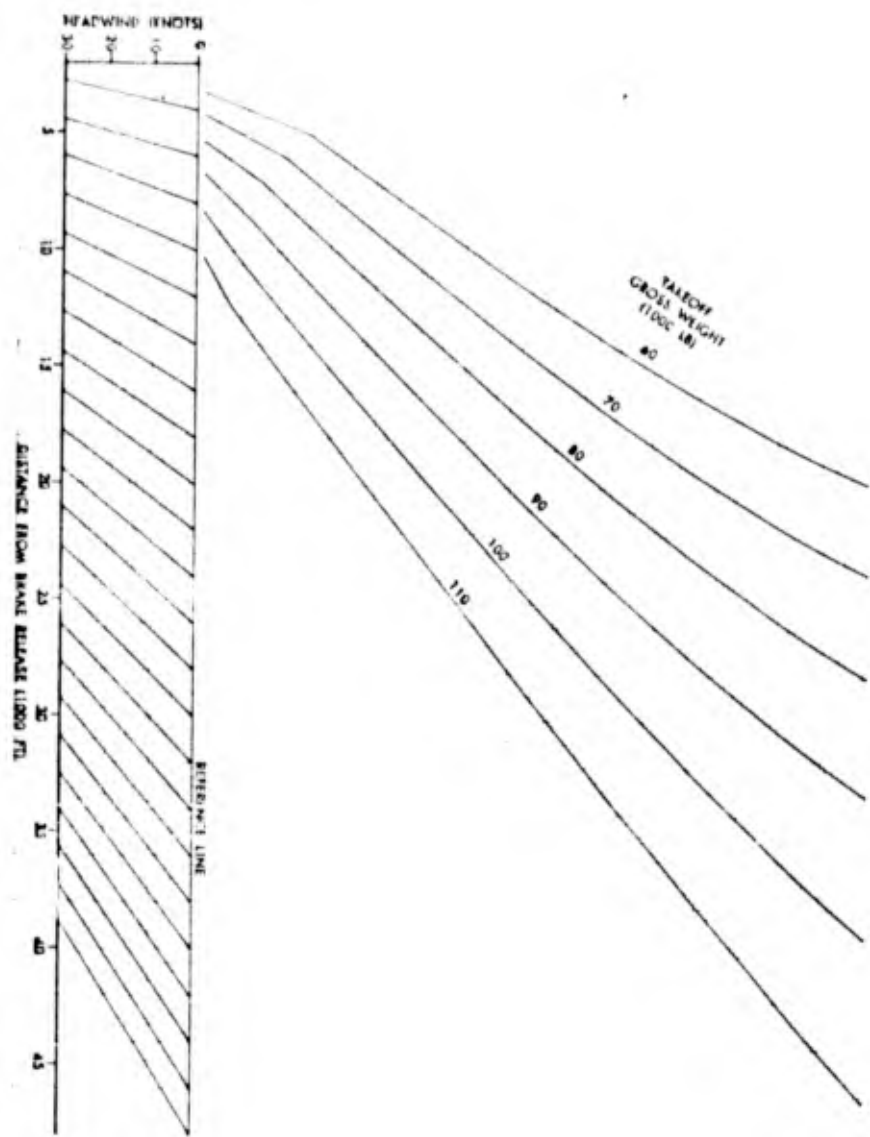


FIGURE 65

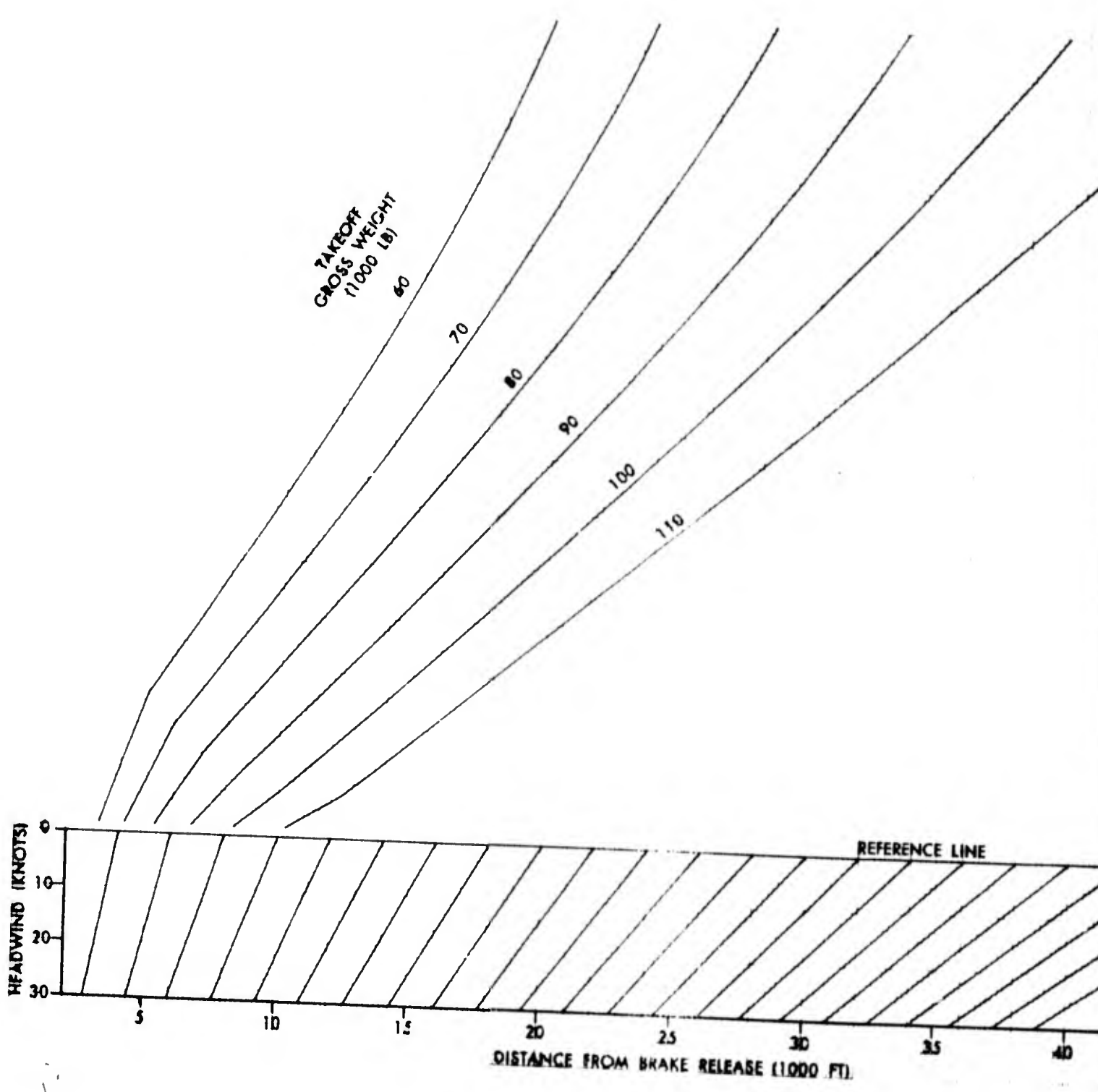
DC-9 SERIES 30
 ALL ENGINE FLIGHT PATH
 4000 FT AIRPORT ALTITUDE
 JDC-9 ENGINES
 5° FLAPS
 CLIMB AT V_{LO} + 10 OR 15° PITCH LIMIT



63

CLIMB 50

DC-9 SERIES
ALL ENGINE FLIGHT
4000 FT AIRPORT
JTD-9 ENGINE
5° FLAPS
CLIMB AT $V_2 + 10$ OR 1



DC-9 SERIES 30
 ALL ENGINE FLIGHT PATH
 6000 FT AIRPORT ALTITUDE
 JT8D-9 ENGINES
 5° FLAPS
 AT $V_2 + 10$ OR 15° PITCH LIMIT

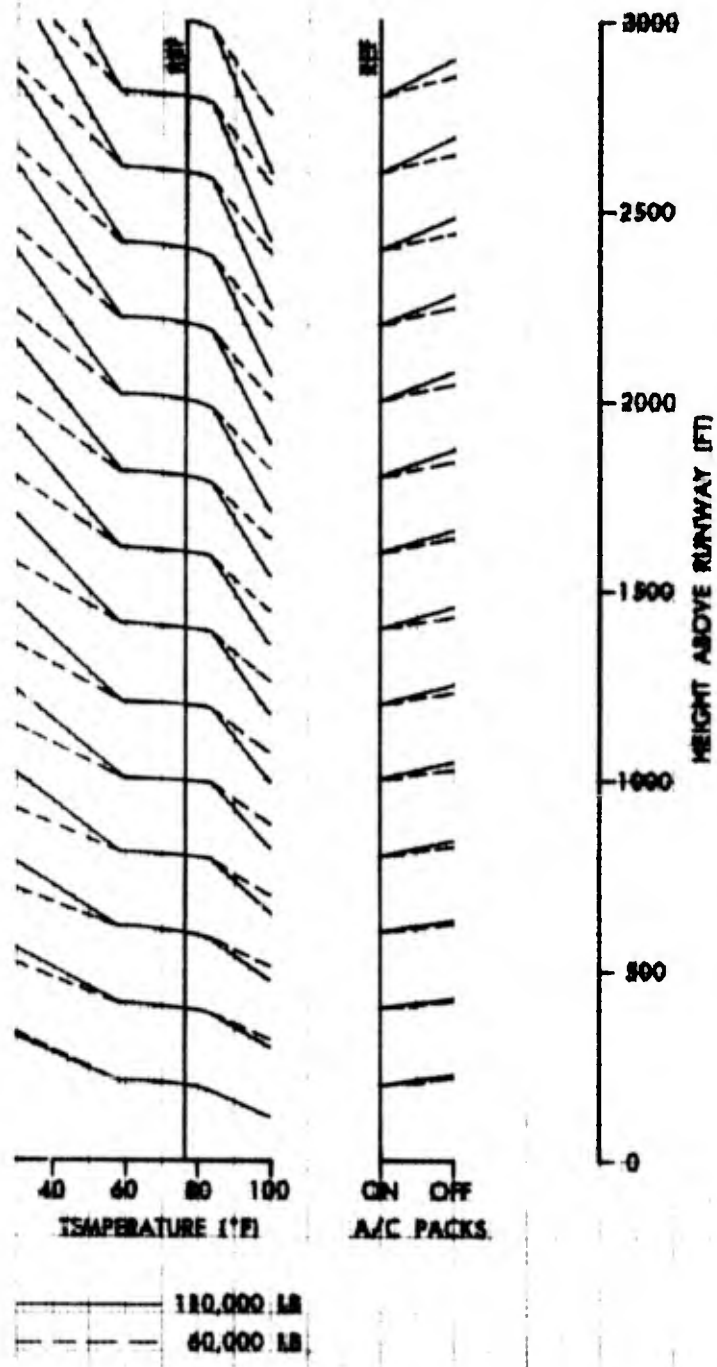
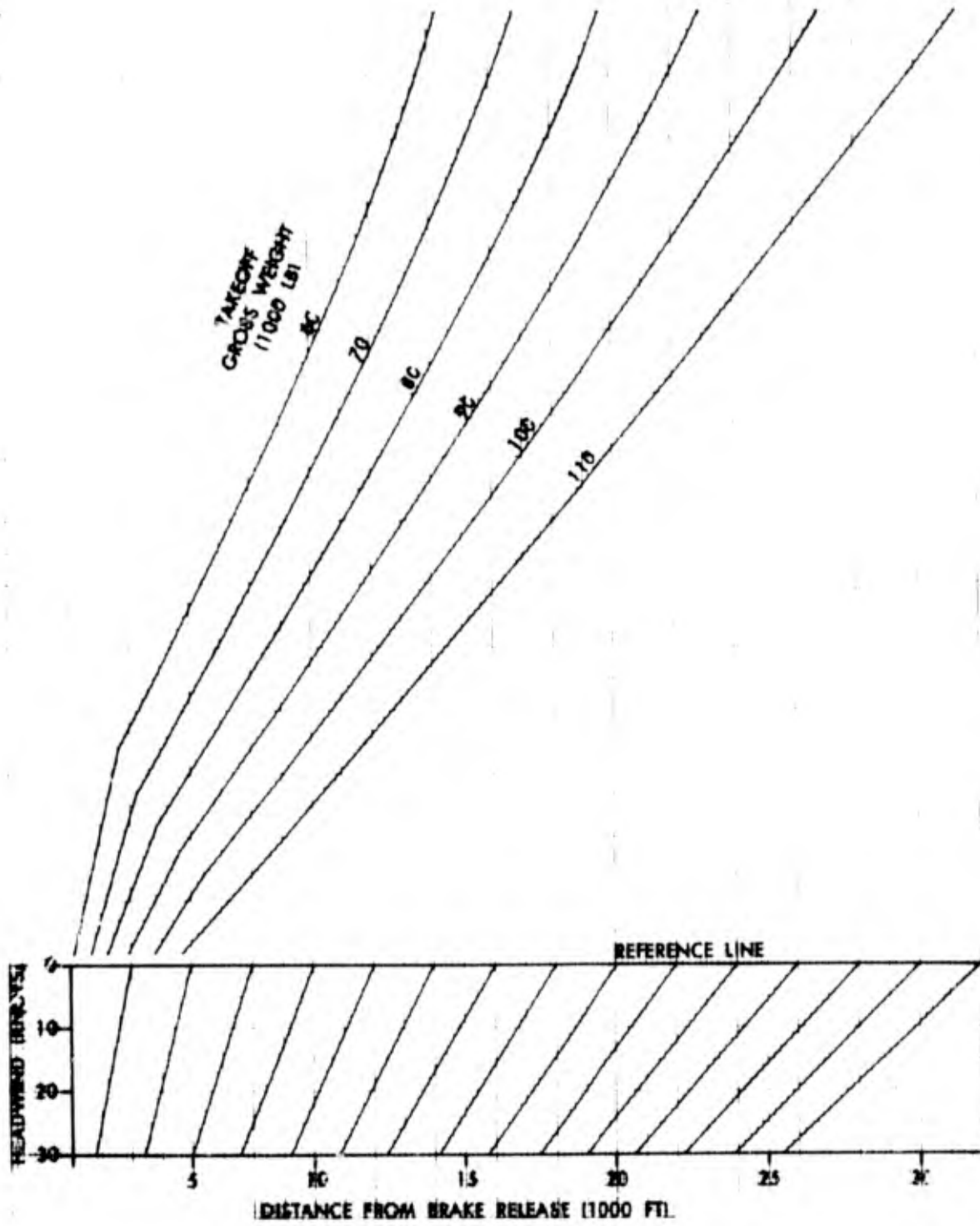


FIGURE 66.

DC-9 SERIES 30
ALL ENGINE FLIGHT
SEA LEVEL AIRPORT ALTITUDE
STD-9 ENGINES
15° FLAPS
CLIMB AT $V_2 + 10$ OR 15°



DC-9 SERIES 30
 ALL ENGINE FLIGHT PATH
 SEA LEVEL AIRPORT ALTITUDE
 STD-9 ENGINES
 15° FLAPS
 $V_2 + 10$ OR 15° PITCH LIMIT

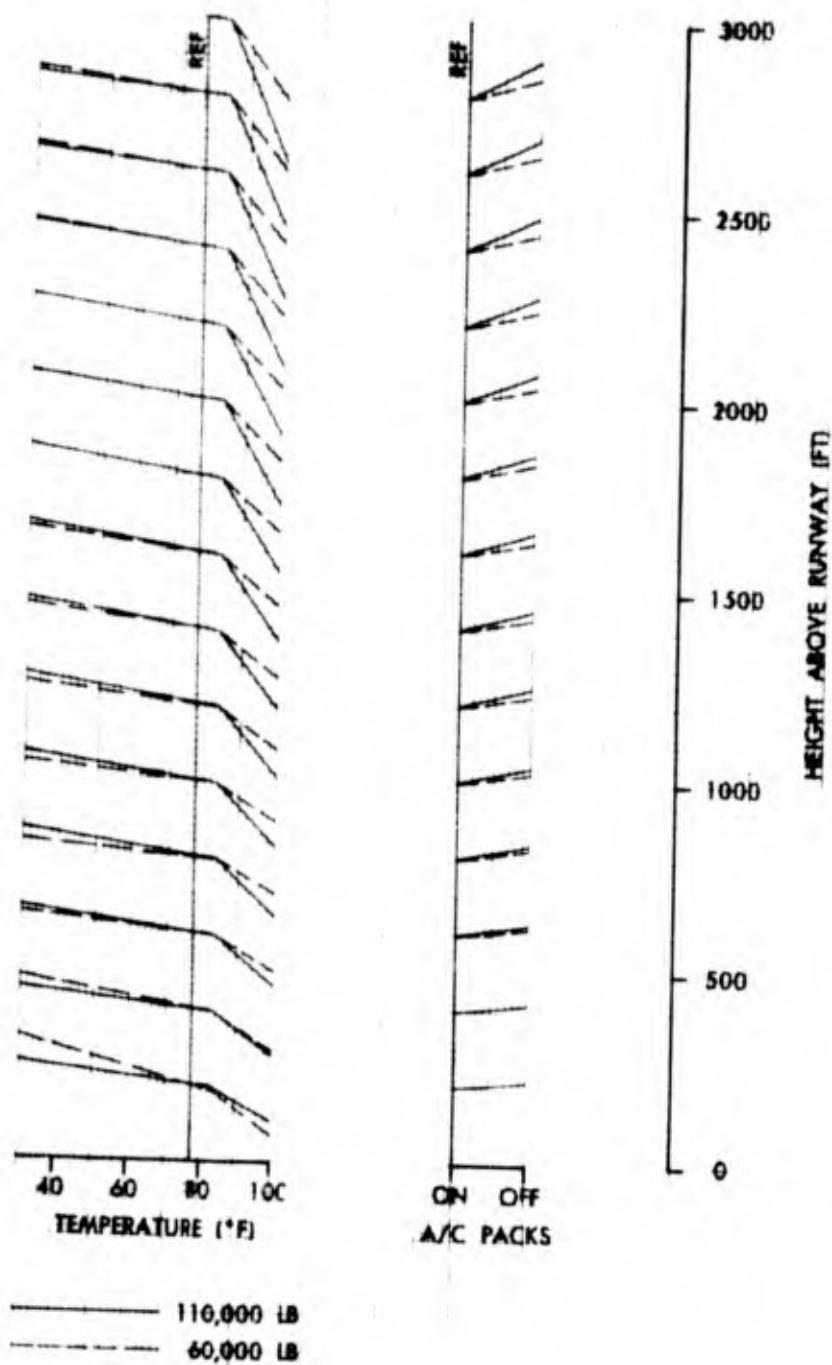
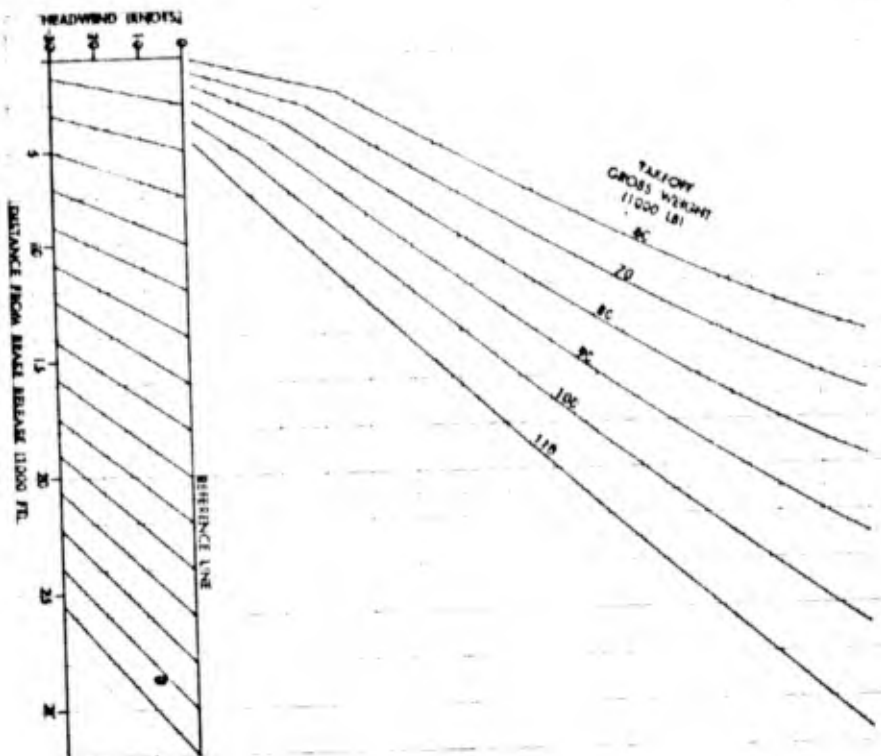
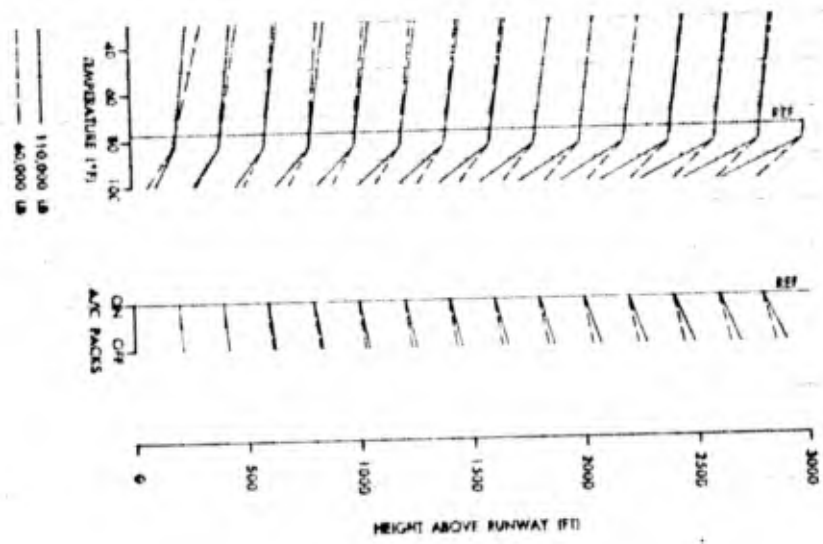


FIGURE 67.



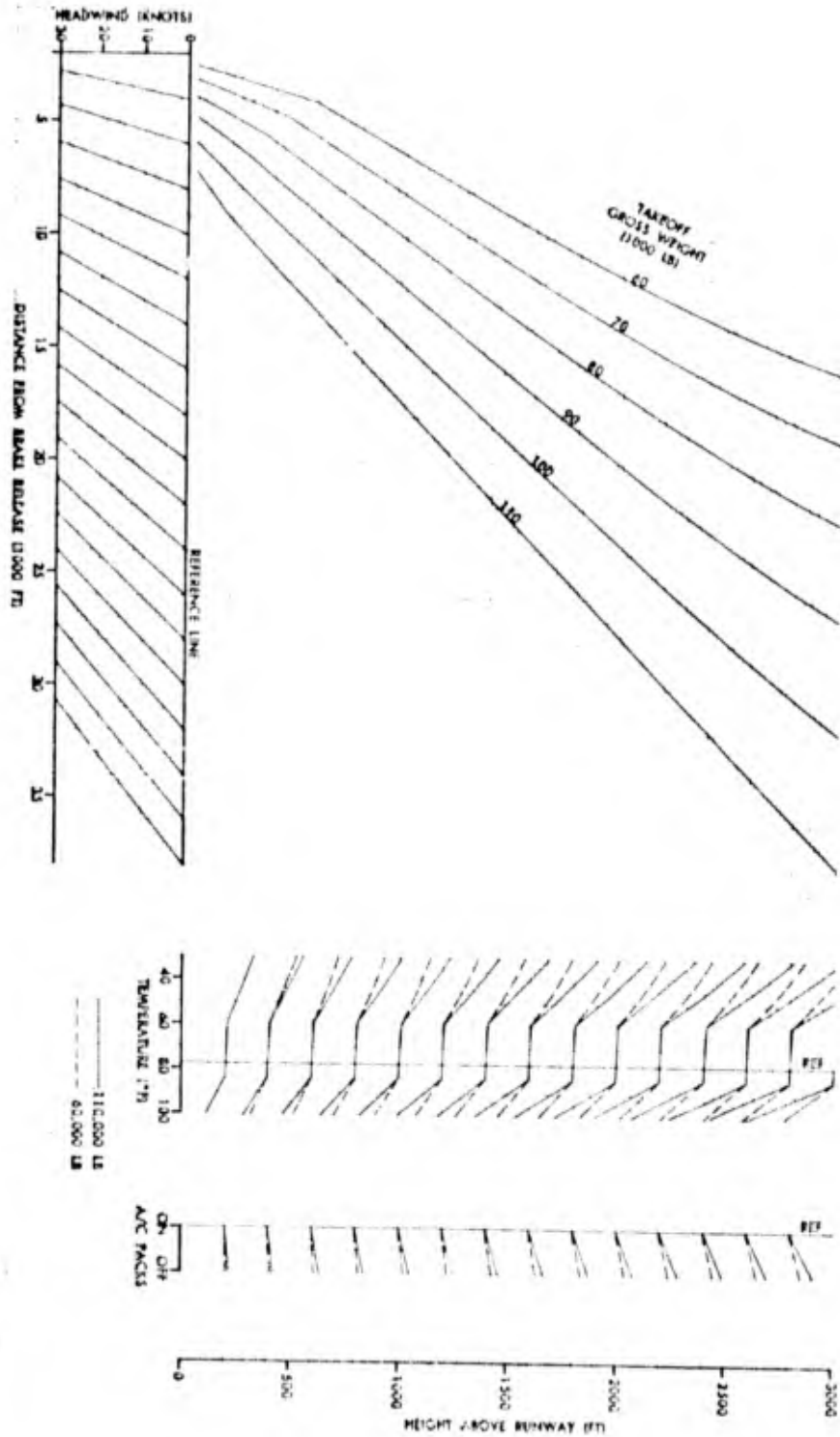
DC-6 SERIES 30
 ALL ENGINE FLIGHT PATH
 SEA LEVEL AIRPORT ALTITUDE
 FIVE 9 ENGINES
 15° FLAPS
 CLIMB AT V_{2+10} OR 15° PITCH LIMIT



64

FIGURE 67

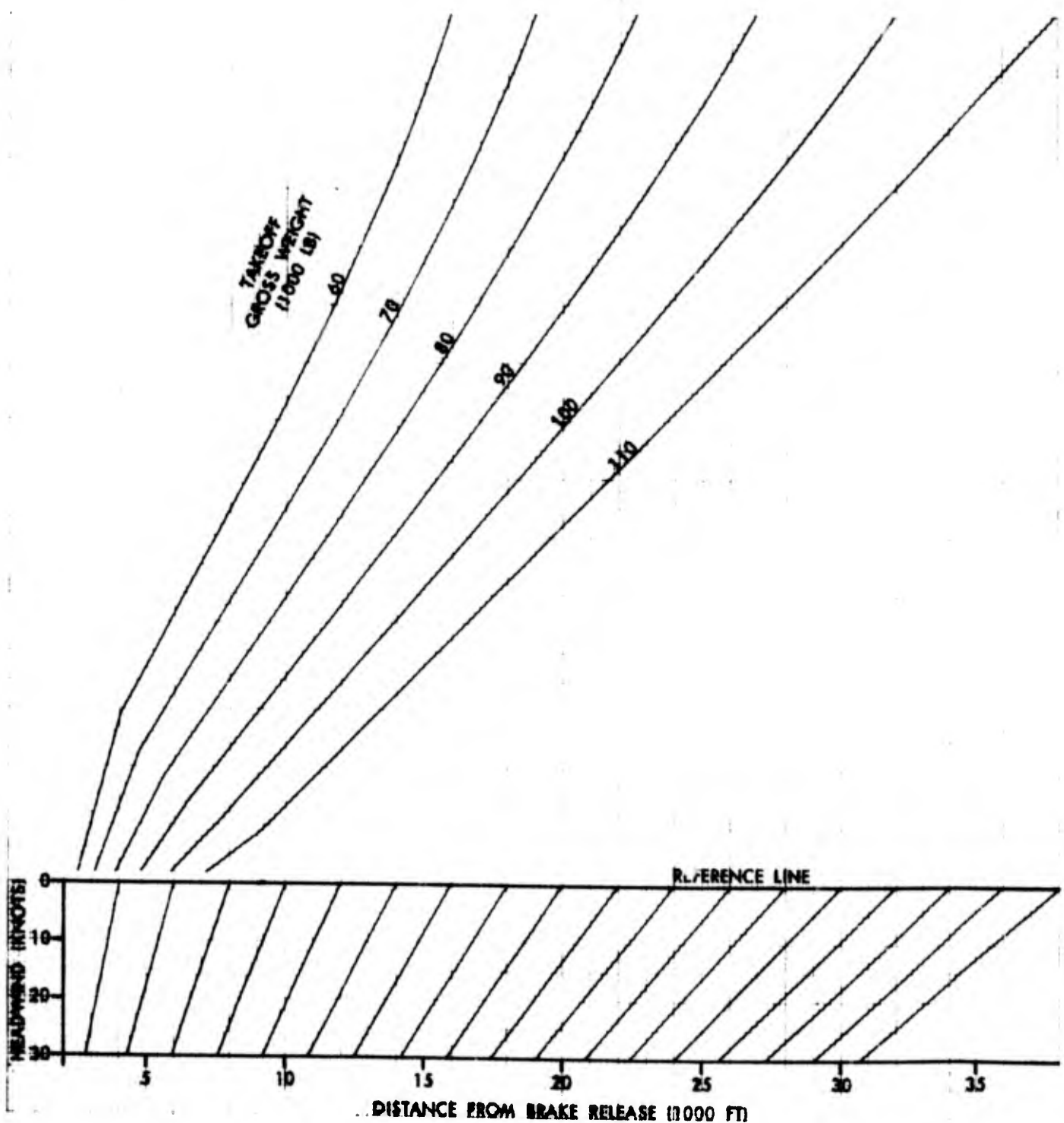
DC-9 SERIES 30
 ALL ENGINE FLIGHT PATH
 8100 FT AIRPORT ALTITUDE
 JETC-9 ENGINES
 15° FLAPS
 CLIMB AT $V_2 + 10$ OR 15° PITCH LIMIT



85

FIGURE 68

DC-9 SERIES 30
ALL ENGINE FLIGHT PA
3000 FT AIRPORT ALTITUDE
JT8D-9 ENGINES
15° FLAPS
CLIMB AT $V_2 + 10$ OR 15° PITCH



A

DC-9 SERIES 30
 1 ENGINE FLIGHT PATH
 3000 FT AIRPORT ALTITUDE
 JTB0-9 ENGINES
 15° FLAPS
 $V_2 + 10$ OR 15° PITCH LIMIT

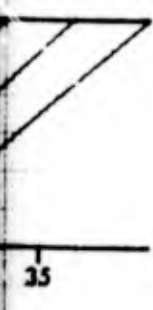
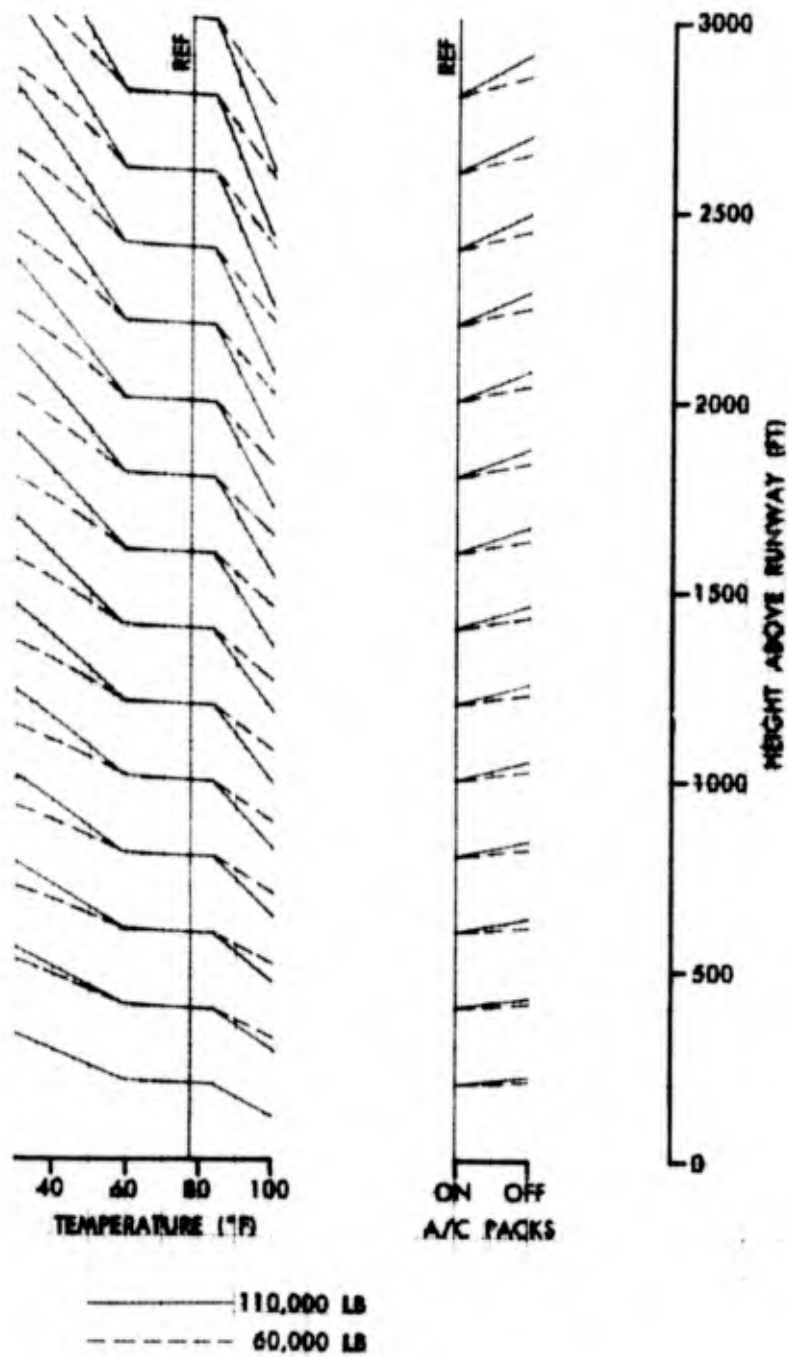
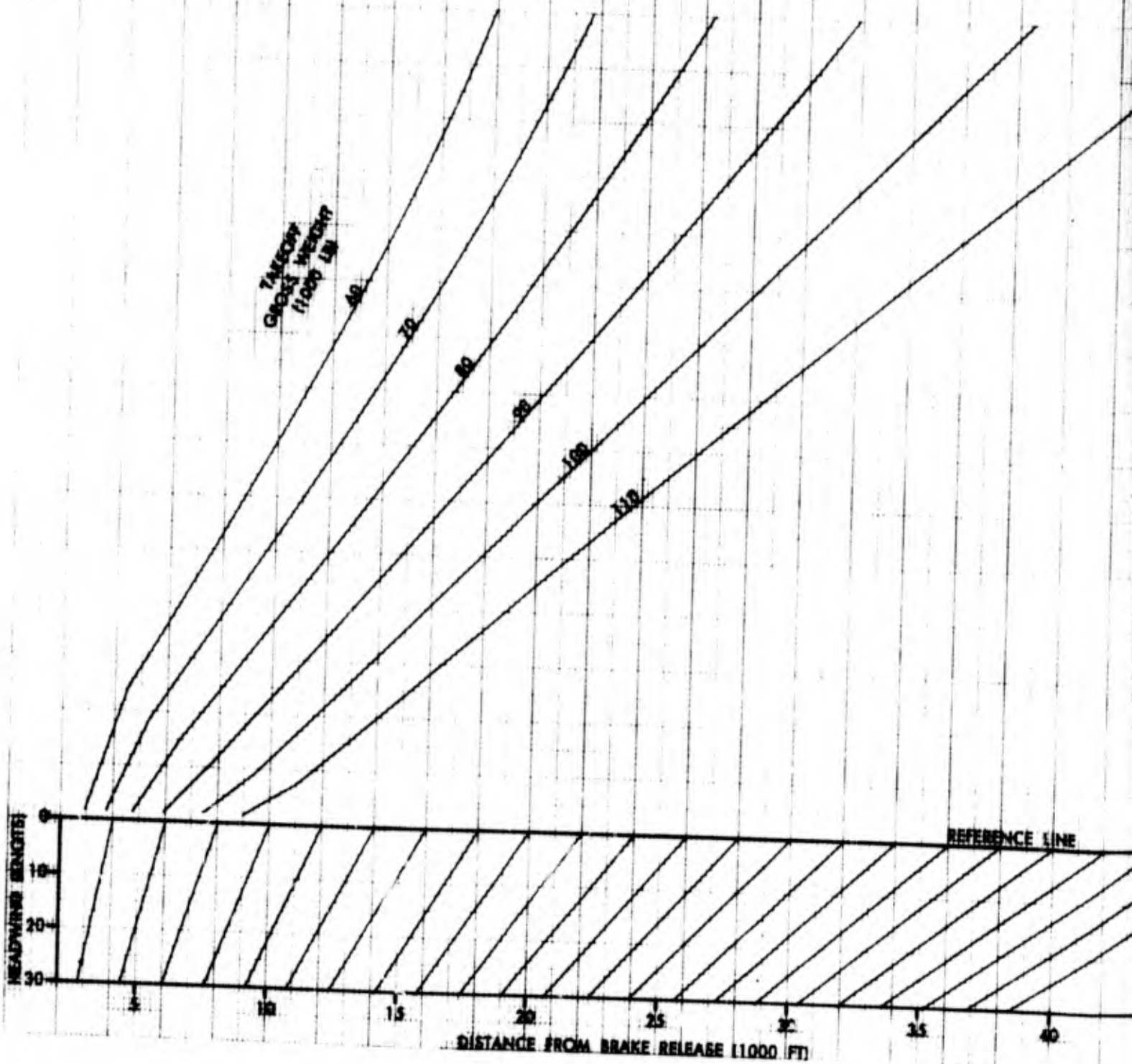
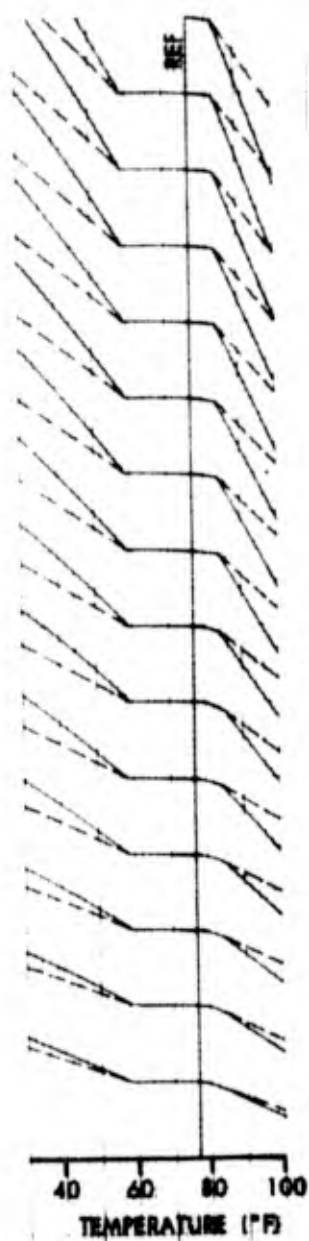


FIGURE 68.

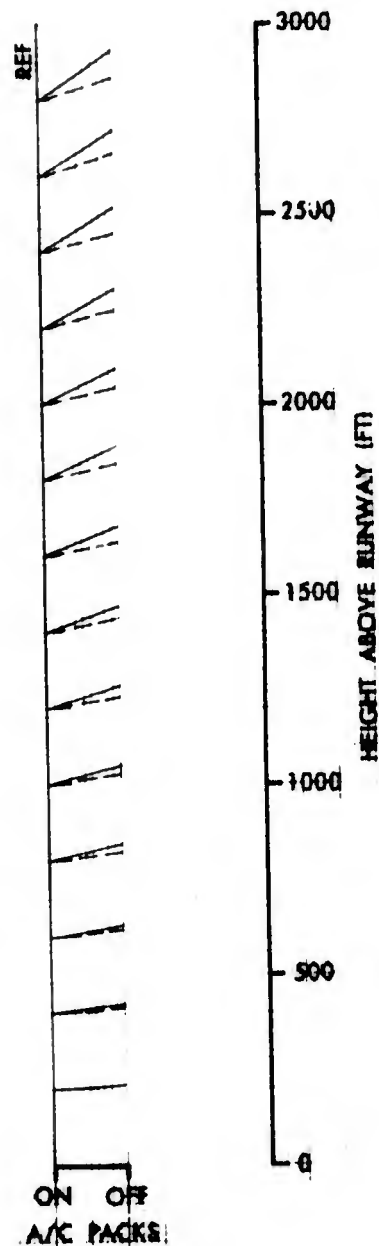
DC-9 SERIES 30
ALL ENGINE FLIGHT PA
4000 FT AIRPORT ALTITUDE
JT8D-9 ENGINES
15° FLAPS
CLIMB AT $V_2 + 10$ OR 15° P

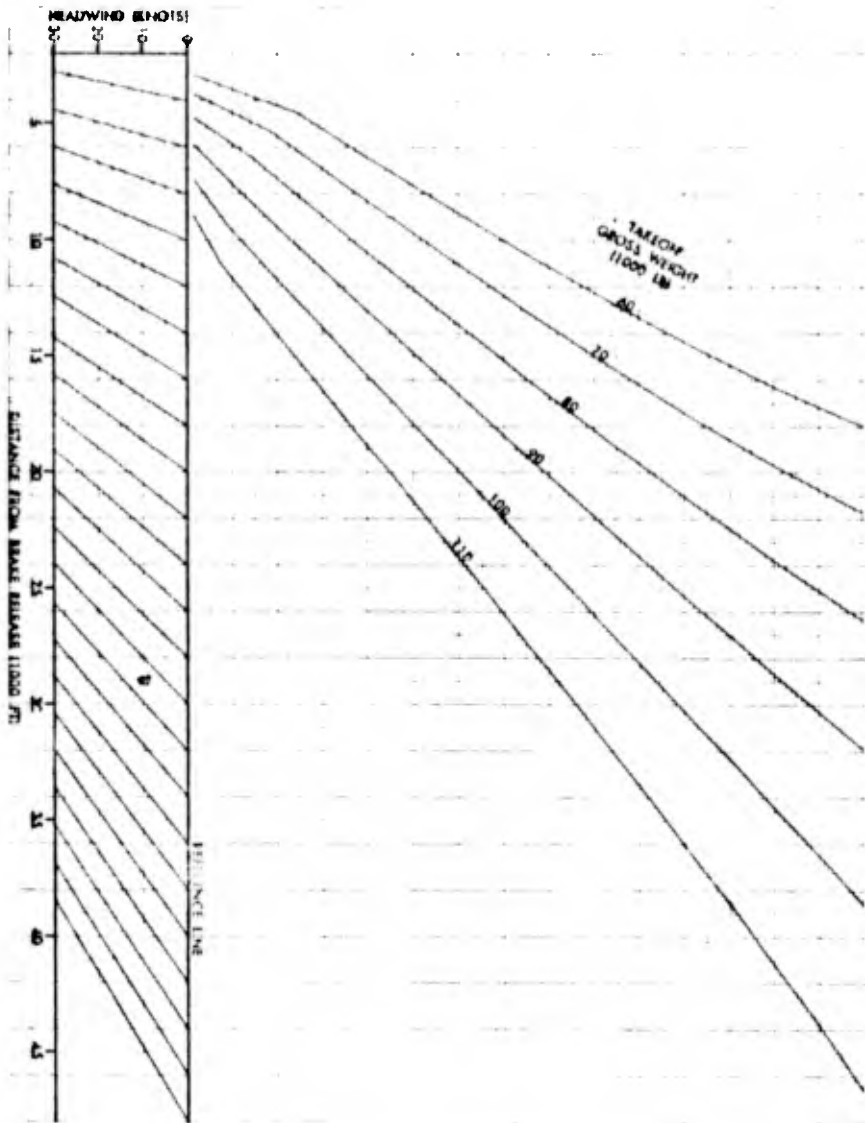


DC-9 SERIES 30
 ALL ENGINE FLIGHT PATH
 6000 FT AIRPORT ALTITUDE
 J180-9 ENGINES
 15° FLAPS
 AT $V_2 + 10$ OR 15° PITCH LIMIT



— 110,000 LB
 - - - 60,000 LB





DC-9 SERIES 30
ALL ENGINE FLIGHT PATH
6000 FT AS CR ALTITUDE
JETS ENGINES
15° FLAPS
CLIMB AT $V_2 + 10$ OR 15° PITCH LIMIT

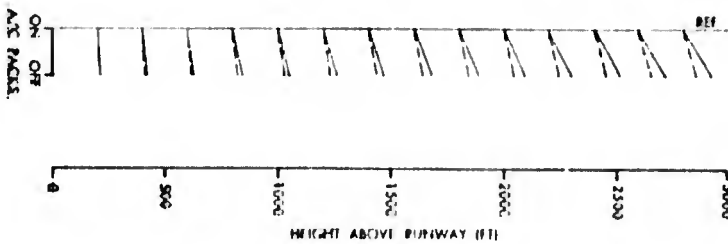
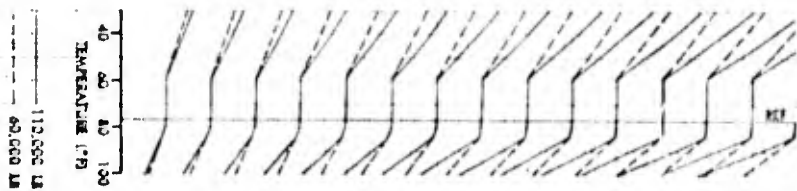


FIGURE 89

DC-9 SERIES 30
 $F_{N/0}$ AND AT CUT BACK
 JT8D-7-9 ENGINES
 FLAPS 5°
 SLATS EXTENDED

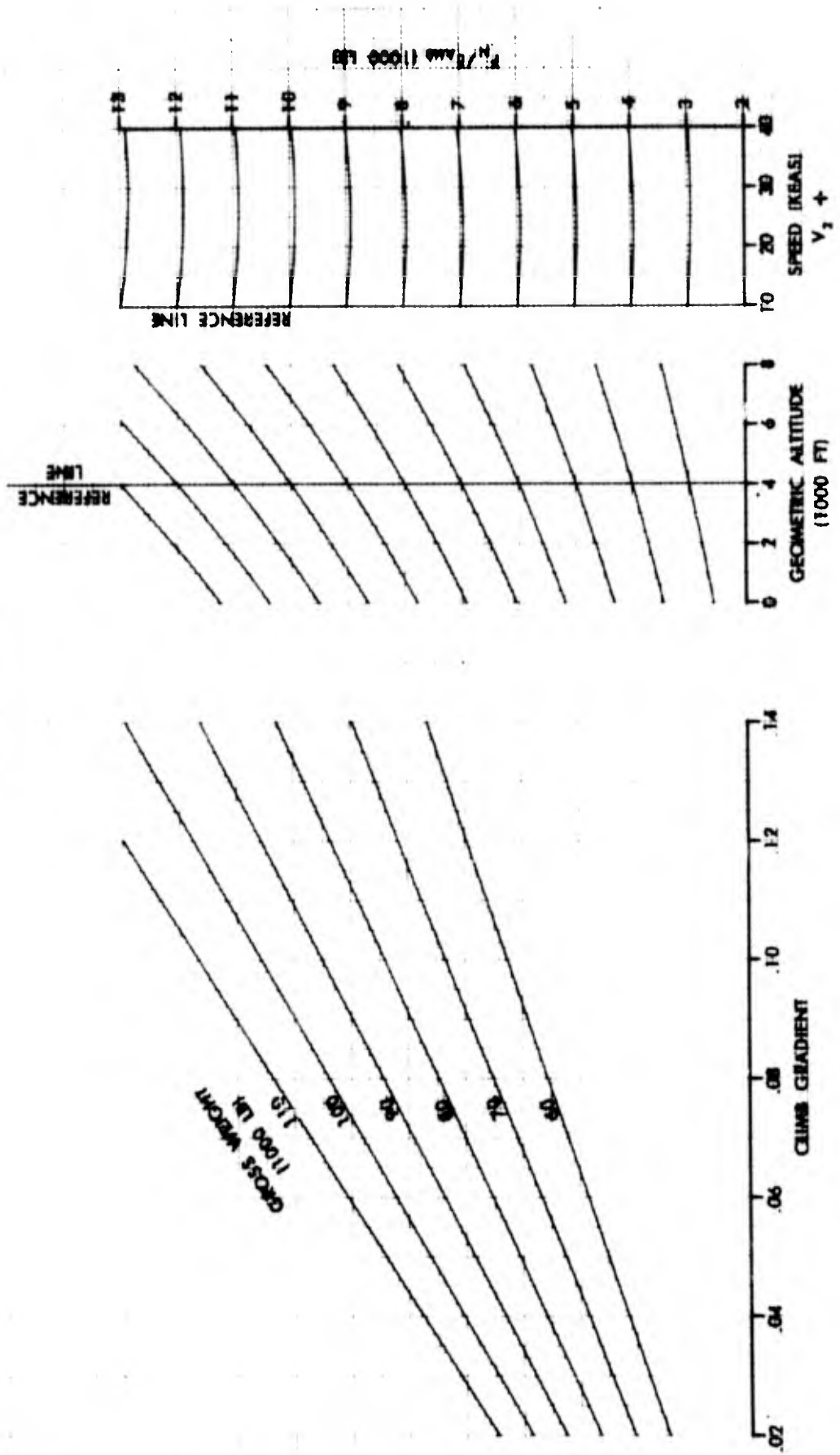


FIGURE 70.

DC-9 SERIES 30
 F_N/δ_{AMB} AT CUT BACK
 JT8D-7/-9 ENGINES
 FLAPS 15°
 SLATS EXTENDED

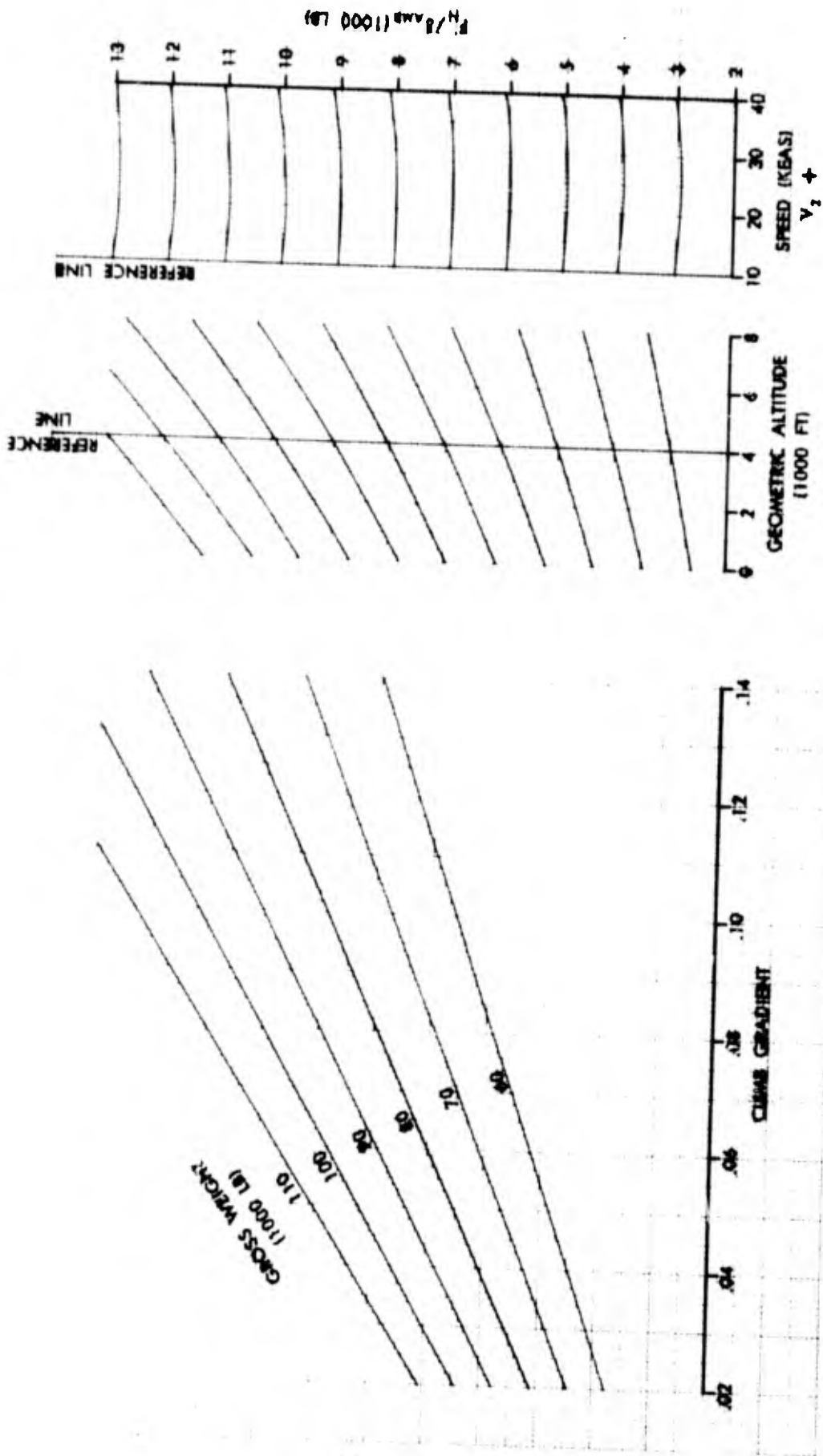


FIGURE 71.

DC-9 SERIES 30
 F_N/δ_{AMB} AT CUTBACK
 JT8D-7/9 ENGINES
 CLEAN CONFIGURATION
 250 KNOTS, IAS

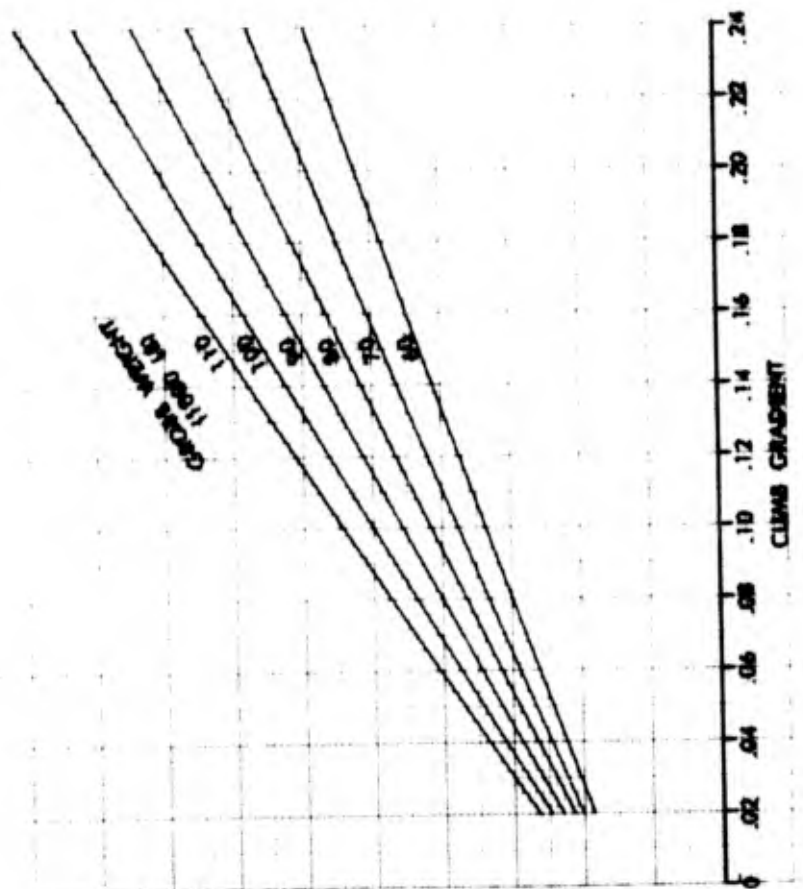
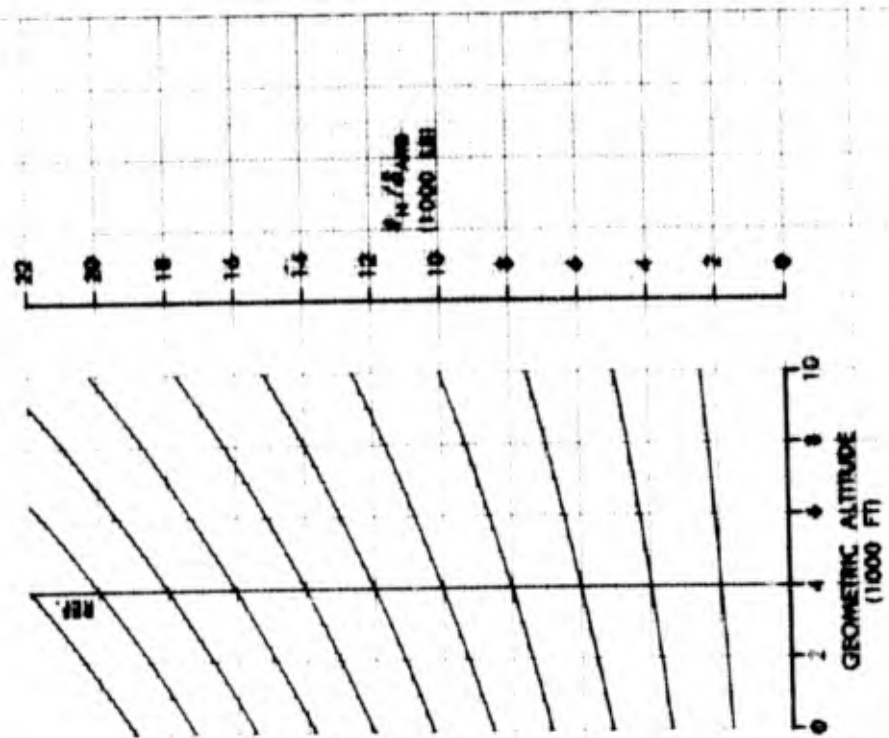


FIGURE 72.

**DC-9 SERIES 30
REFERRED FAN SPEED VS GUIDE SLOPE
JT8D-9 ENGINES
30° FLAPS**

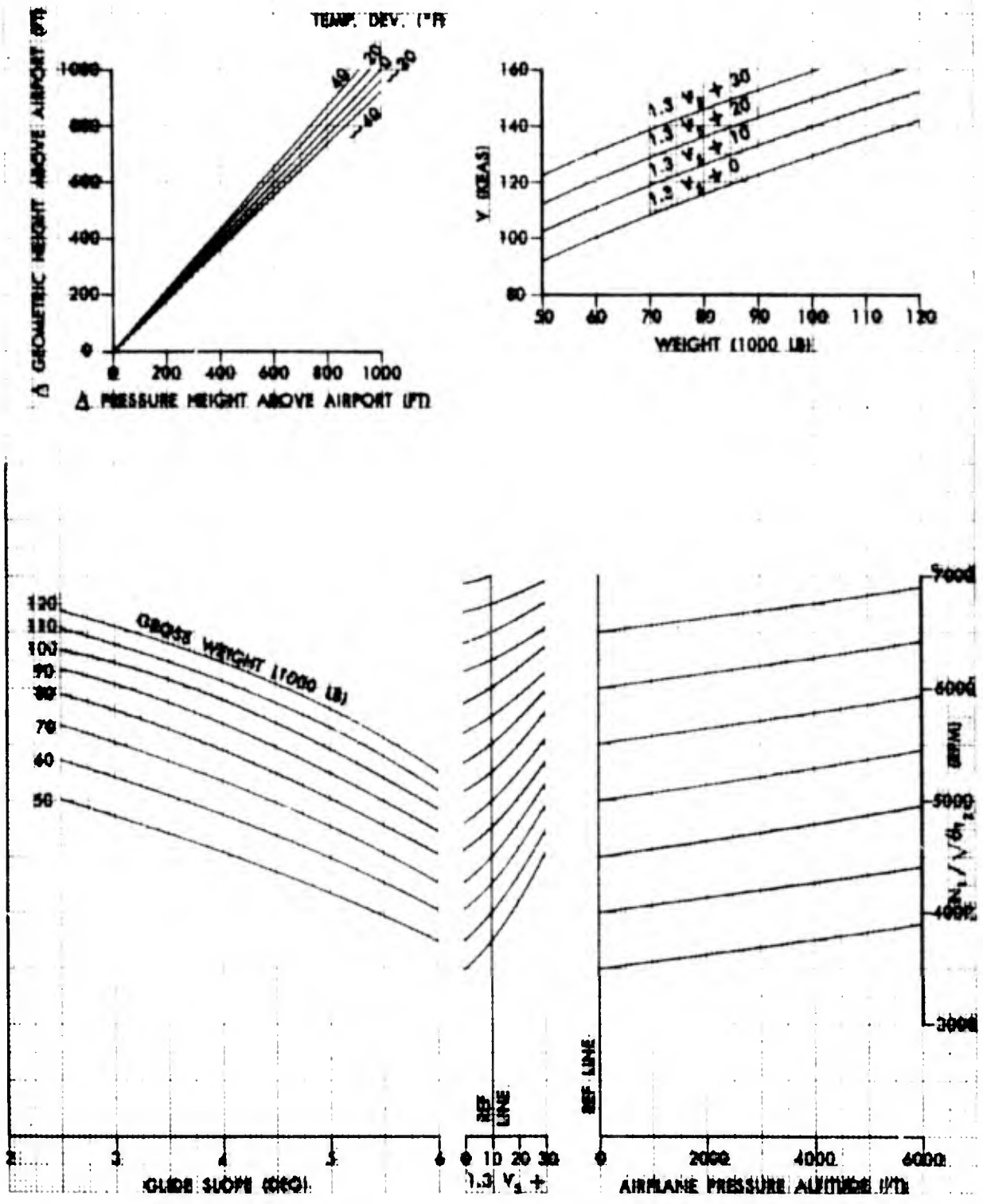


FIGURE 73.

MODEL DC-9 SERIES 30
 JTD-9 & -11 ENGINES
 INSTALLED NET THRUST

ENGINE OPERATION
 INSTALLATION EFFECTS, GENERATOR COOLING,
 POWER EXTRACTION AND AIR CONDITIONING
 SEA LEVEL TO 35,000 FEET

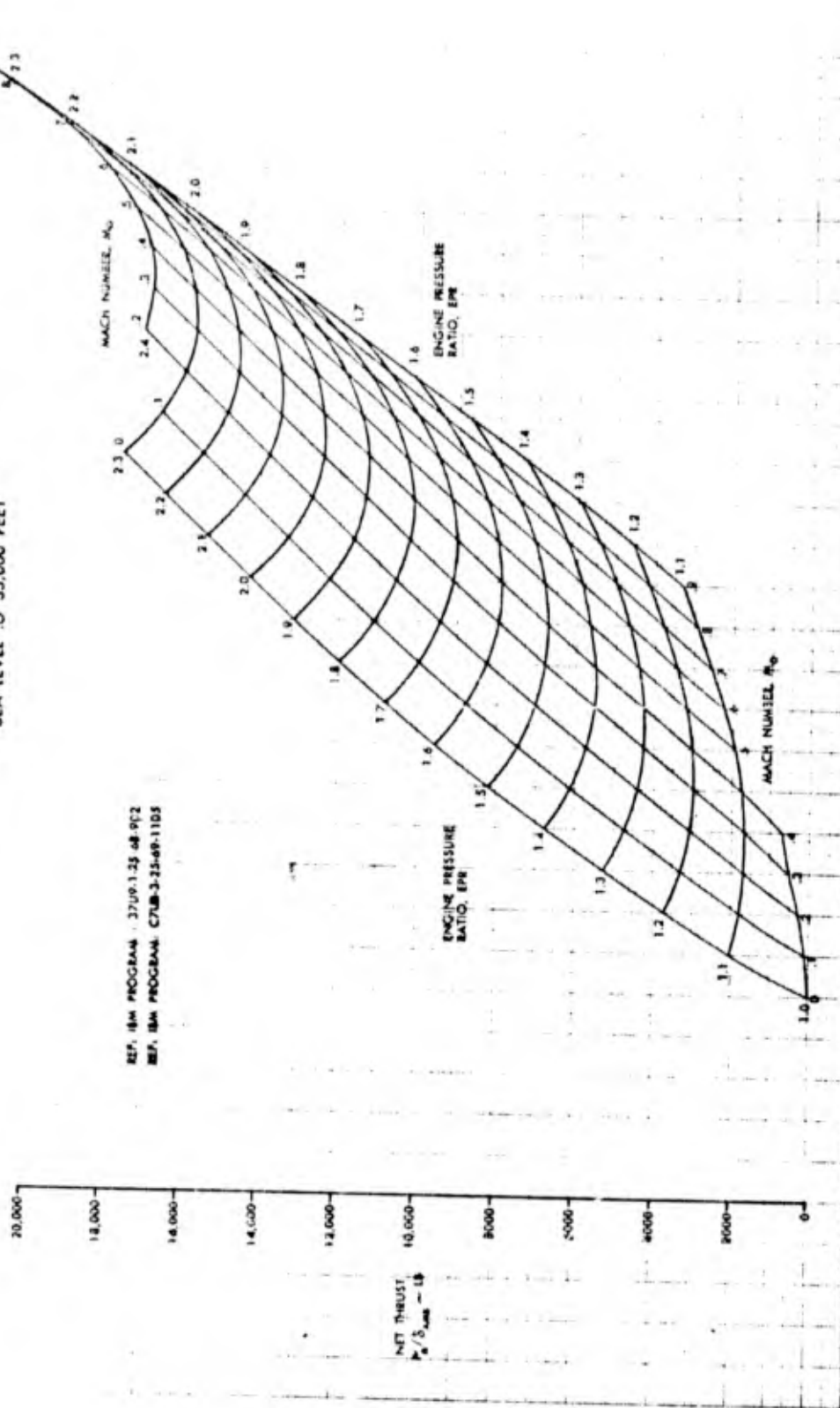
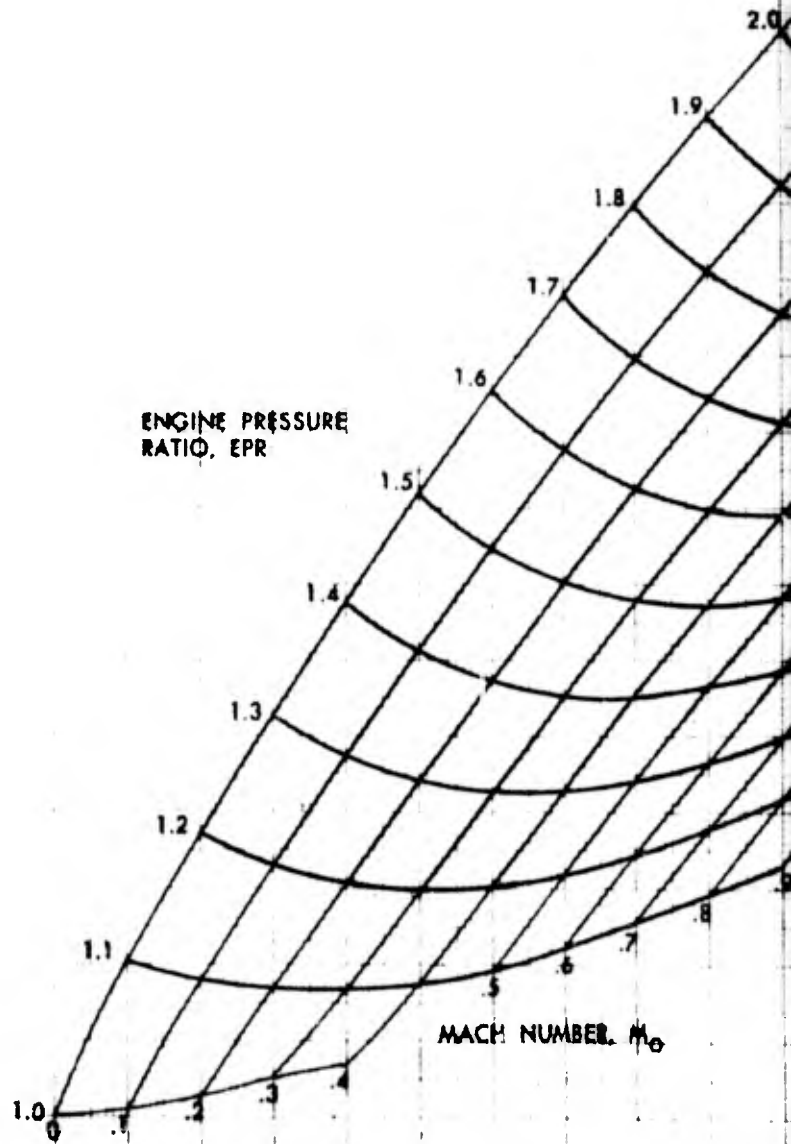
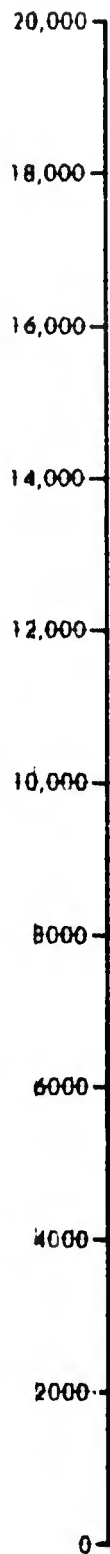


FIGURE 74.

MODEL DC-9 SERIES
 JTBD 7 & -11 ENGINE
 INSTALLED NET THRUST
 2 ENGINE OPERATION
 INSTALLATION EFFECTS: GENERAL
 POWER EXTRACTION AND AIR
 SEA LEVEL TO 35,000

REF: IBM PROGRAM : 37U9-1-25-68-902
 REF: IBM PROGRAM: C7UB-3-25-69-1105

NET THRUST
 $F_n / \delta_{AMB} \sim LB$



**MODEL DC-9 SERIES 30
JTBD-9 & -11 ENGINES
INSTALLED NET THRUST**

**2 ENGINE OPERATION
INSTALLATION EFFECTS: GENERATOR COOLING,
POWER EXTRACTION AND AIR CONDITIONING
SEA LEVEL TO 35,000 FEET**

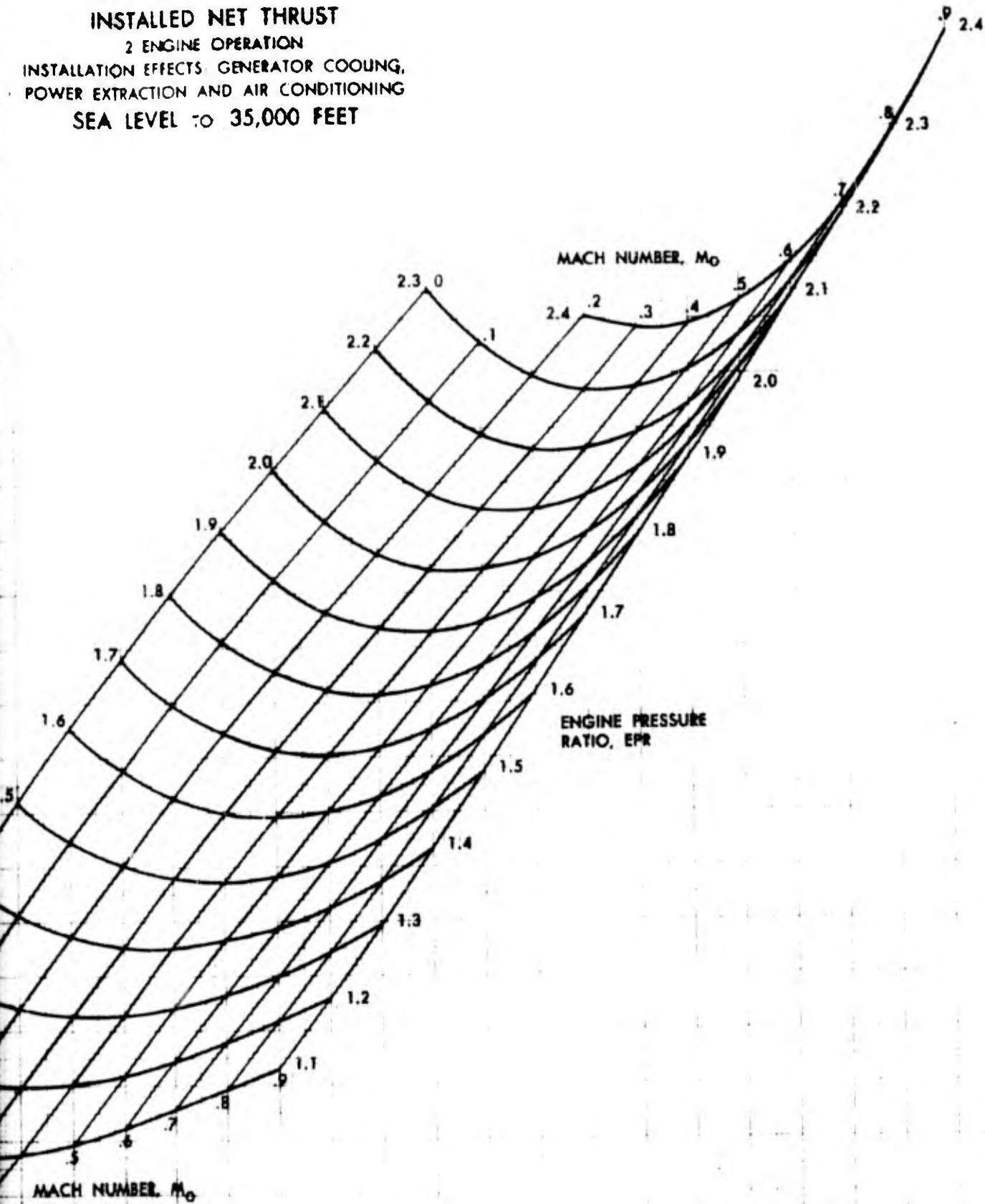


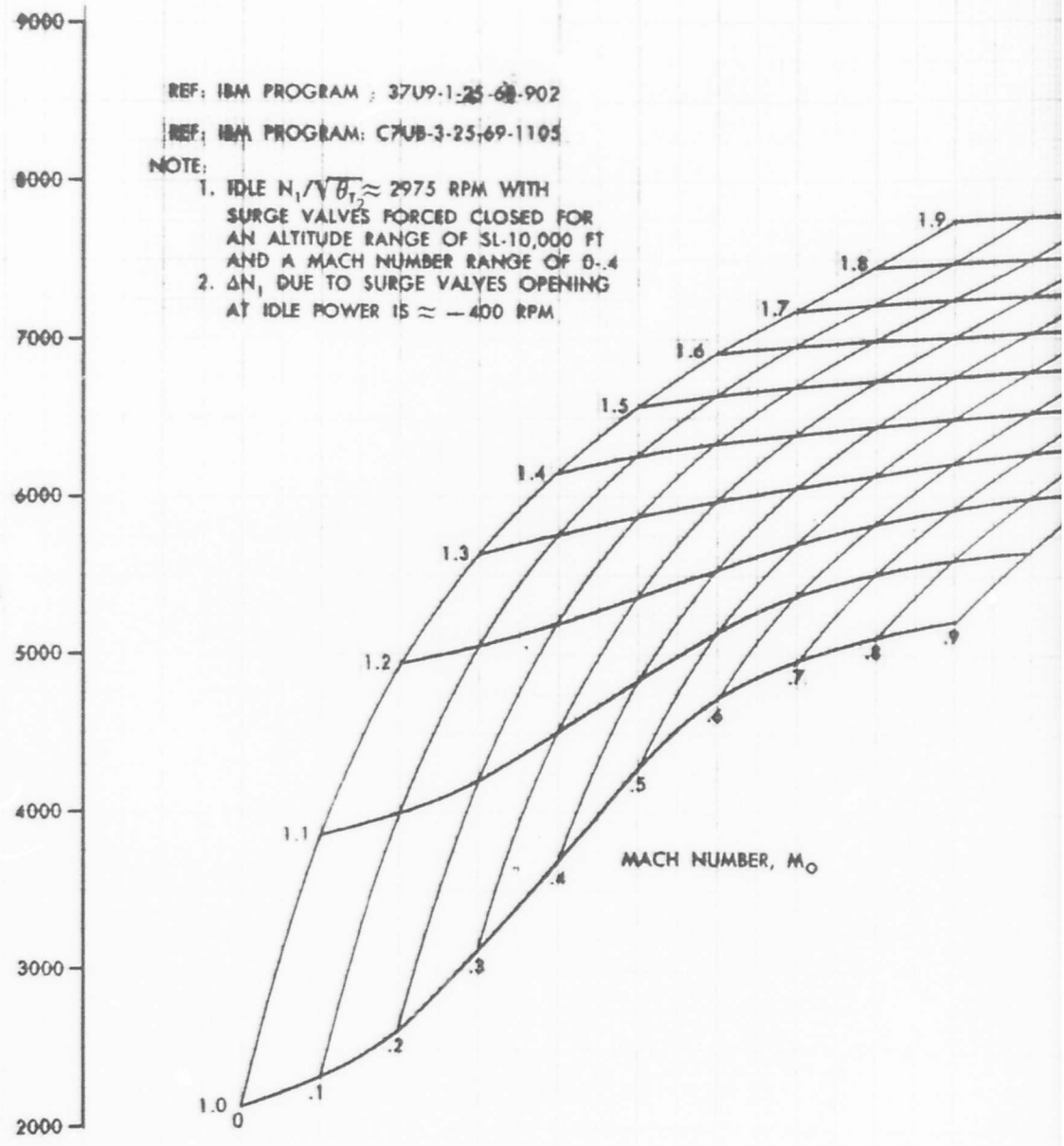
FIGURE 74

MODEL DC-9 SERIES 20
 J1109 & J11 EN2
 INSTALLED LOW PRESSURE
 2 ENGINE OPERATION
 INSTALLATION EFFECTS: GENERATOR
 POWER EXTRACTION AND AIR COOLING
 SEA LEVEL TO 35,000
 SURGE VALVES CLOSED

REF: IBM PROGRAM : 37U9-1-25-68-902
 REF: IBM PROGRAM: C7UB-3-25-69-1105

- NOTE:
1. IDLE $N_1/\sqrt{\theta_{T_2}} \approx 2975$ RPM WITH SURGE VALVES FORCED CLOSED FOR AN ALTITUDE RANGE OF SL-10,000 FT AND A MACH NUMBER RANGE OF 0-.4
 2. ΔN_1 DUE TO SURGE VALVES OPENING AT IDLE POWER IS ≈ -400 RPM

ROTOR SPEED,
 $N_1/\sqrt{\theta_{T_2}} \sim$ RPM



8

DC-9 SERIES 30, 30 & 40
7000 P & 11 ENGINES
LOW PRESSURE ROTOR SPEED
2 ENGINE OPERATION
OPERATION EFFECTS: GENERATOR COOLING,
EXTRACTION AND AIR CONDITIONING
SEA LEVEL TO 35,000 FEET
SURGE VALVES CLOSED

AIR CONDITIONING "ON"

ENGINE PRESSURE
RATIO, EPR

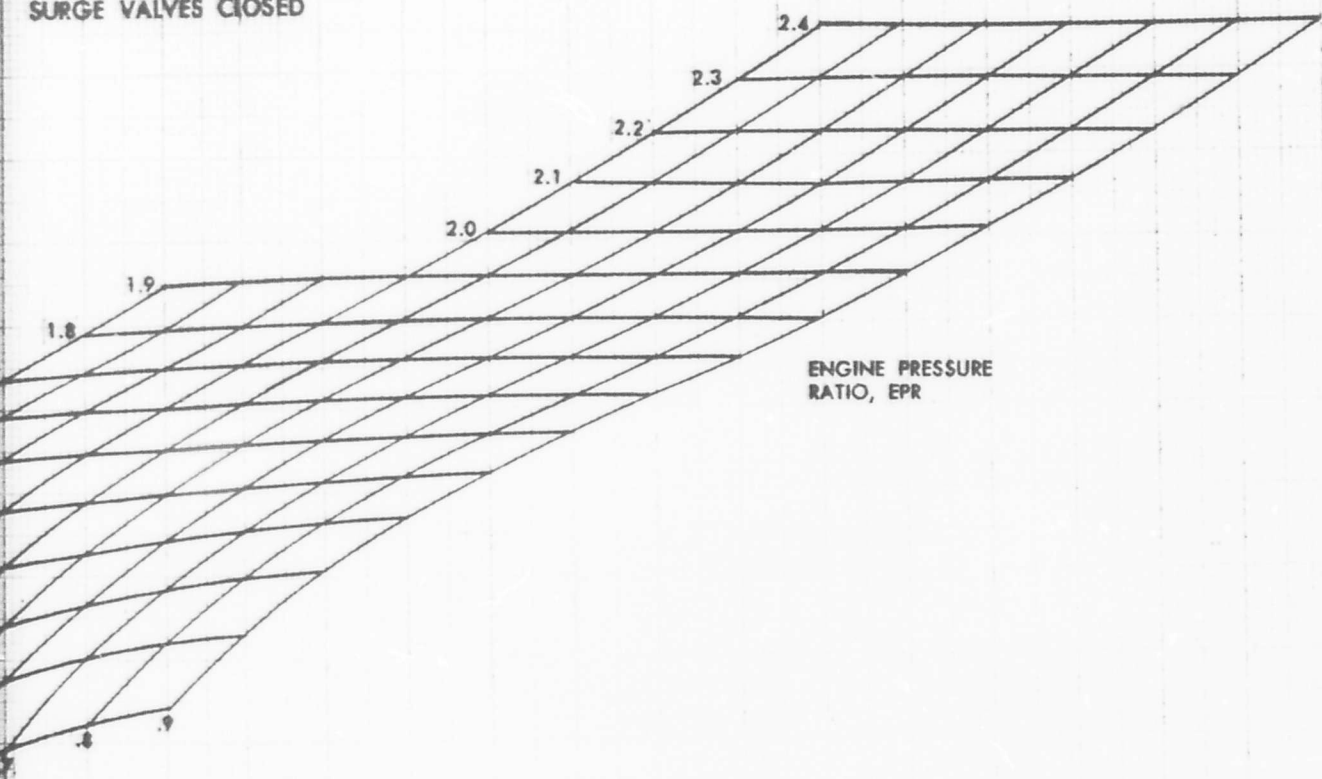


FIGURE 75.

MO-100-27
 1. ENGINE OPERATION
 2. ENGINE OPERATION
 3. ENGINE OPERATION
 4. ENGINE OPERATION
 5. ENGINE OPERATION
 6. ENGINE OPERATION
 7. ENGINE OPERATION
 8. ENGINE OPERATION
 9. ENGINE OPERATION
 10. ENGINE OPERATION
 11. ENGINE OPERATION
 12. ENGINE OPERATION
 13. ENGINE OPERATION
 14. ENGINE OPERATION
 15. ENGINE OPERATION
 16. ENGINE OPERATION
 17. ENGINE OPERATION
 18. ENGINE OPERATION
 19. ENGINE OPERATION
 20. ENGINE OPERATION
 21. ENGINE OPERATION
 22. ENGINE OPERATION
 23. ENGINE OPERATION
 24. ENGINE OPERATION

INSTALLED LOW PRESSURE MOTOR SPEED
 POWER EXTRACTION AND AIR CONDITIONING
 SEA LEVEL TO 35,000 FEET
 SURGE VALVES CLOSED

REF. IBM PROGRAM : 2709-125-08 902
 REF. IBM PROGRAM : CN8-2254P-1102
 NOTE:
 1. IDLE N/\sqrt{g} = 2675 RPM WITH SURGE VALVES FORCED CLOSED FOR AN ALTITUDE RANGE OF 31,000 FT AND A MACH NUMBER RANGE OF 0.4
 2. ΔN , DUE TO SURGE VALVES OPENING AT IDLE POWER IS ≈ -400 RPM

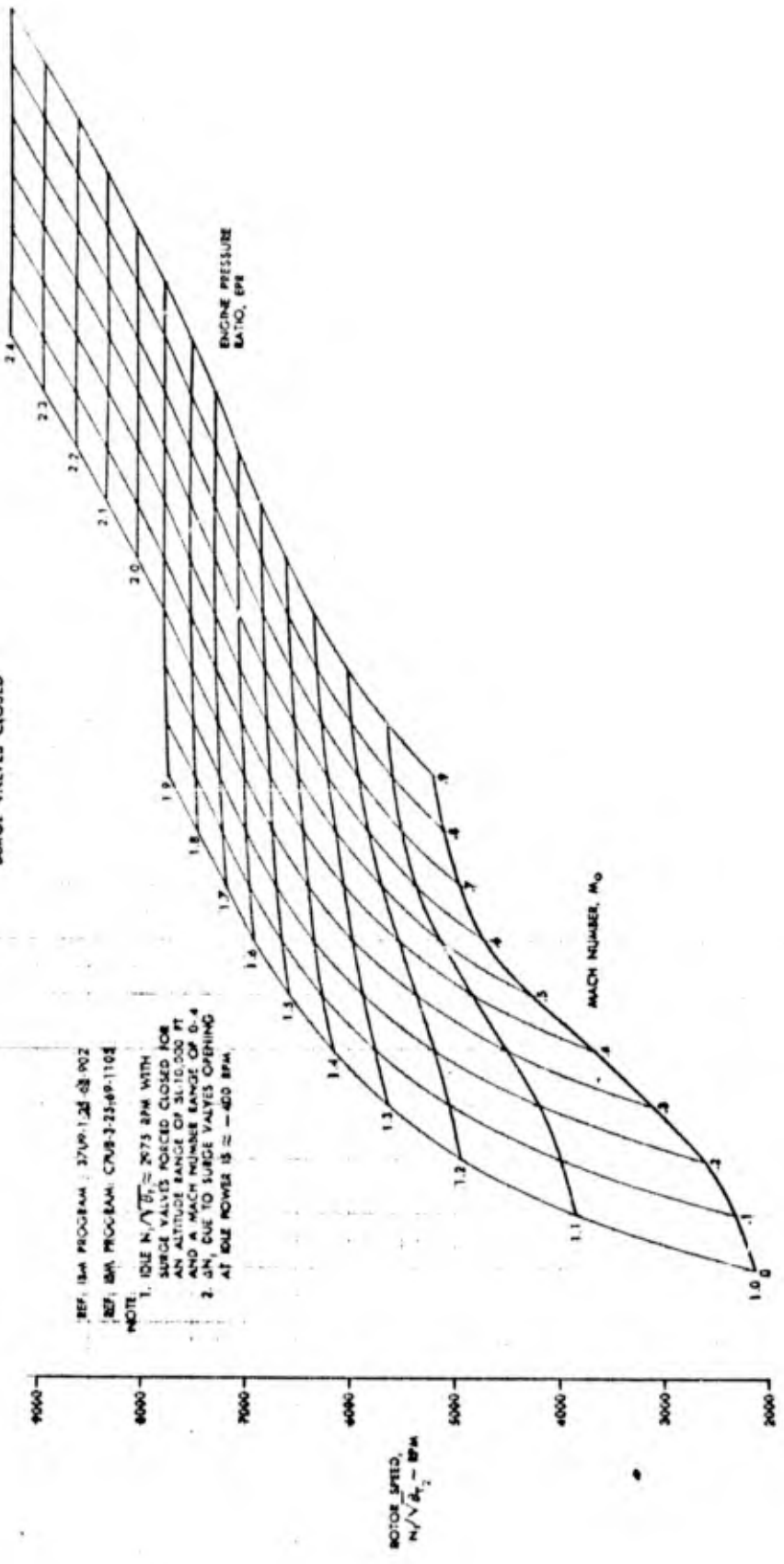


FIGURE 75

2.7 DC-10-10

2.7.1 Aircraft Description

The DC-10-10, shown in Figure 76, is the domestic version of the series of the Douglas wide-bodied fan-jets, and is powered by three high-bypass-ratio CF6-6D engines manufactured by the General Electric Company. The maximum takeoff gross weight is 440,000 pounds and the maximum landing gross weight is 363,500 pounds. Figure 77 shows a dimensioned three-view drawing of the aircraft. The seating capacity (high density) is 380.

The CF6-6D has a maximum thrust rating of 40,000 pounds, flat rated to 88°F. The bypass ratio is 5.86. The referred fan speed of 3420 rpm, noted on the noise curves, is representative of the takeoff power setting.

2.7.2 Acoustic Data

Figures 78 and 79 present plots of EPNL and A-weighted sound level for five power settings in terms of referred fan speed ranging from takeoff to approach power. The curves are based on data acquired during the FAA noise certification test described in Reference 3 and during a Douglas-funded flyover noise survey conducted at Brown Field, California.

Figures 80 through 82 present the takeoff flight-path data for a continuous range of flap settings from 0 to 20 degrees for the various runway altitudes. These data combined with the data from the plots in Figures 83 and 84, the cutback charts, and in Figures 78 and 79, the noise curves, will provide the aircraft noise levels. Approach data are found in Figures 85 and 86 for 50- and 35-degree flaps, respectively. Figure 87 presents curves relating thrust and fan speed.

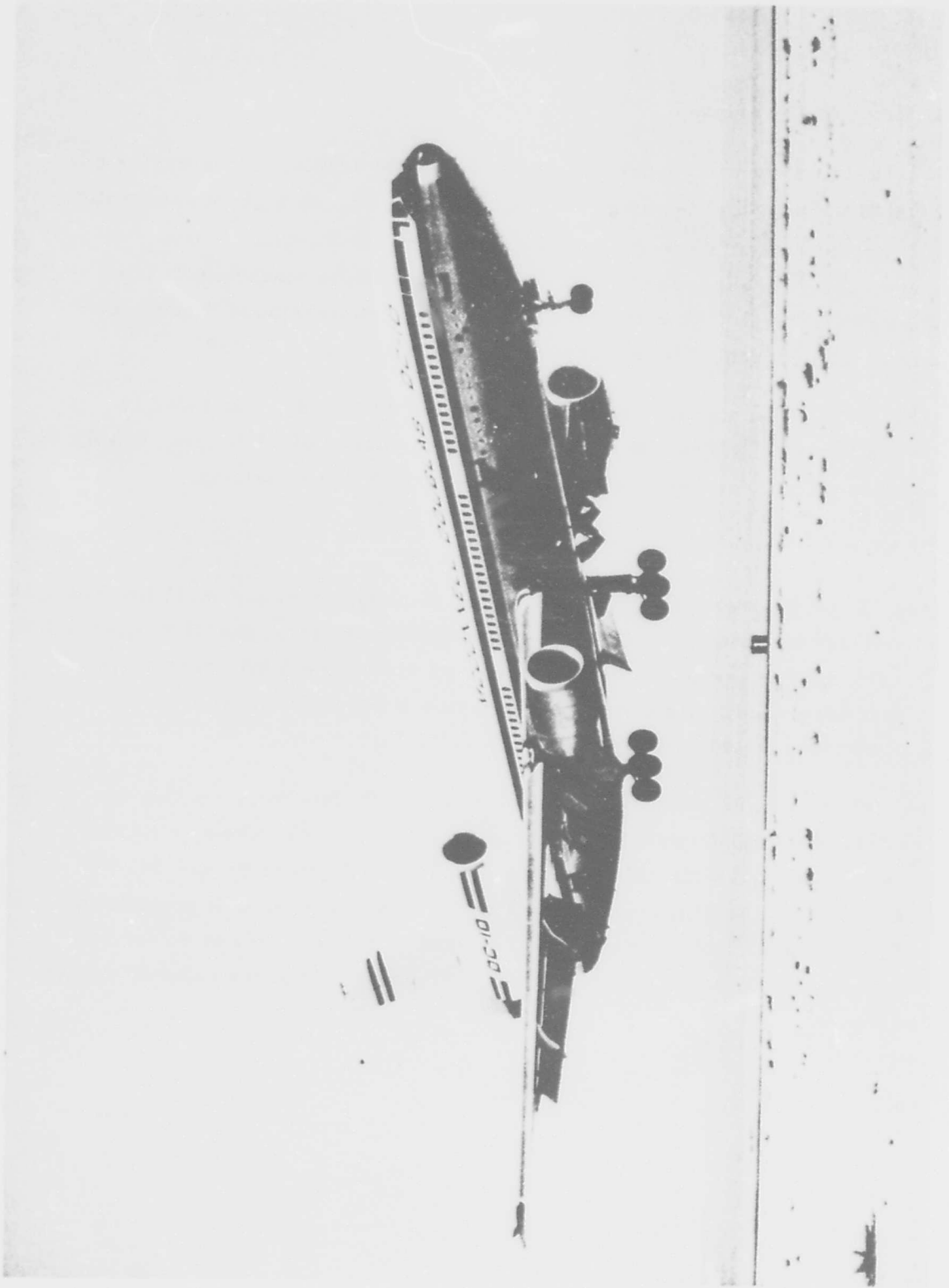


FIGURE 76.

WING

SPAN - OVERALL 155 FT 4 IN
 AREA - TOTAL 2850 SQ FT
 AREA - CHORD 1715 SQ FT
 TIP CHORD 124.548 IN
 DIHEDRAL 6°
 ADAPT ASY/O 6.8
 MOUNTING 30°
 FLAPS - T/T/S 30°/48.2° IN
 DOUBLE SLOTTED

TAIL

HORIZONTAL

AREA 1328.256 SQ FT
 CHORD 30°
 SPAN 77 FT 2 IN
 VERTICAL

AREA 805 SQ FT
 CHORD 40°
 FROM GROUND 8 FT 1 IN

FUSELAGE

OUTSIDE DIAMETER 237 IN
 FUSELAGE LENGTH 170 FT 8 IN
 LENGTH - OVERALL 181 FT 8 IN

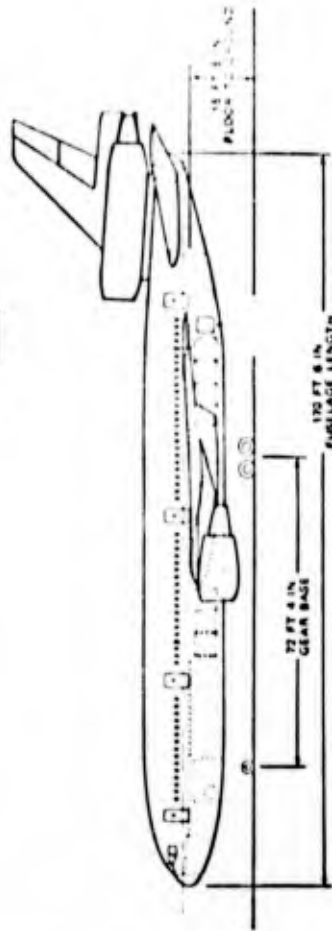
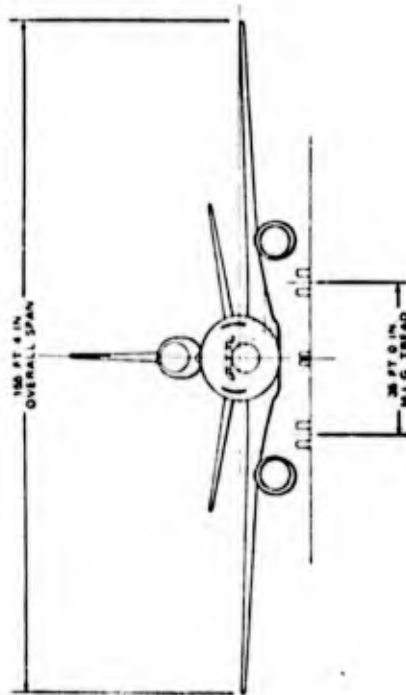
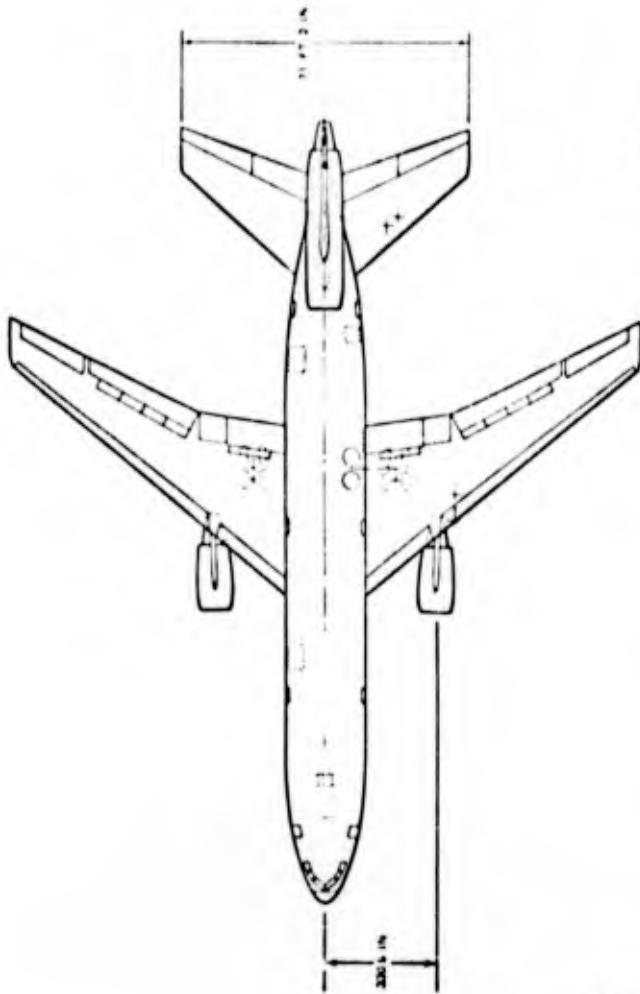


FIGURE 7H DC-15-10

WING

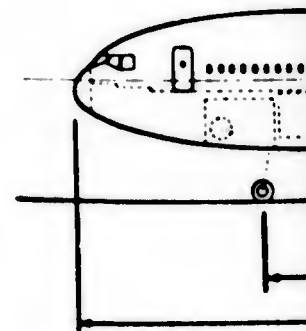
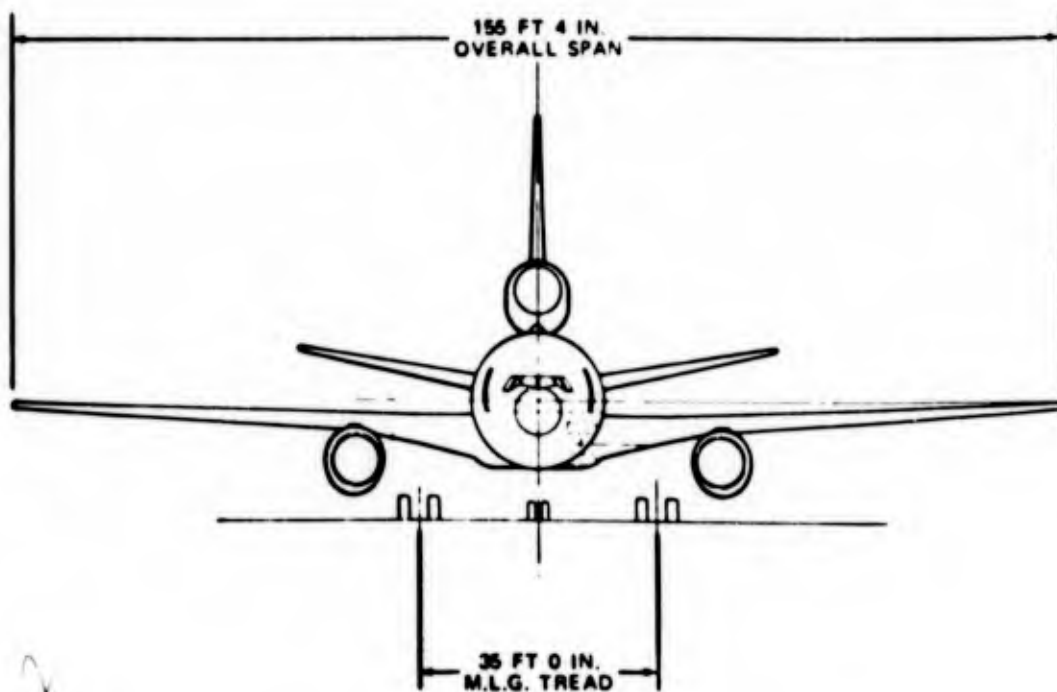
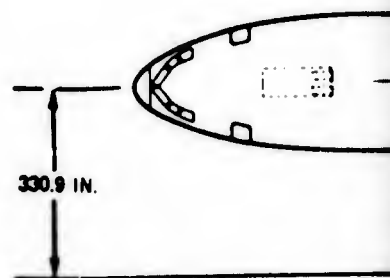
SPAN - OVERALL	155 FT 4 IN.
AREA - TOTAL	3650 SQ FT
ROOT CHORD	421.820 IN.
TIP CHORD	128.546 IN.
DIHEDRAL	6°
ASPECT RATIO	6.8
SWEEPBACK	35°
M.A.C. (TRUE)	300.682 IN.
FLAPS - TYPE	DOUBLE-SLOTTED

TAIL

HORIZONTAL	
AREA	1338.256 SQ FT
DIHEDRAL	10°
SWEEPBACK	35°
SPAN	71 FT 2 IN.
VERTICAL	
AREA	605 SQ FT
SWEEPBACK	40°
TOP OF FIN	
FROM GROUND	58 FT 1 IN.

FUSELAGE

OUTSIDE DIAMETER	237 IN.
FUSELAGE LENGTH	170 FT 6 IN.
LENGTH - OVERALL	181 FT 5 IN.



R

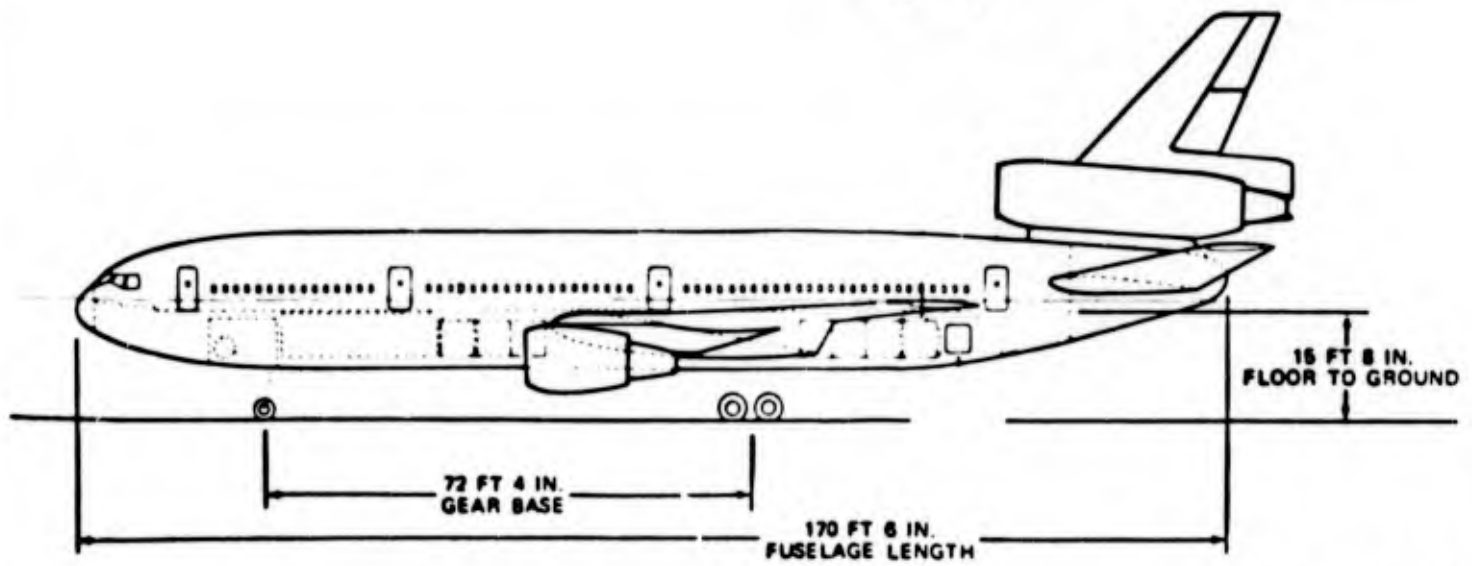
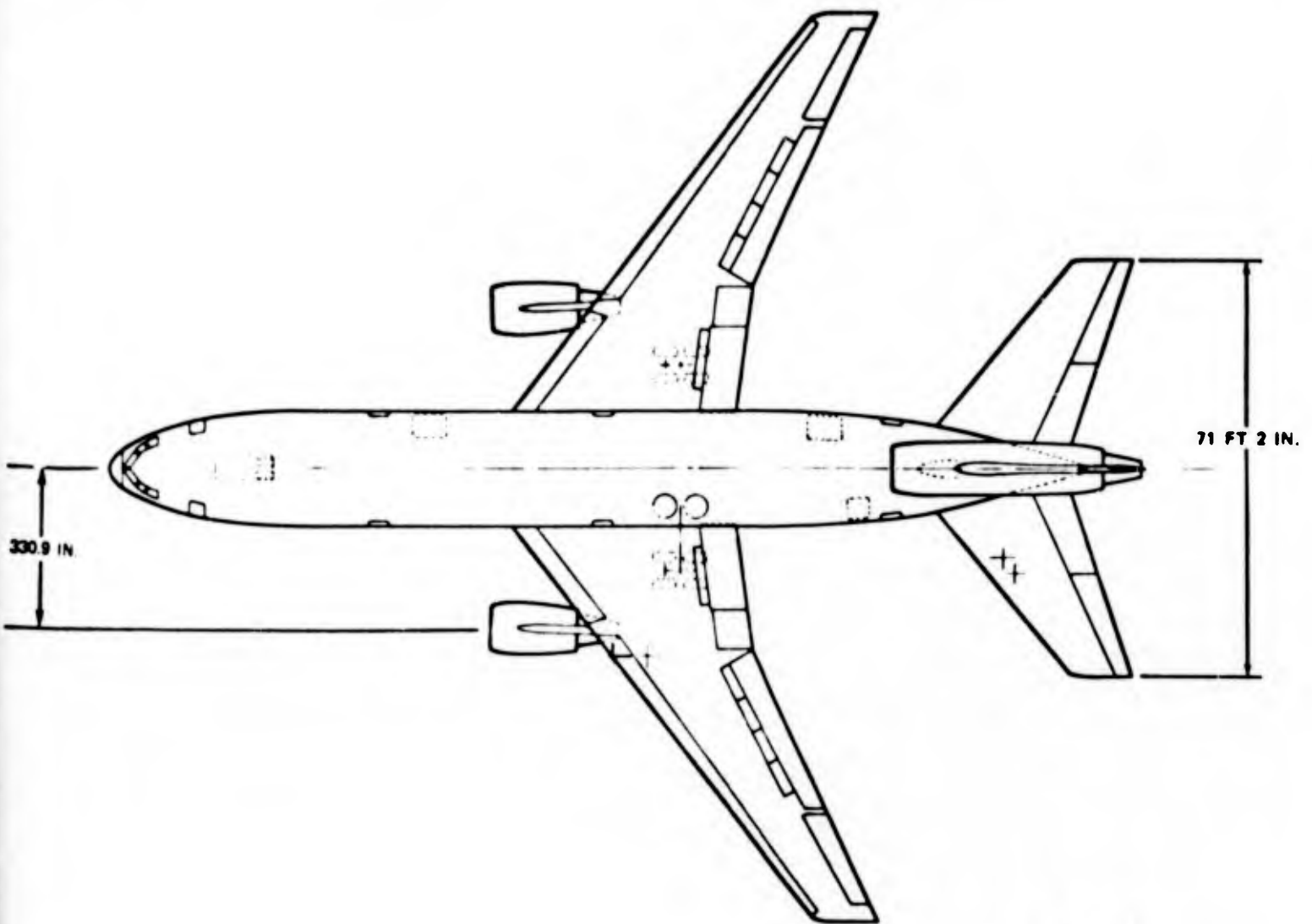


FIGURE 77. DC-10-10

DATE AUGUST 30 1973

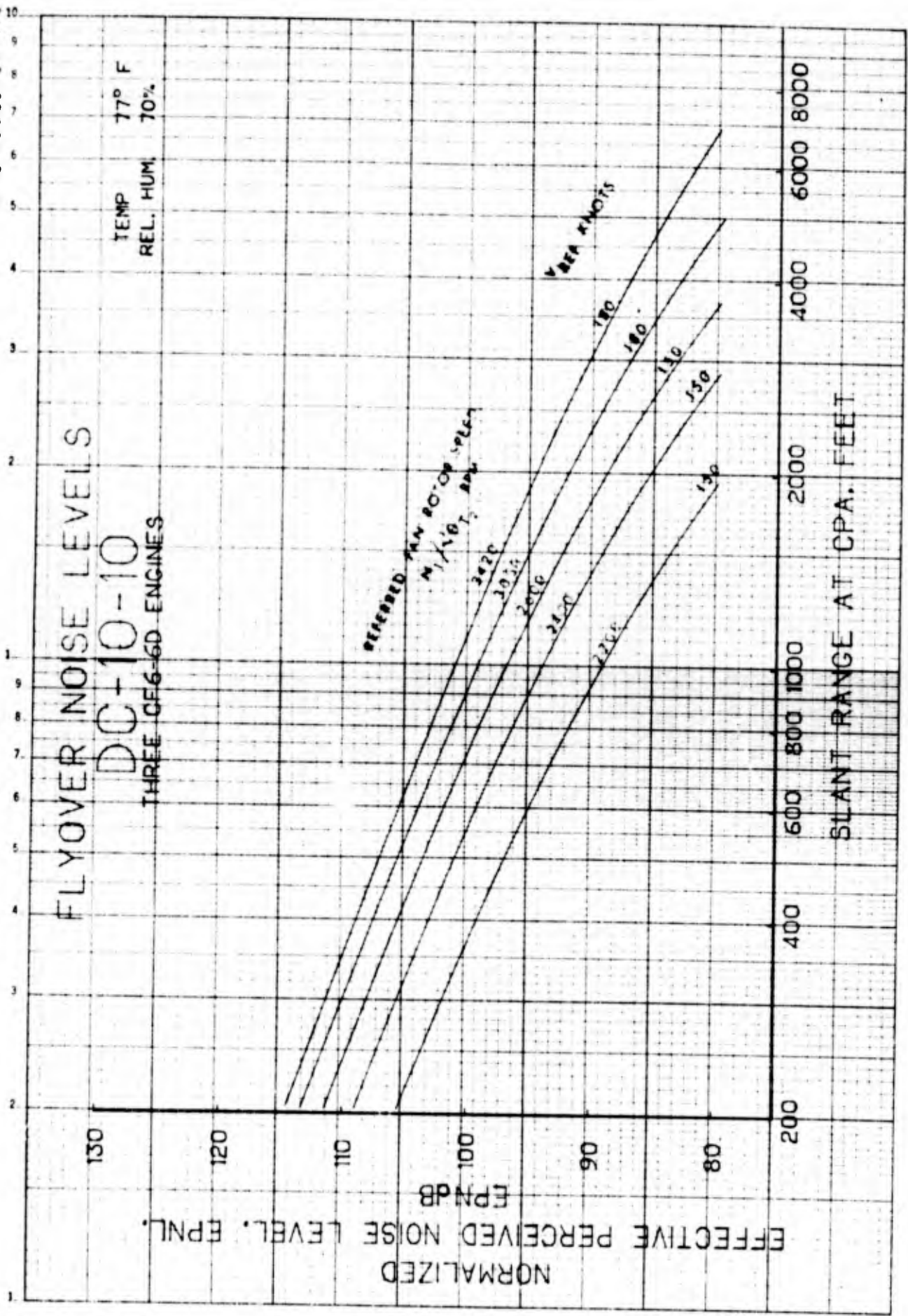


FIGURE 78.

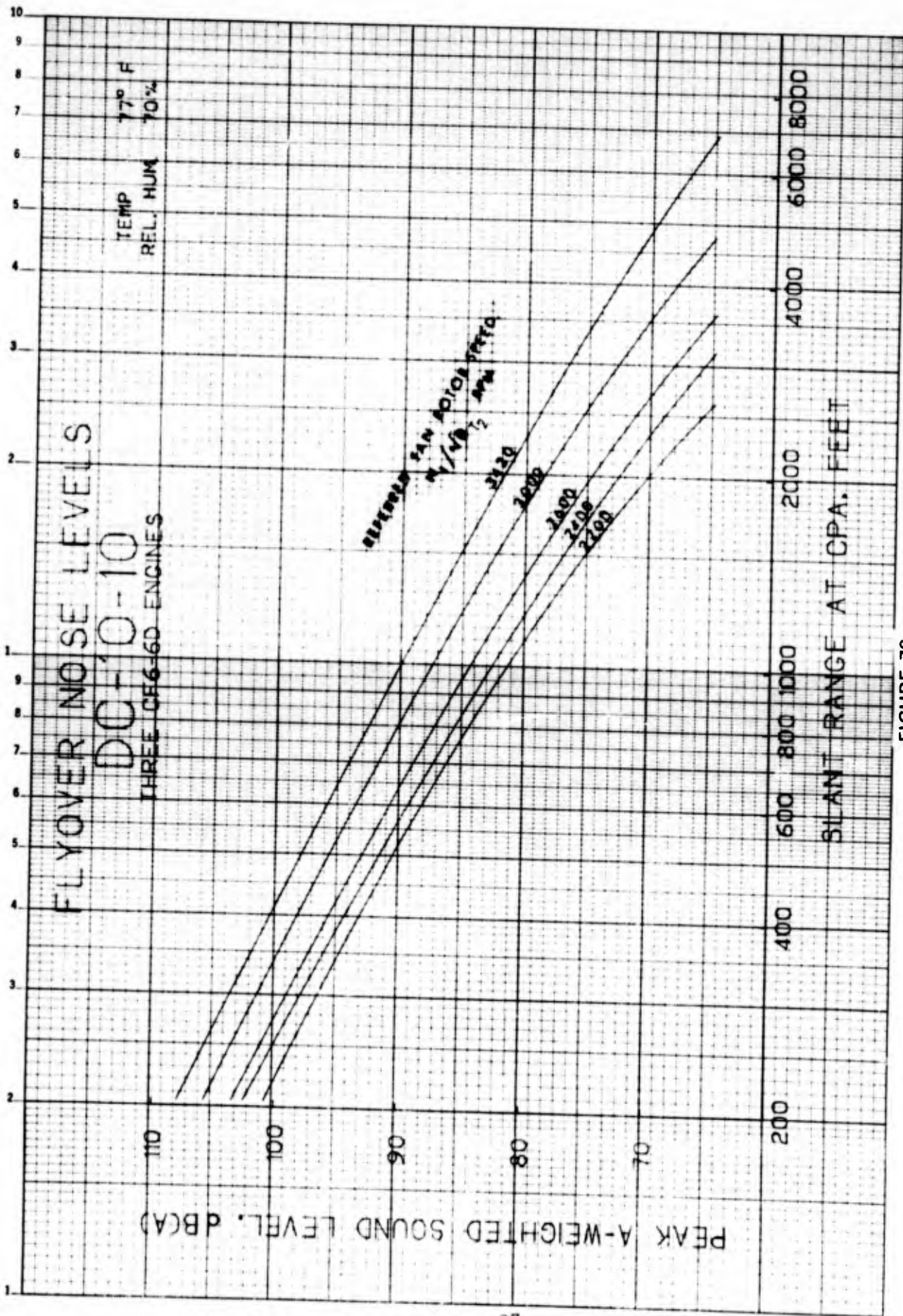
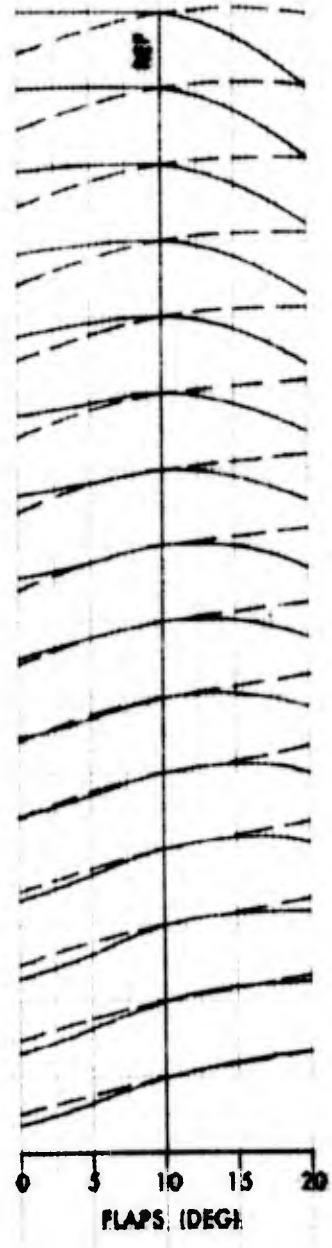
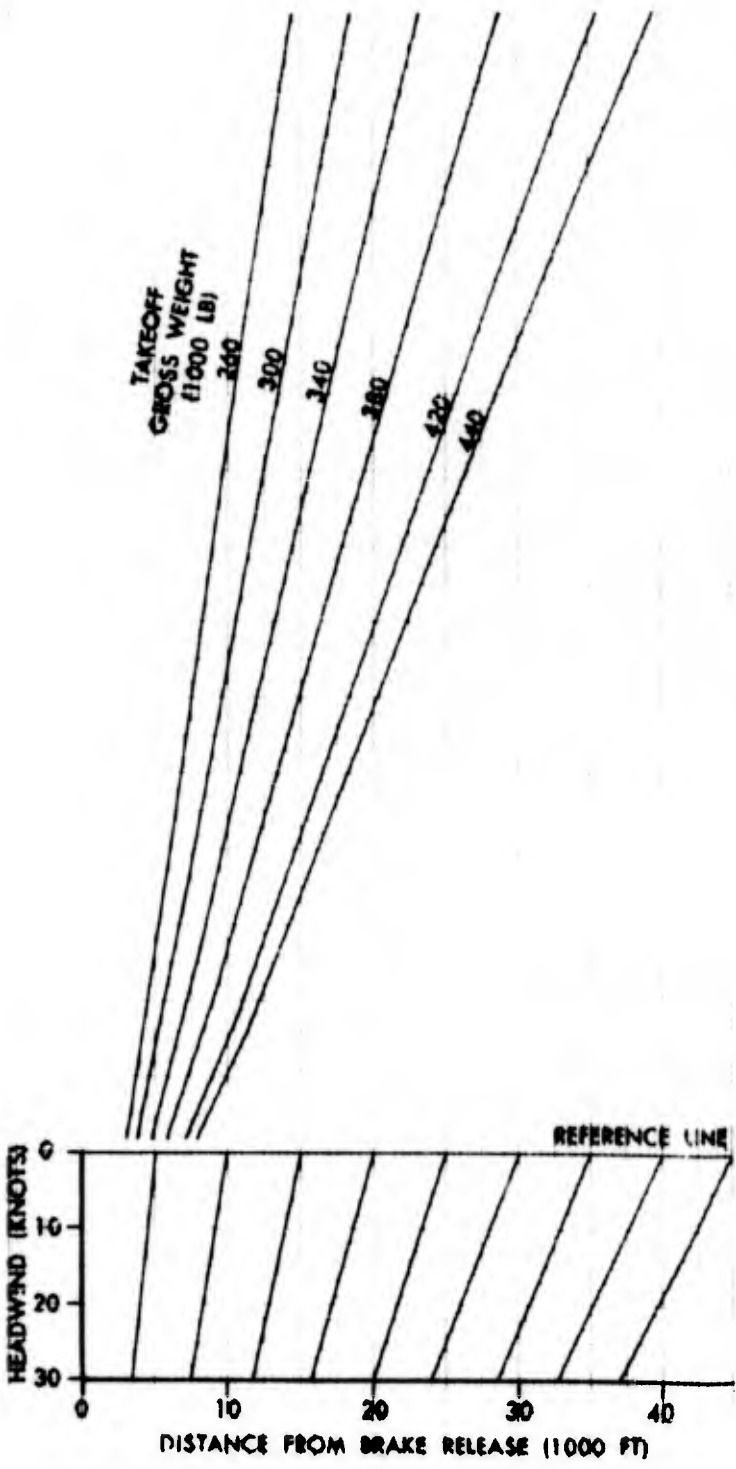
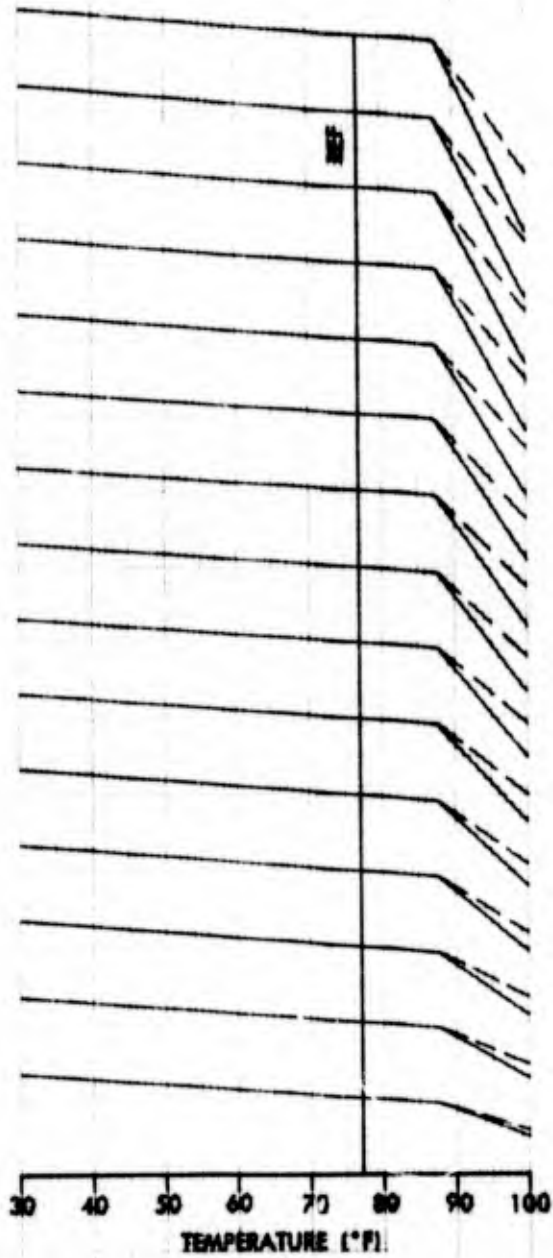


FIGURE 79.

DC-10 SERIES 10
 ALL ENGINE FLIGHT
 SEA LEVEL AIRPORT ALTITUDE
 CF6-40 ENGINES
 0°-20° FLAPS
 CLIMB AT $V_2 + 10$



DC-10 SERIES 10
 ENGINE FLIGHT PATH
 SEA LEVEL AIRPORT ALTITUDE
 CFM-40 ENGINES
 0°-20° FLAPS
 CLIMB AT $V_2 + 10$



----- 260,000 LB
 _____ 440,000 LB

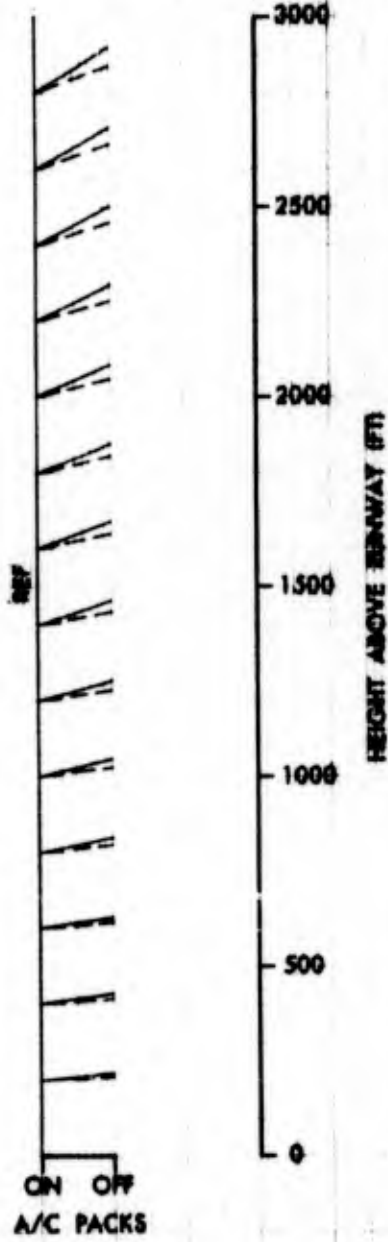


FIGURE 80.

B

DC-10 SERIES 10
 ALL ENGINE FLIGHT PATH
 SEA LEVEL AIRPORT ALTITUDE
 C-900 ENGINES
 0°-20° FLAPS
 CLIMB AT $V_2 + 10$

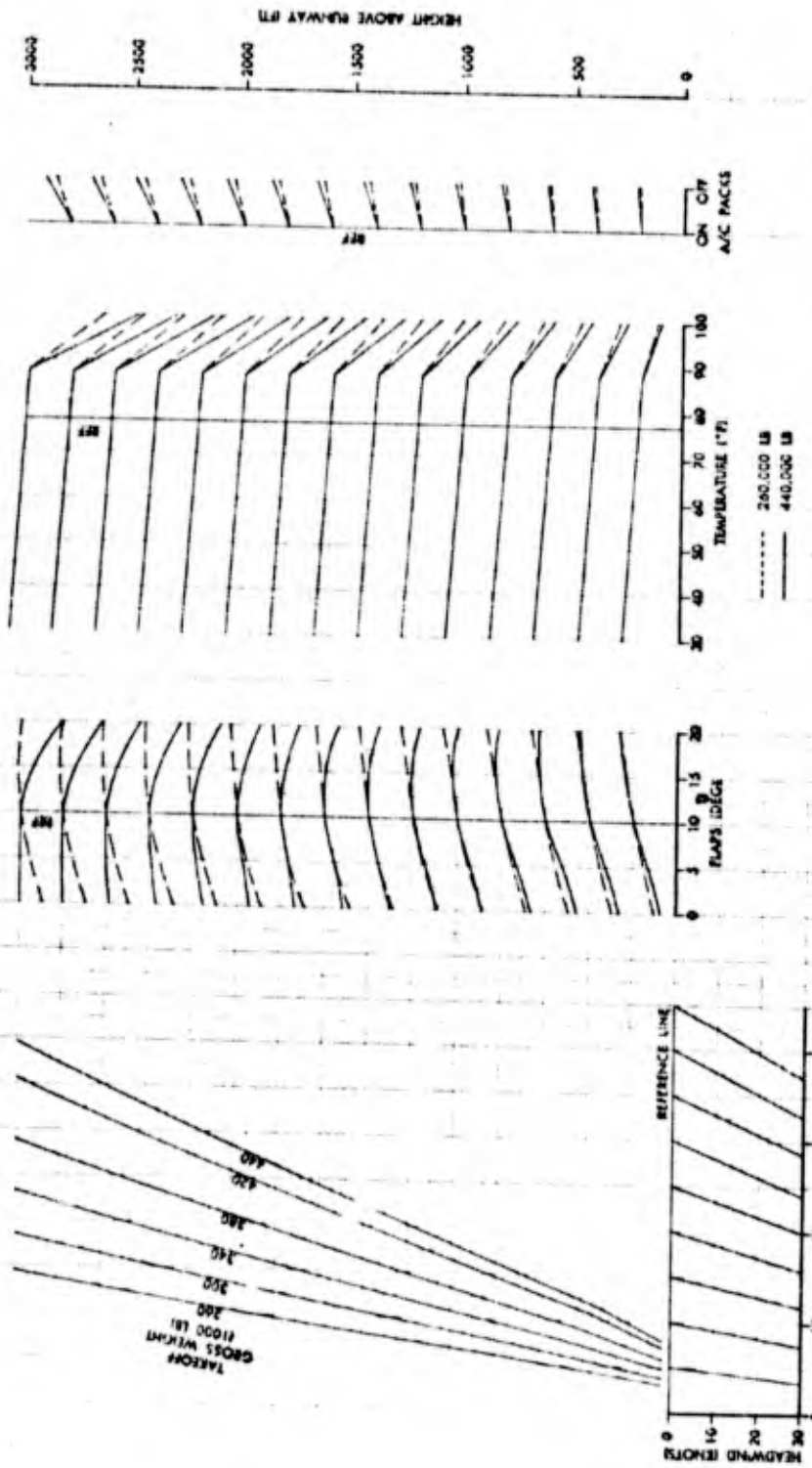


FIGURE 80

DC-10 SERIES 10
 LALL ENGINE FLIGHT PATH
 3500 FT AIRPORT ALTITUDE
 C1542 ENGINES
 0°-20° FLAPS
 CLIMB AT $V_2 + 10$

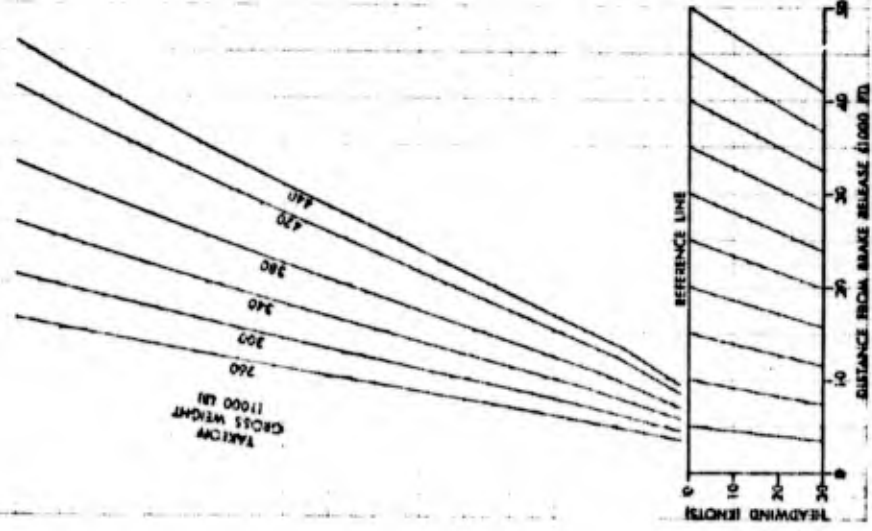
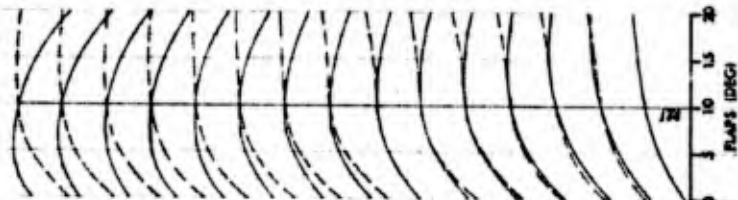
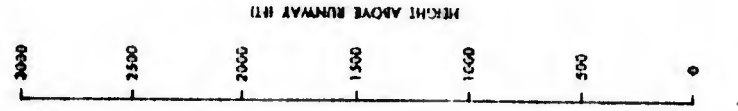
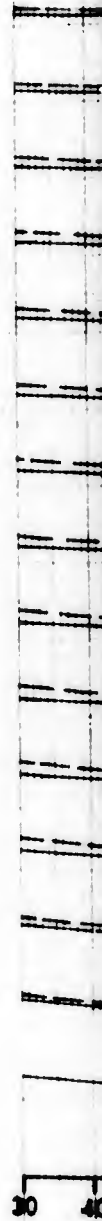
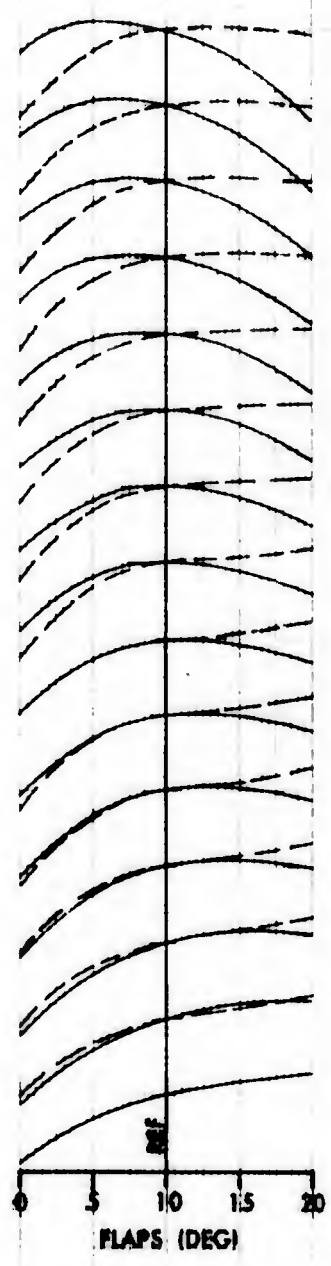
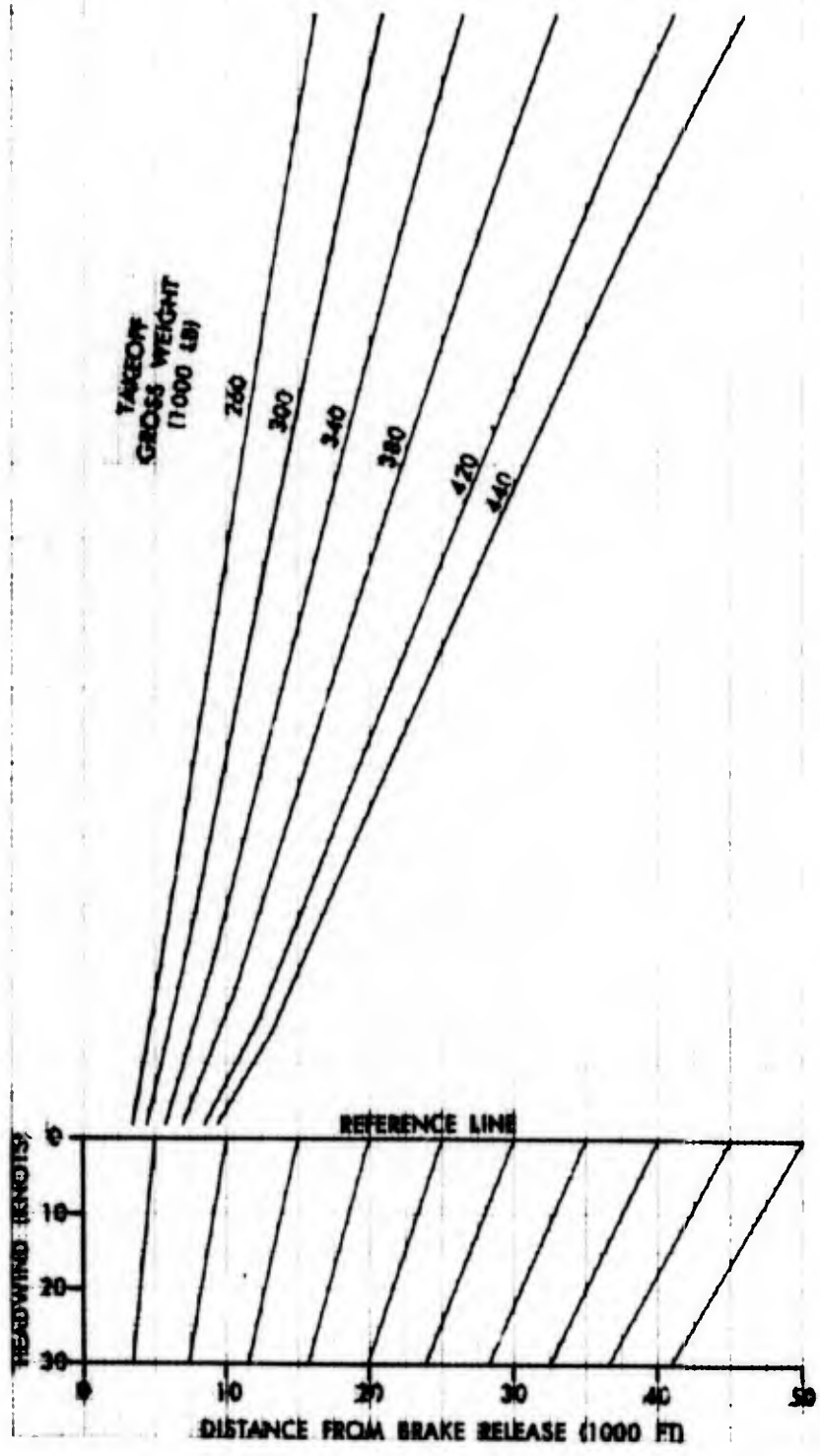


FIGURE 61

DC-10 SERIES
 ALL ENGINE FLIGHT
 3000 FT AIRPORT ALT
 CF6-4D ENGINE
 0°-20° FLAPS
 CLIMB AT V_2



A

DC-10 SERIES 10
 ALL ENGINE FLIGHT PATH
 3000 FT AIRPORT ALTITUDE
 CF6-60 ENGINES
 0°-20° FLAPS
 CLIMB AT $V_2 + 10$

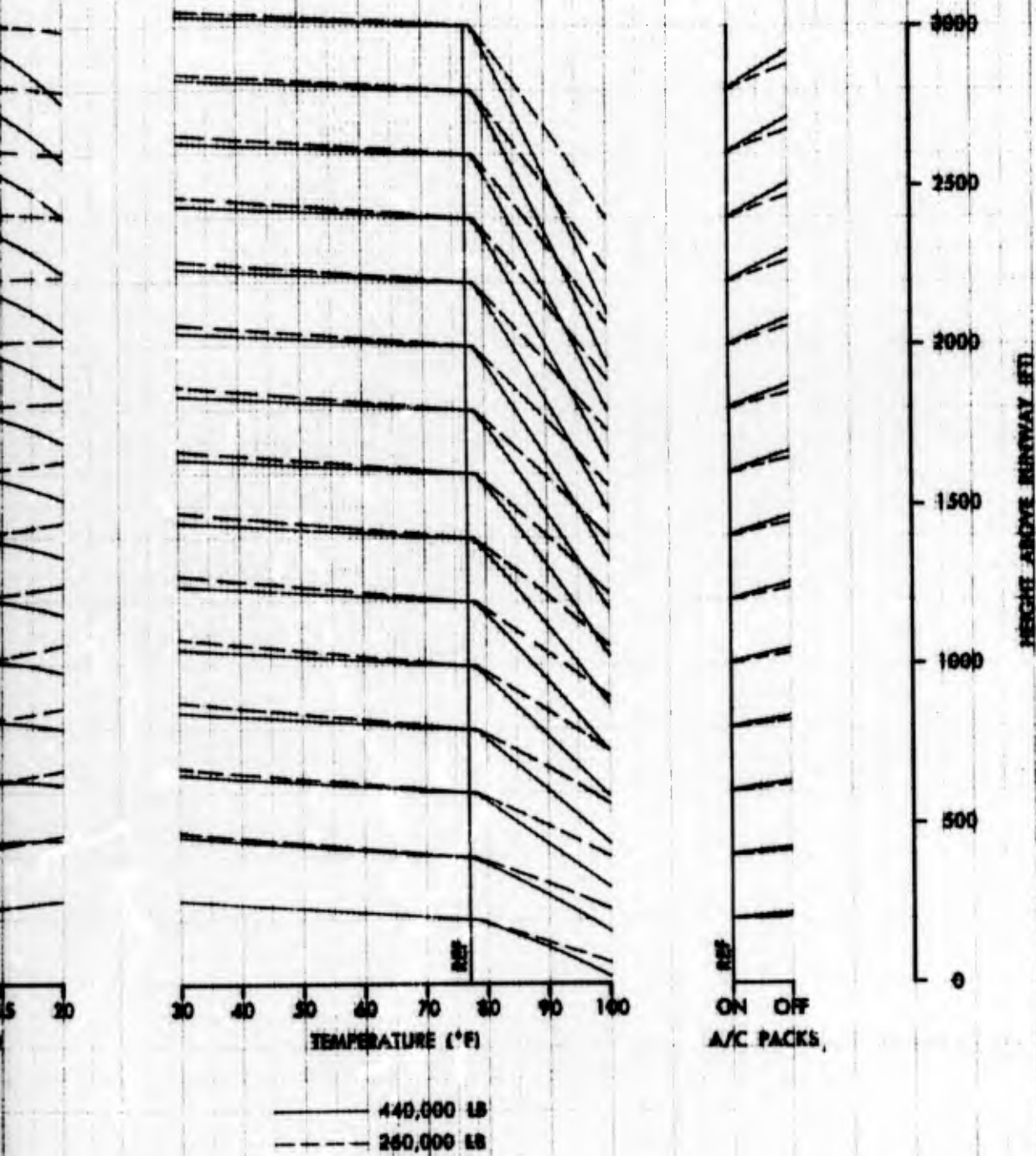
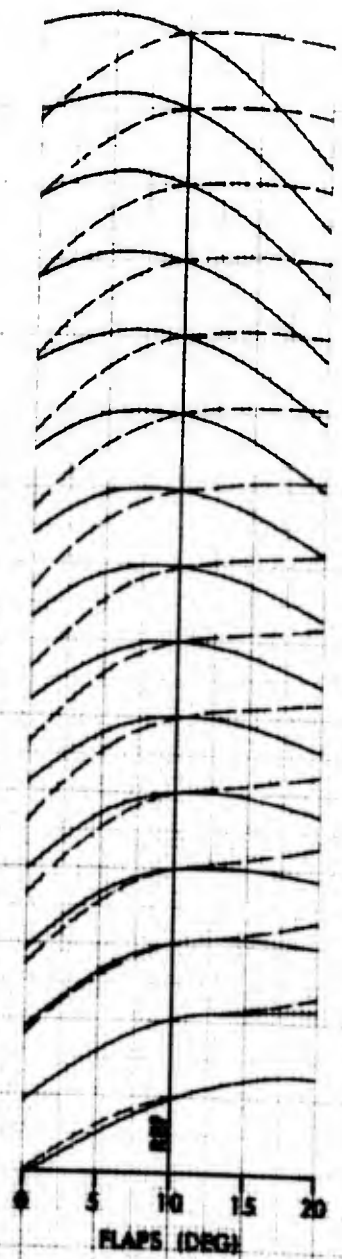
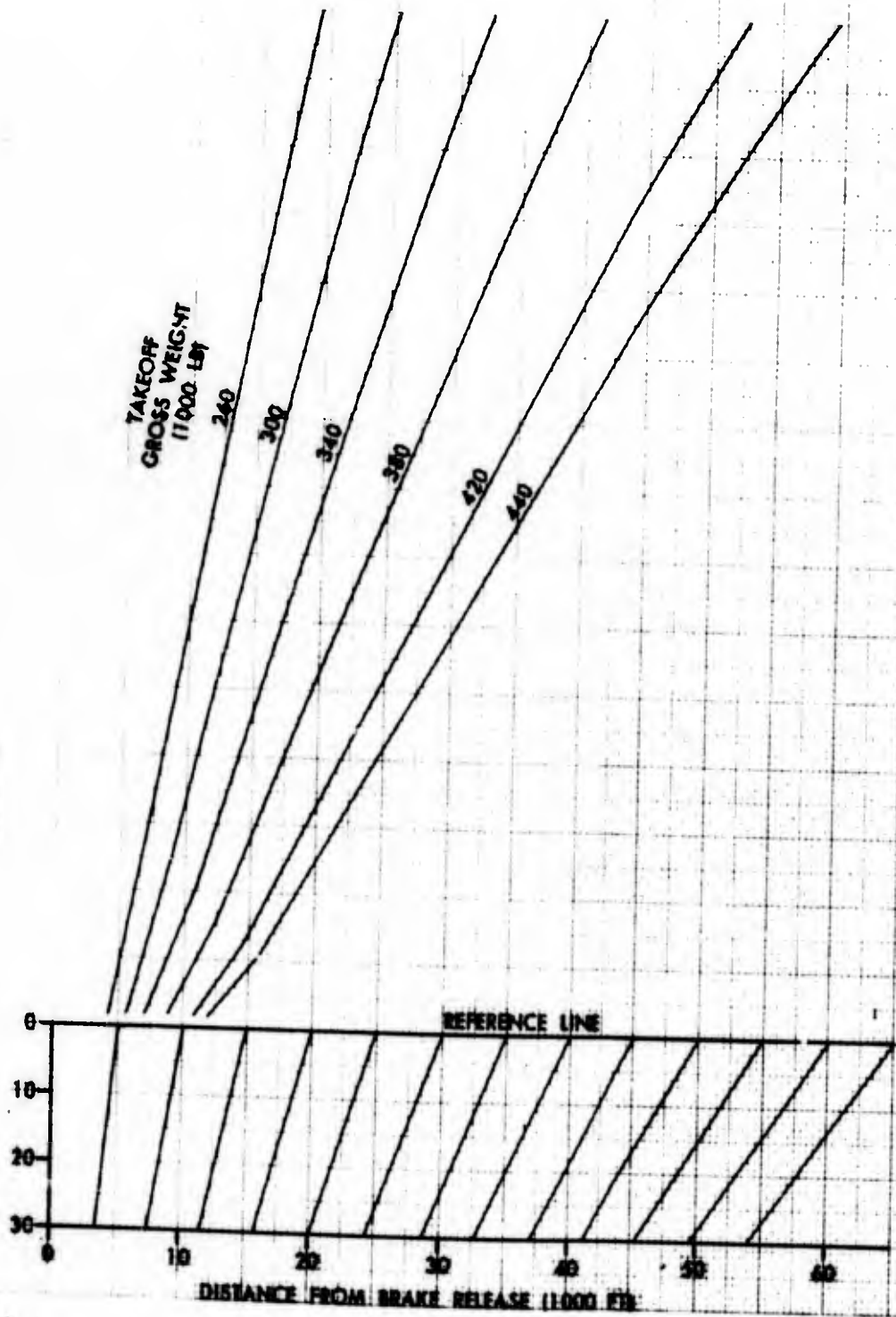


FIGURE 81.

B

DC-10 SERIES 10
 ALL ENGINE FLIGHT P
 4000 FT AIRPORT ALTITUDE
 CF6-80 ENGINES
 0°-20° FLAPS
 CLIMB AT $V_2 + 10$



X

DC-10 SERIES 10
ALL ENGINE FLIGHT PATH
 6000 FT AIRPORT ALTITUDE
 CF6-60 ENGINES
 0°-20° FLAPS
 CLIMB AT $V_2 + 10$

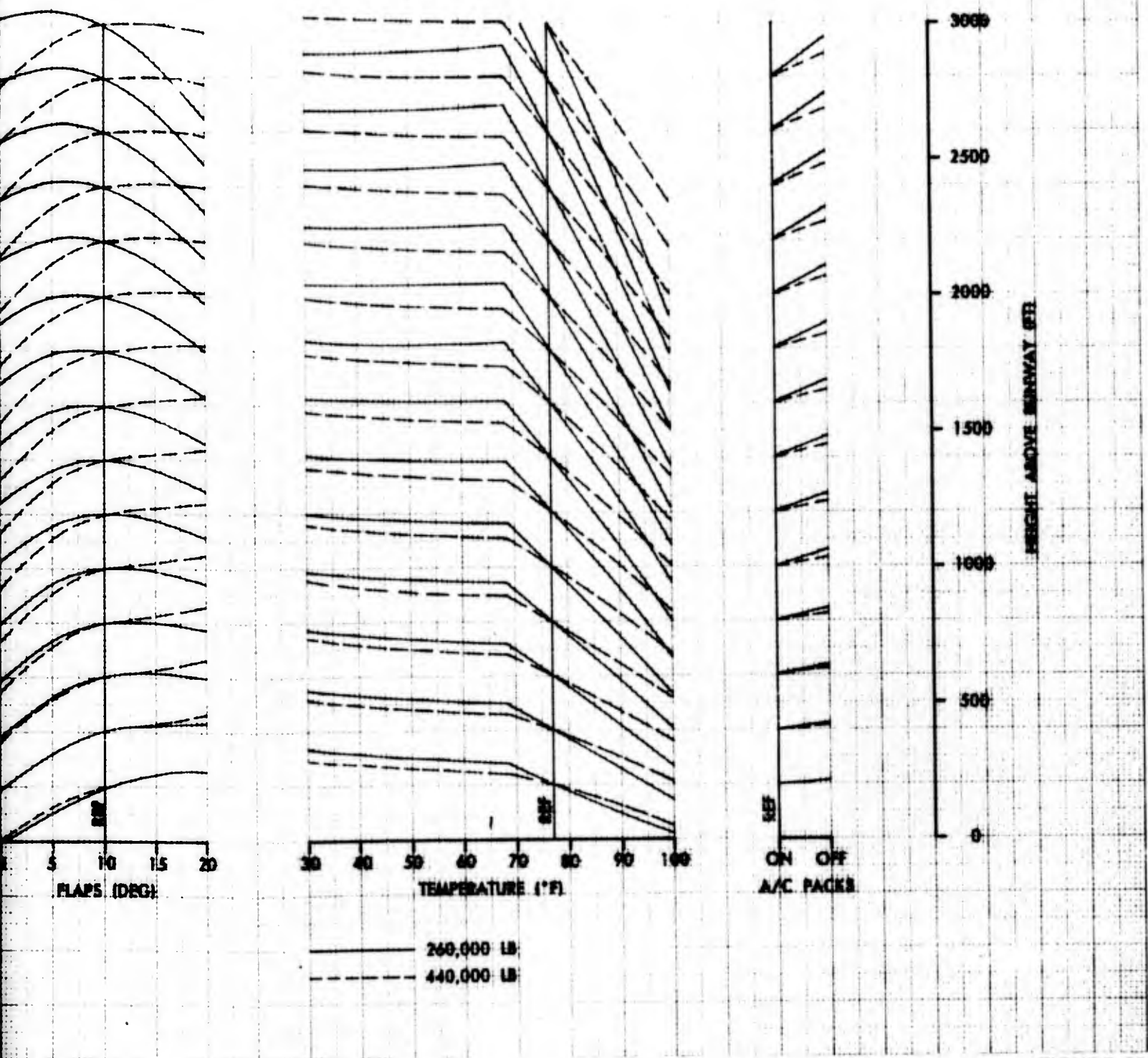


FIGURE 82.

B

DC-10 SERIES 10
 ALL ENGINE FLIGHT PATH
 4000 FT A.S.L. ALTITUDE
 C76-40 ENGINES
 0°-20° FLAPS
 CLIMB AT $V_2 + 10$

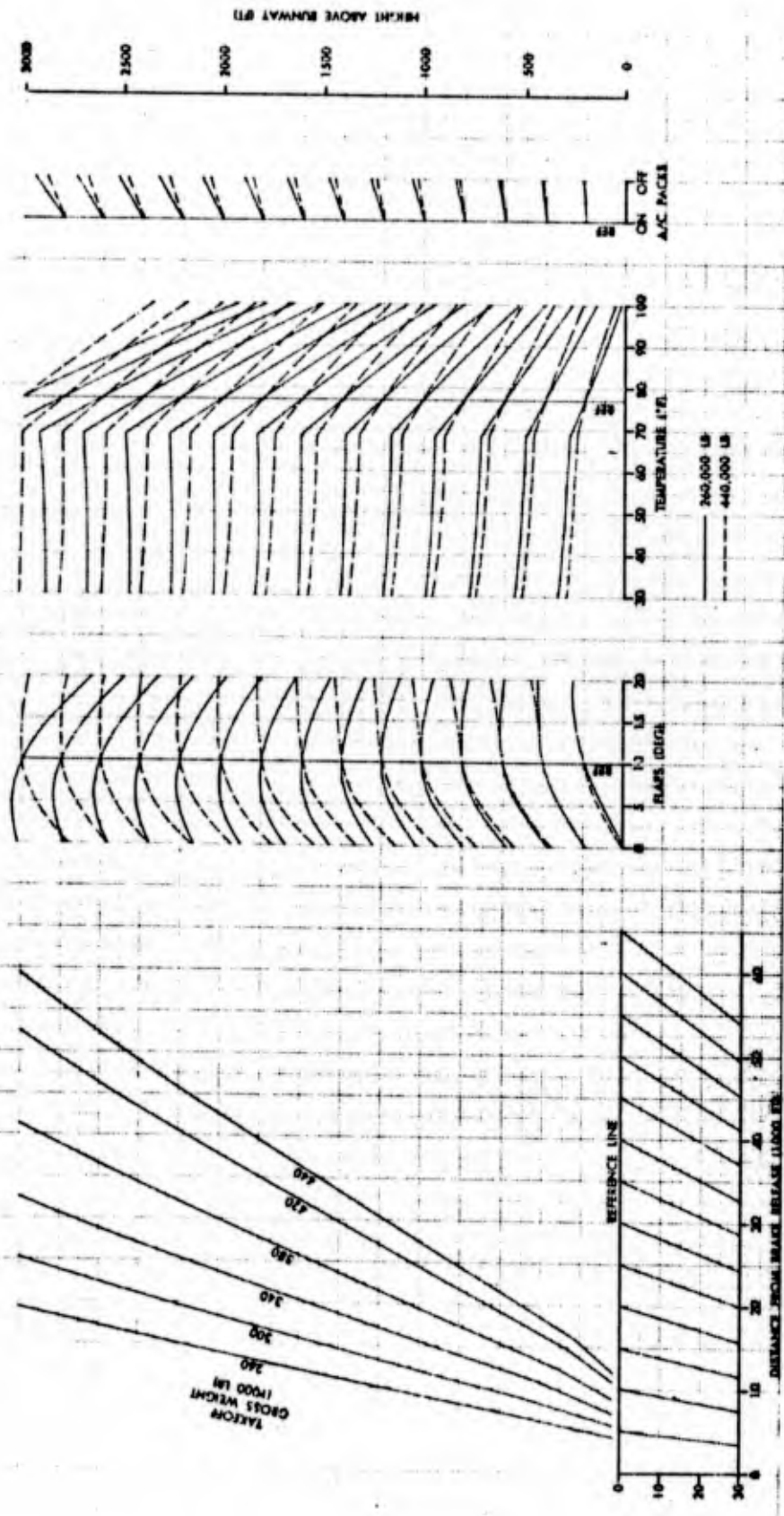


FIGURE 82.

DC-10 SERIES 10
 $M_1/\sqrt{h_1}$ AT CUTBACK
 C16-60 INCHES

100% $M_1/\sqrt{h_1}$ @ 3433 RPM

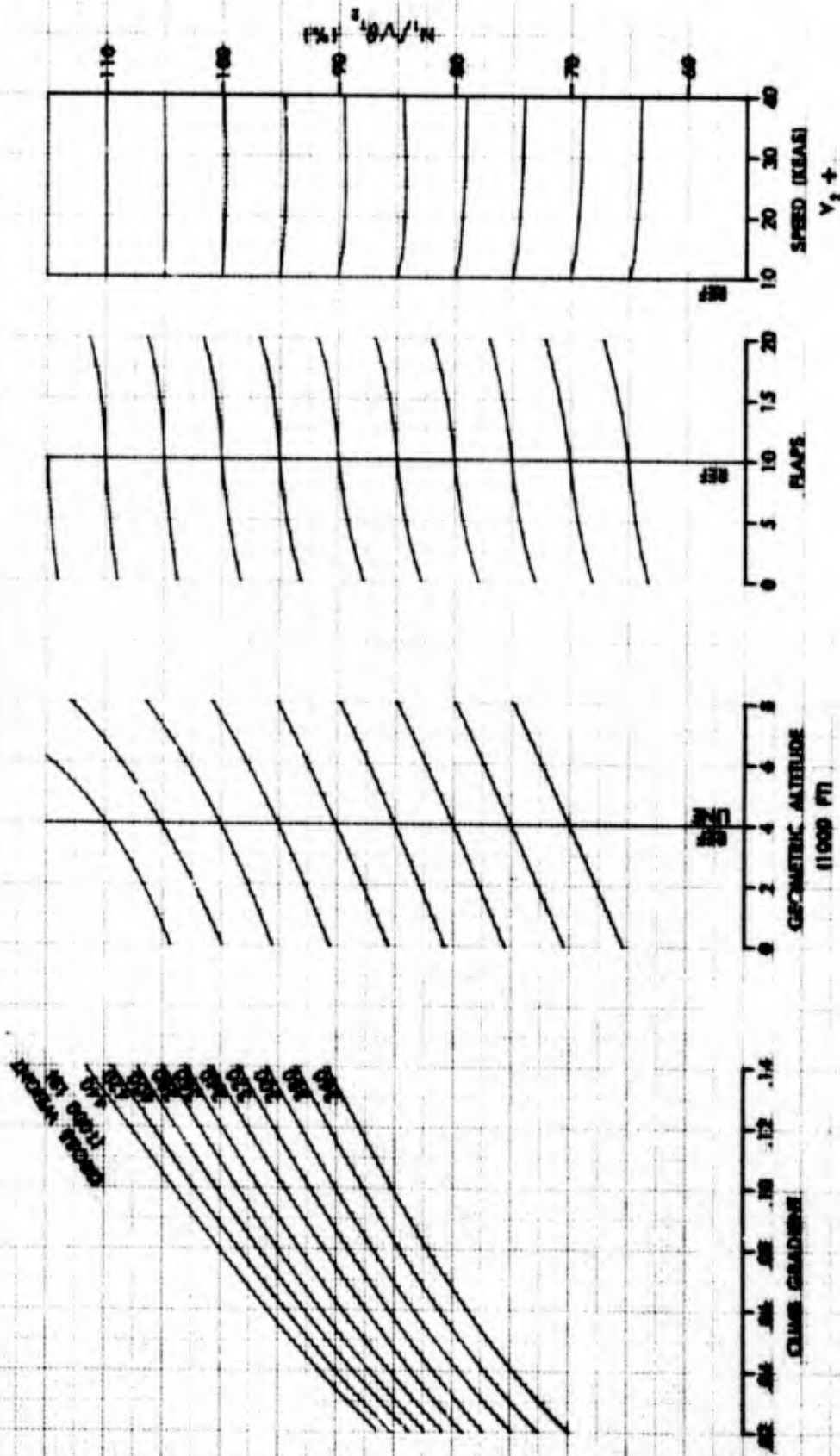


FIGURE 83.

**DC-10 SERIES 10
 $N_1/\sqrt{\theta_{T_7}}$ AT CUTBACK**

CF6-80 ENGINES
 CLEAN CONFIGURATION
 250 KNOTS IAS

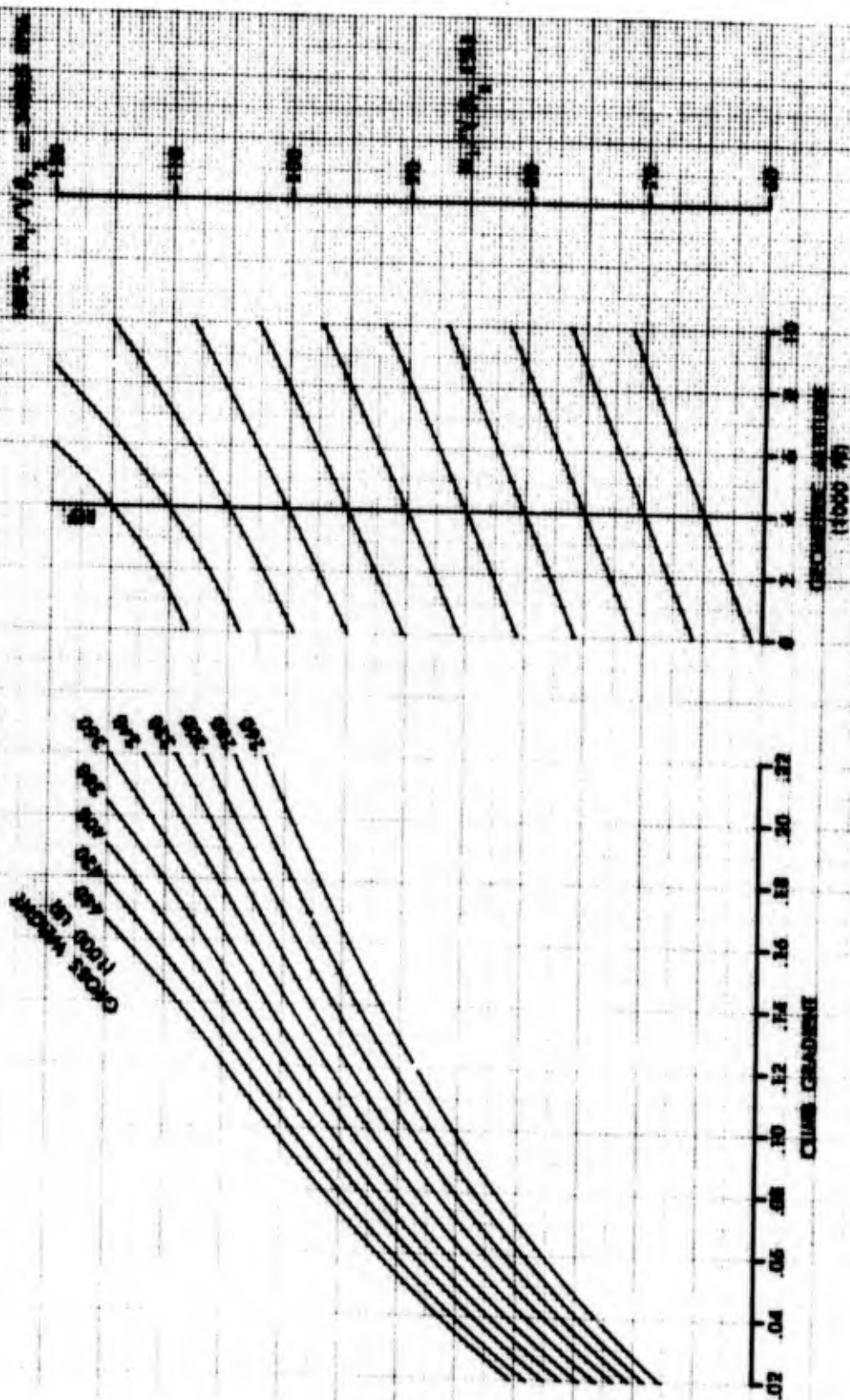


FIGURE 84.

**DC-10 SERIES 70
REFERRED FAN SPEED VS GLIDE SLOPE
CF6-80 ENGINE
30° FLARE**

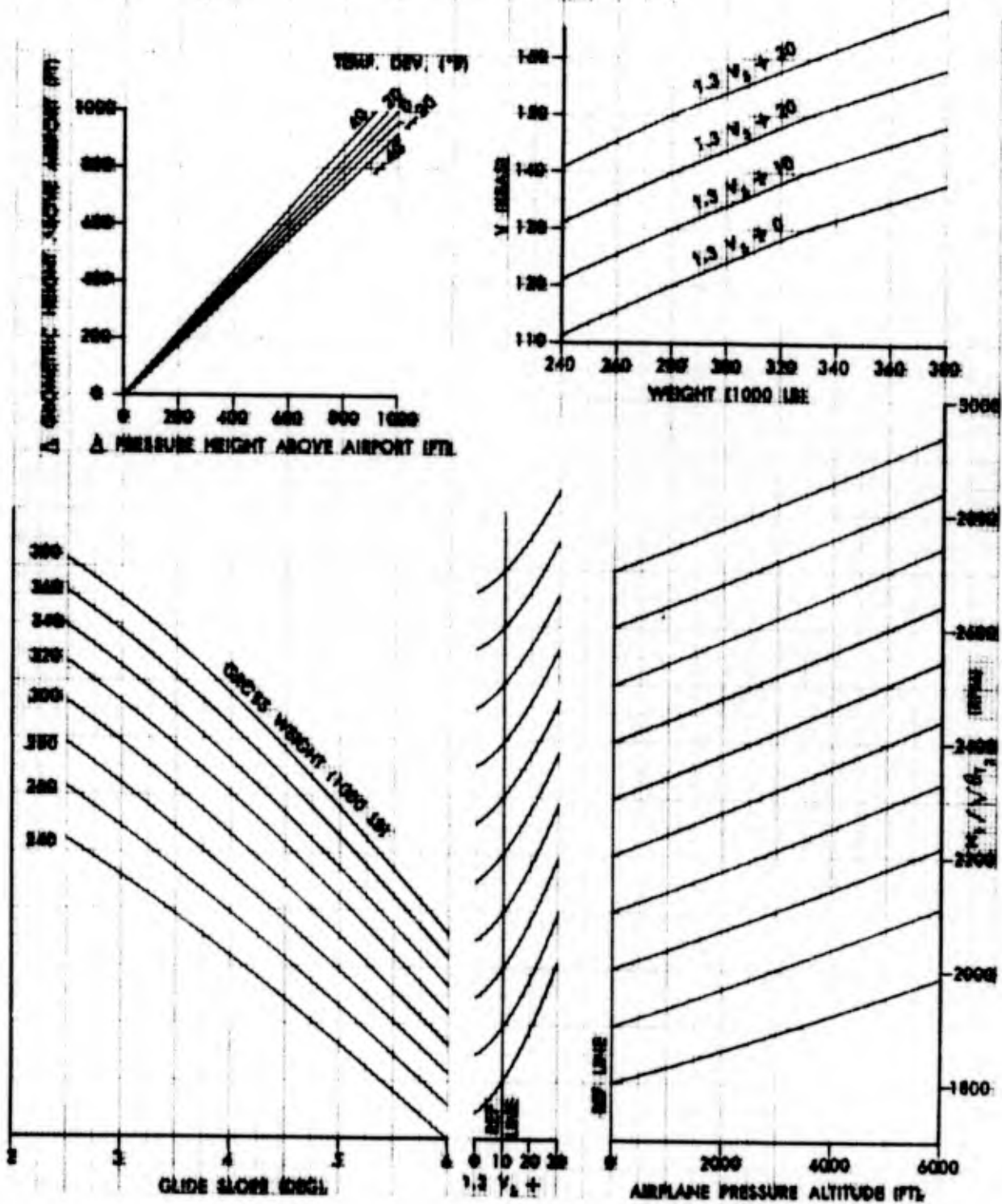


FIGURE 85.

**DC-10 SERIES 10
REFERRED FAN SPEED VS GLIDE SLOPE
CF6-60 ENGINES
35° FLAPS**

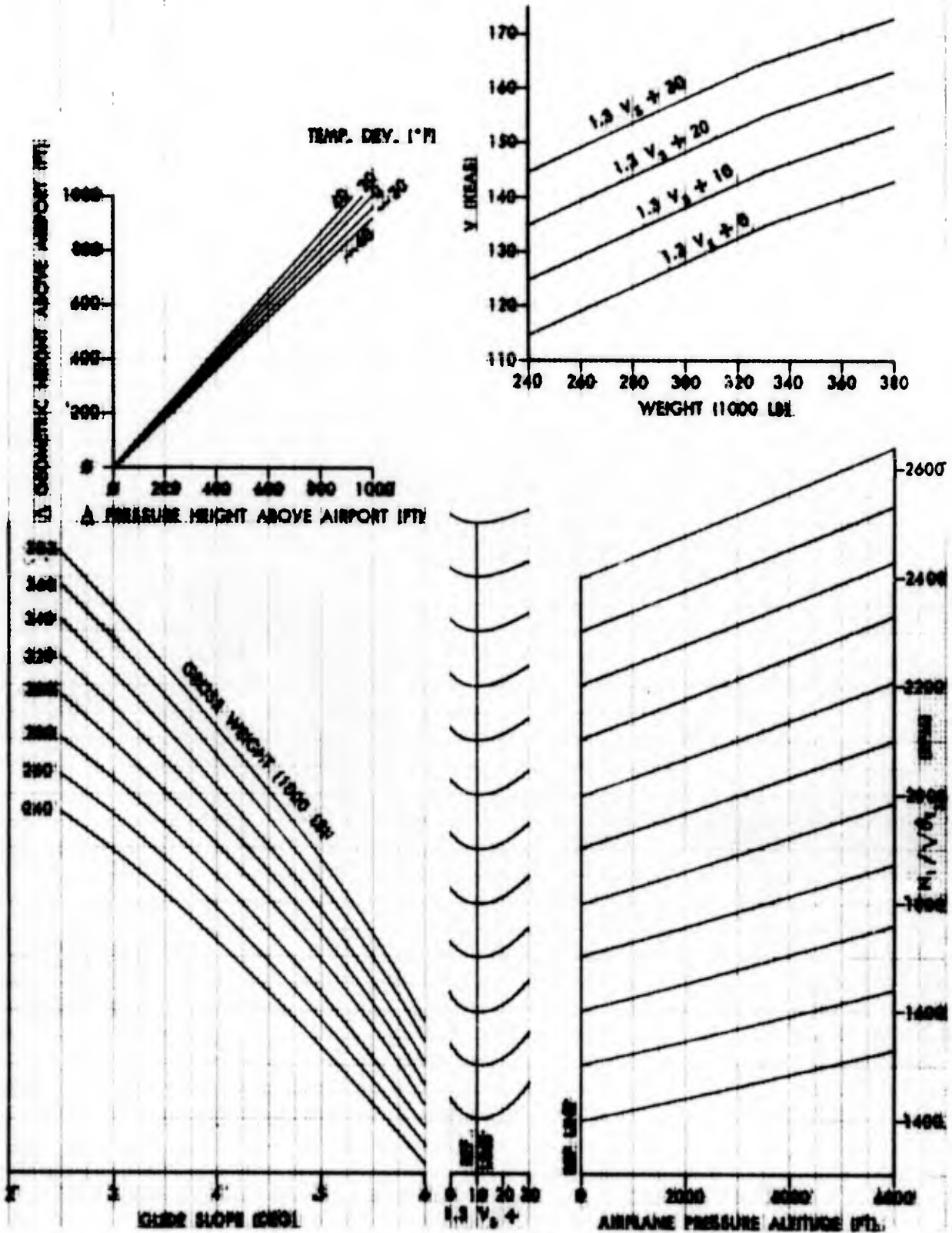


FIGURE 86.

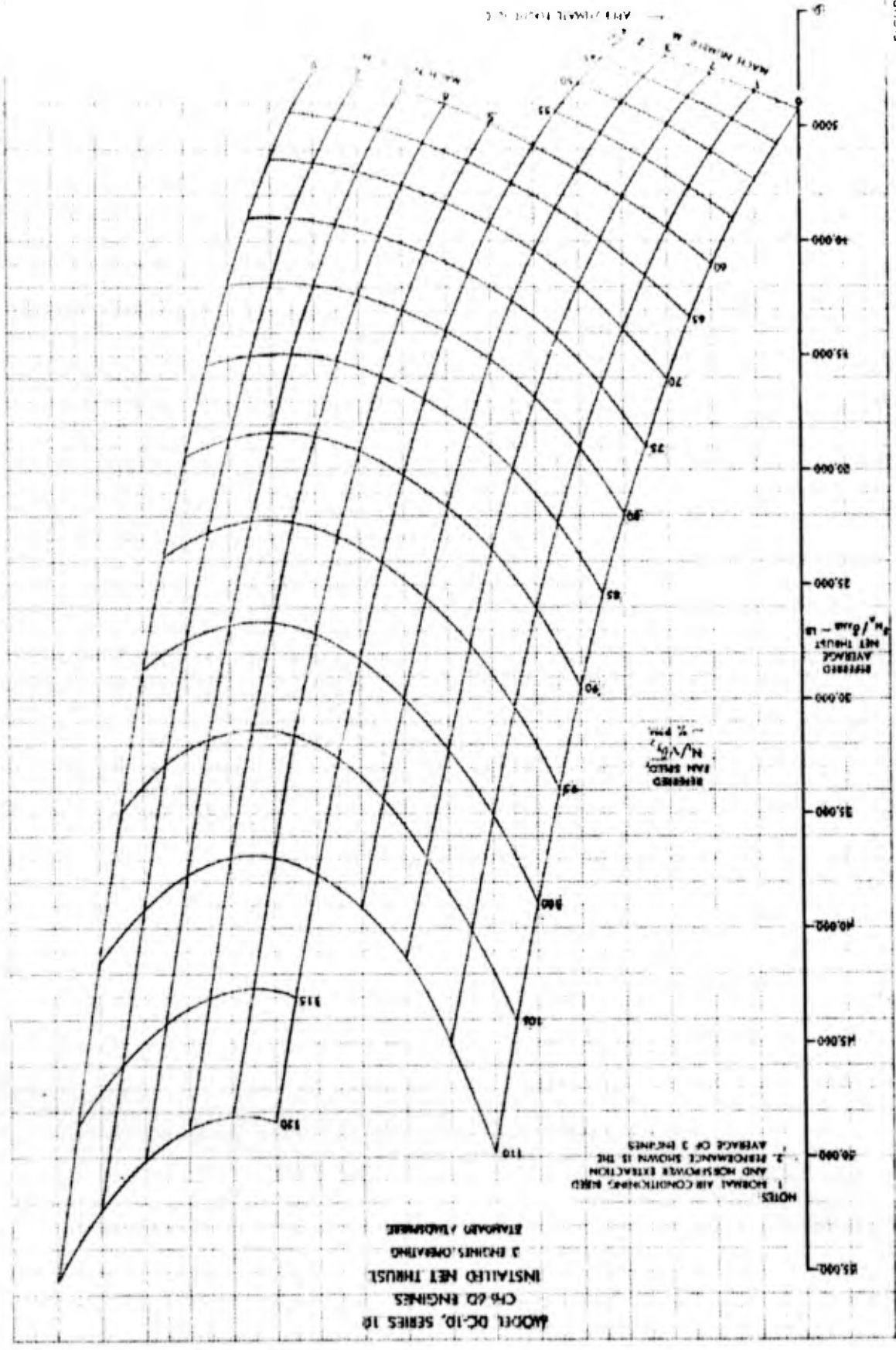
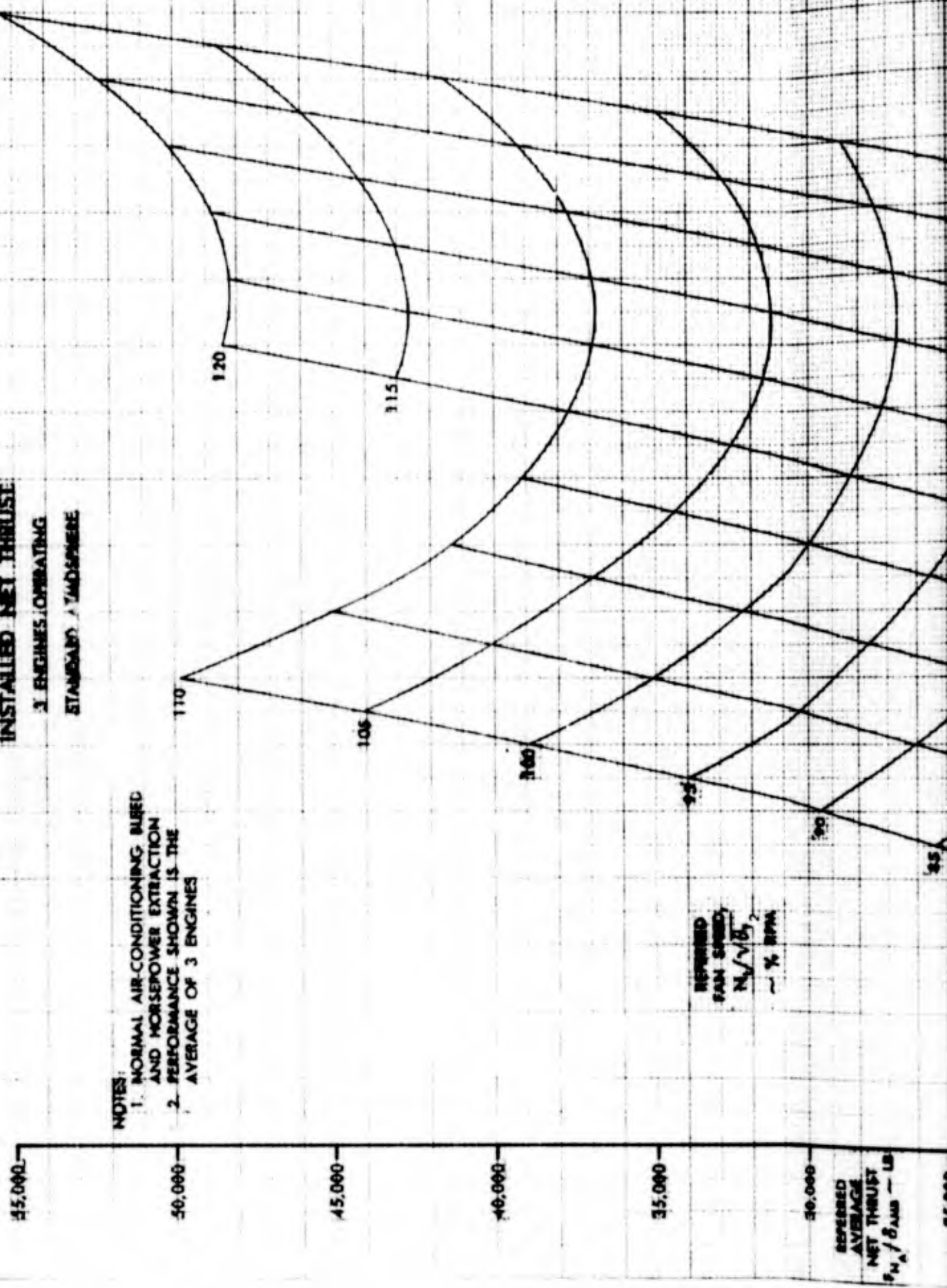


FIGURE 87

MODEL DC-10, SERIES 10
GEARED ENGINES
INSTALLED NET THRUST
3 ENGINES OPERATING
STANDARD ATMOSPHERE

- NOTES:**
1. NORMAL AIR-CONDITIONING BLEED AND HORSEPOWER EXTRACTION
 2. PERFORMANCE SHOWN IS THE AVERAGE OF 3 ENGINES



REFERRED
 FAN SPEED
 $N/\sqrt{\delta}$
 ~ % RPM

REFERRED
 AVERAGE
 NET THRUST
 F_{N_A} / δ_{AMB} - LB

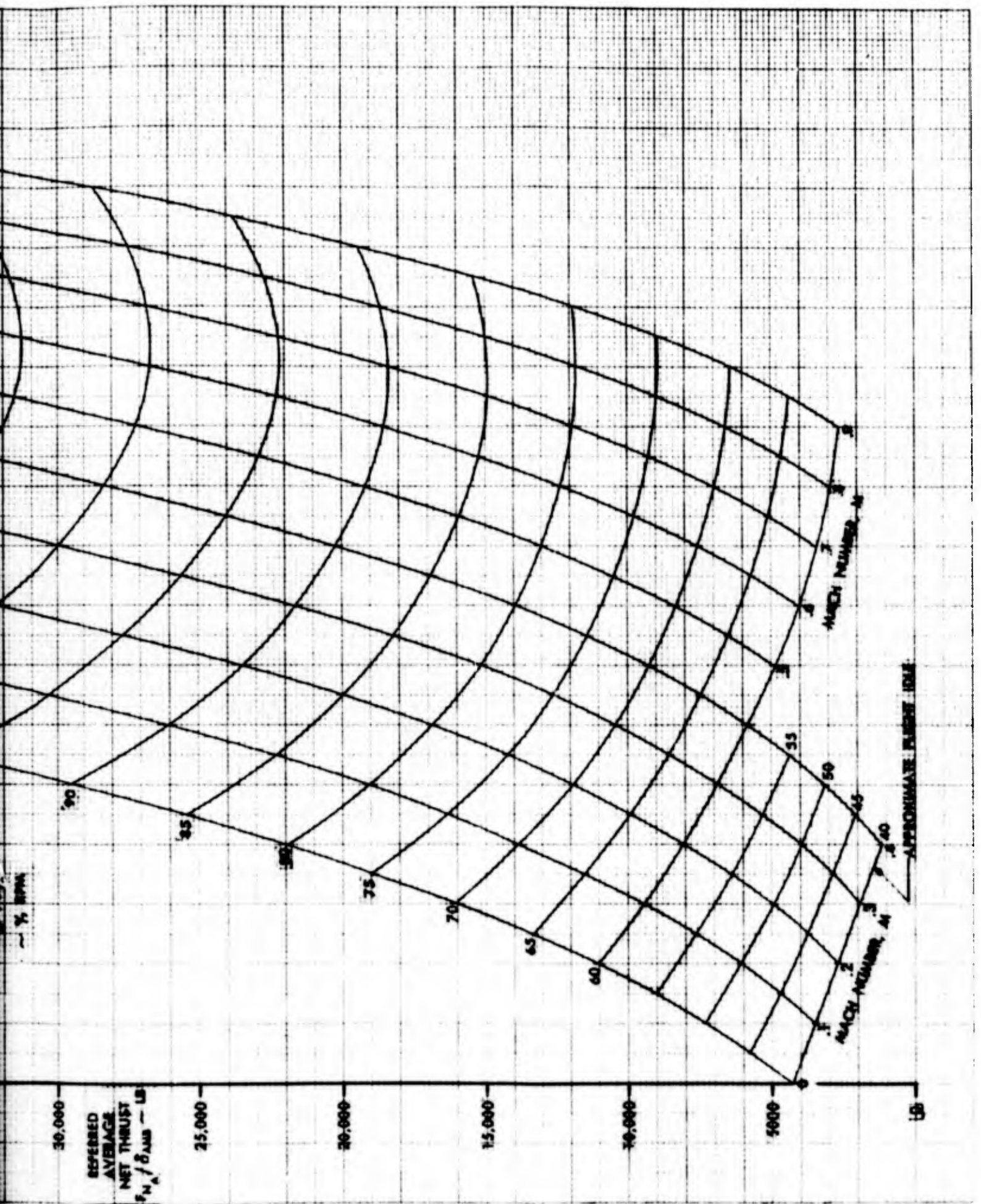


FIGURE 87

2.8 DC-10-40

2.8.1 Aircraft Description

The DC-10-40, shown in Figure 88, is a long-range version of the series of Douglas wide-bodied fan-jets powered by three high-bypass-ratio JT9D-20 engines manufactured by Pratt and Whitney Aircraft. The engines have the capability of being operated with water injection to increase the takeoff thrust. The maximum gross weights certified for use are 530,000 pounds for takeoff and 380,000 pounds for landing. A dimensioned three-view drawing is shown in Figure 89. The seating capacity (high density) is 380.

The maximum engine thrust ratings are 49,400 pounds for wet operation, flat rated to 86°F, and 46,300 pounds for dry operation, flat rated to 84°F. The bypass ratios are 5.1.5 and 5.21, respectively.

2.8.2 Acoustic Data

The EPNL and A-weighted sound level plots are presented in Figures 90 and 91 in terms of referred fan speed are based on data obtained during the FAA noise certification test described in Reference 2. The referred fan speed for wet takeoff is 3410 rpm and the referred fan speed for dry takeoff, which is not shown, is approximately 3350 rpm.

2.8.3 Performance Data

Figures 92 through 94 present the takeoff flight path data for a continuous range of flap settings from 5 to 25 degrees for the various runway altitudes. Data from these curves combined with the data from the curves of Figures 95 and 96, the cutback charts, and the data in Figures 90 and 91, the noise curves, will provide the aircraft noise levels. Approach data are presented in Figures 97 and 98 for 50- and 35-degree flaps, respectively. Figures 99 and 100 present curves relating thrust, fan speed, and EPR for various Mach numbers.

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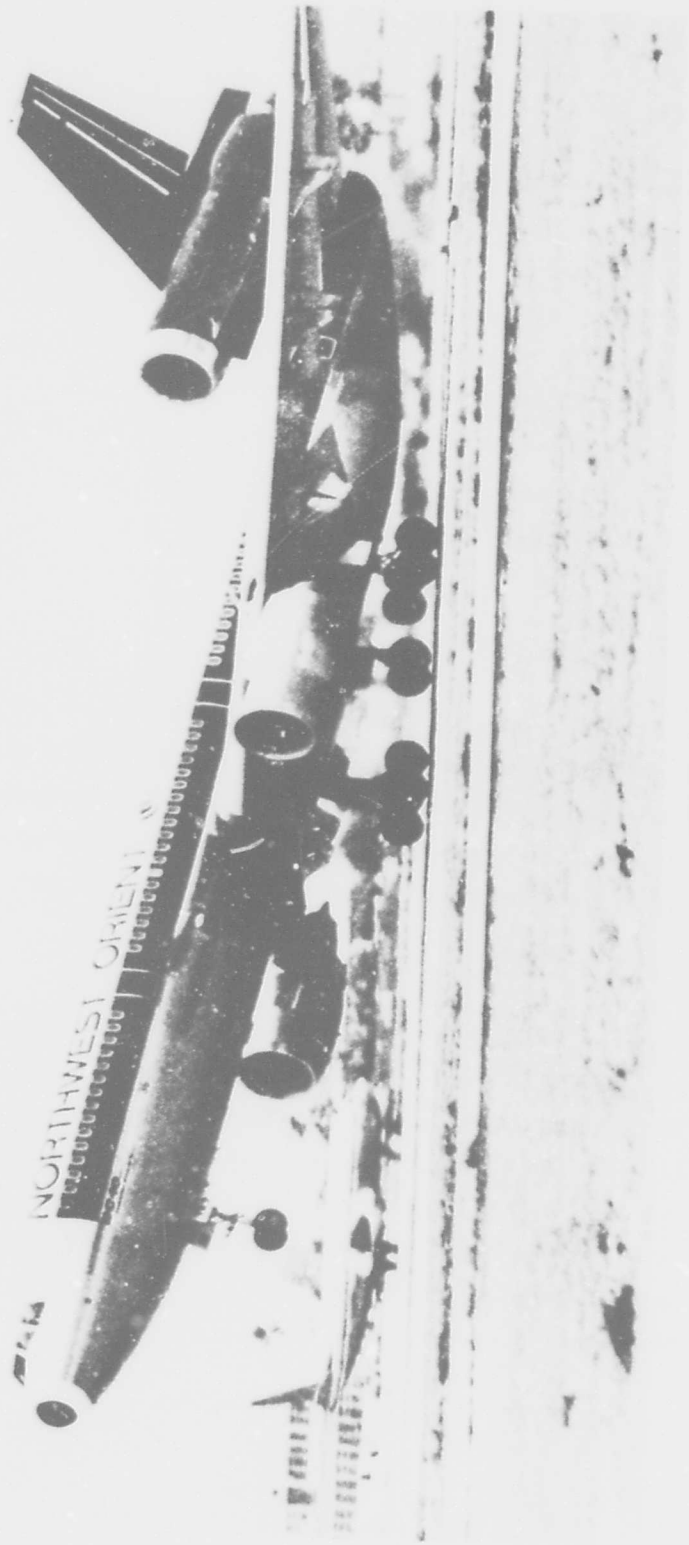


FIGURE 88.

WING	SPAN - OVERALL	165 FT 4 IN
	SPAN - TYPICAL	138 FT 3 IN
	ROOT CHORD	42 FT 8 IN
	TIP CHORD	13 FT 5 1/2 IN
	DIRECTIONAL	0°
	SWEEPBACK	30°
	M.A.C. (TRAJ)	295 FT 9 IN
	FLAPS - TYPE	DOUBLE - SLOTTED
	TAIL	
	HORIZONTAL	138 FT 3 IN
	AREA	250
	SWEEPBACK	11 FT 2 IN
	VERTICAL	85 FT 5 IN
	SWEEPBACK	40°
	TOP OF FIN	58 FT 1 IN
	FROM GROUND	
	FUSELAGE	
	OUTSIDE DIAMETER	227 IN
	FUSELAGE LENGTH	170 FT 6 IN
	LENGTH - OVERALL	182 FT 3 IN

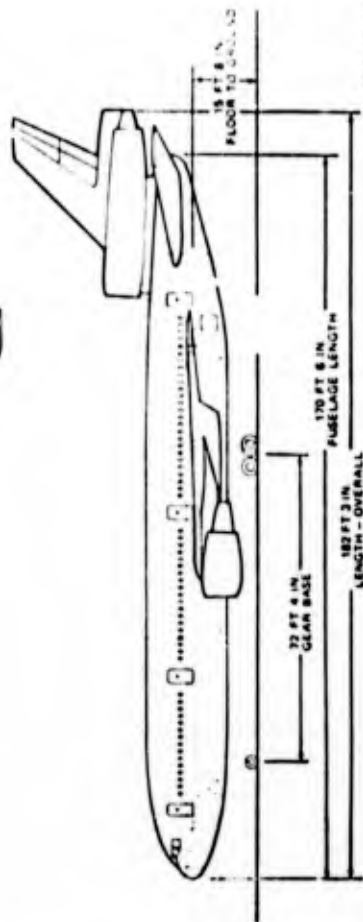
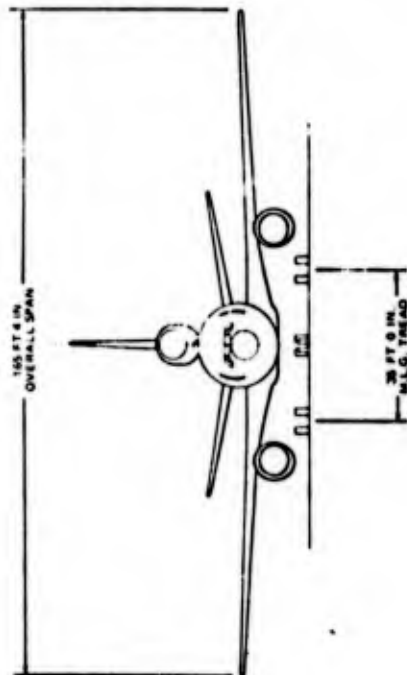
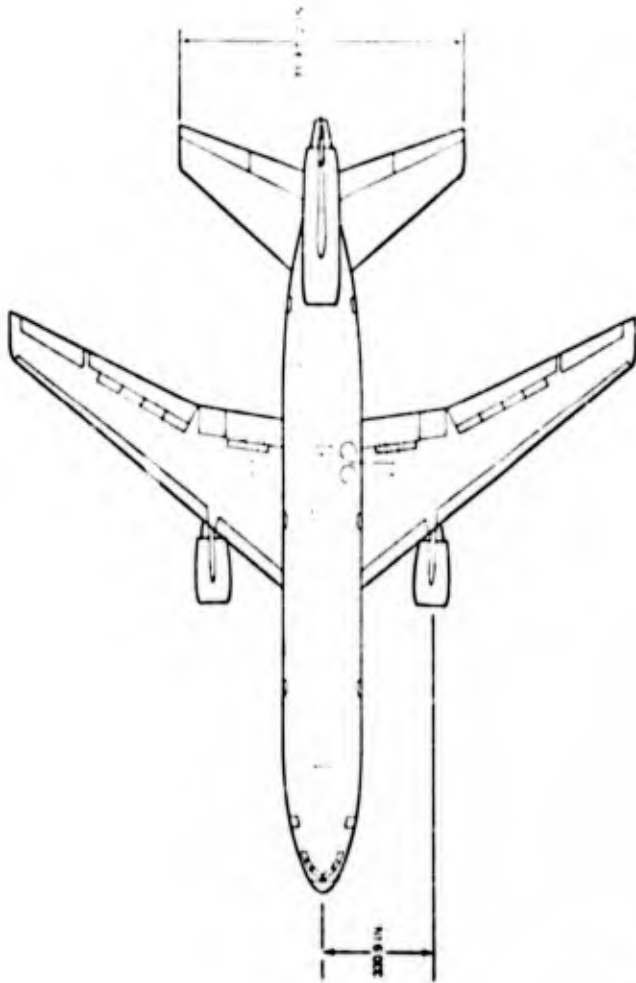


FIGURE 88 DC 10-40

WING

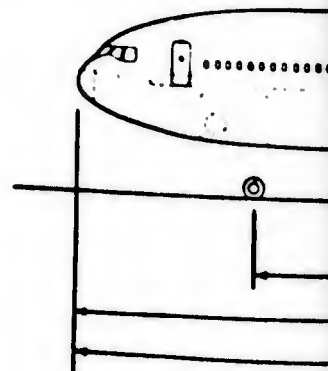
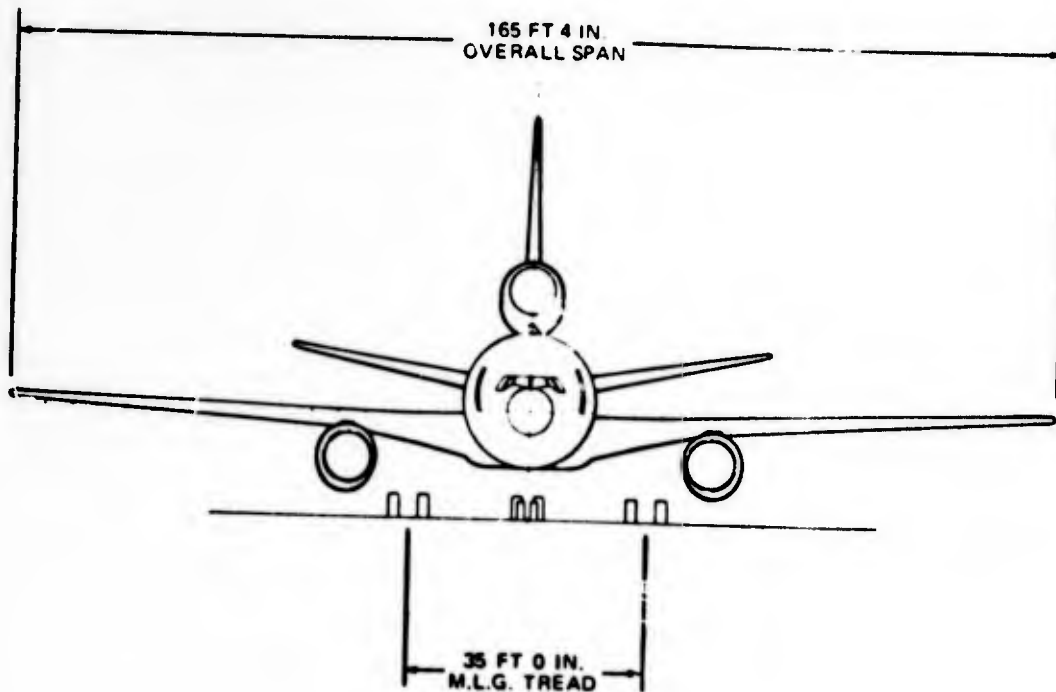
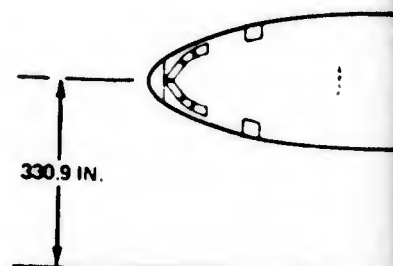
SPAN - OVERALL	165 FT 4 IN.
AREA - TOTAL	3647 SQ FT
ROOT CHORD	421.820 IN.
TIP CHORD	107.542 IN.
DIHEDRAL	6°
ASPECT RATIO	7.50
SWEEPBACK	35°
M.A.C. (TRUE)	295.779 IN.
FLAPS - TYPE	DOUBLE - SLOTTED

TAIL

HORIZONTAL	
AREA	1338.256 SQ FT
DIHEDRAL	10°
SWEEPBACK	35°
SPAN	71 FT 2 IN.
VERTICAL	
AREA	805 SQ FT
SWEEPBACK	40°
TOP OF FIN	
FROM GROUND	58 FT 1 IN.

FUSELAGE

OUTSIDE DIAMETER	237 IN.
FUSELAGE LENGTH	170 FT 6 IN.
LENGTH - OVERALL	182 FT 3 IN.



A

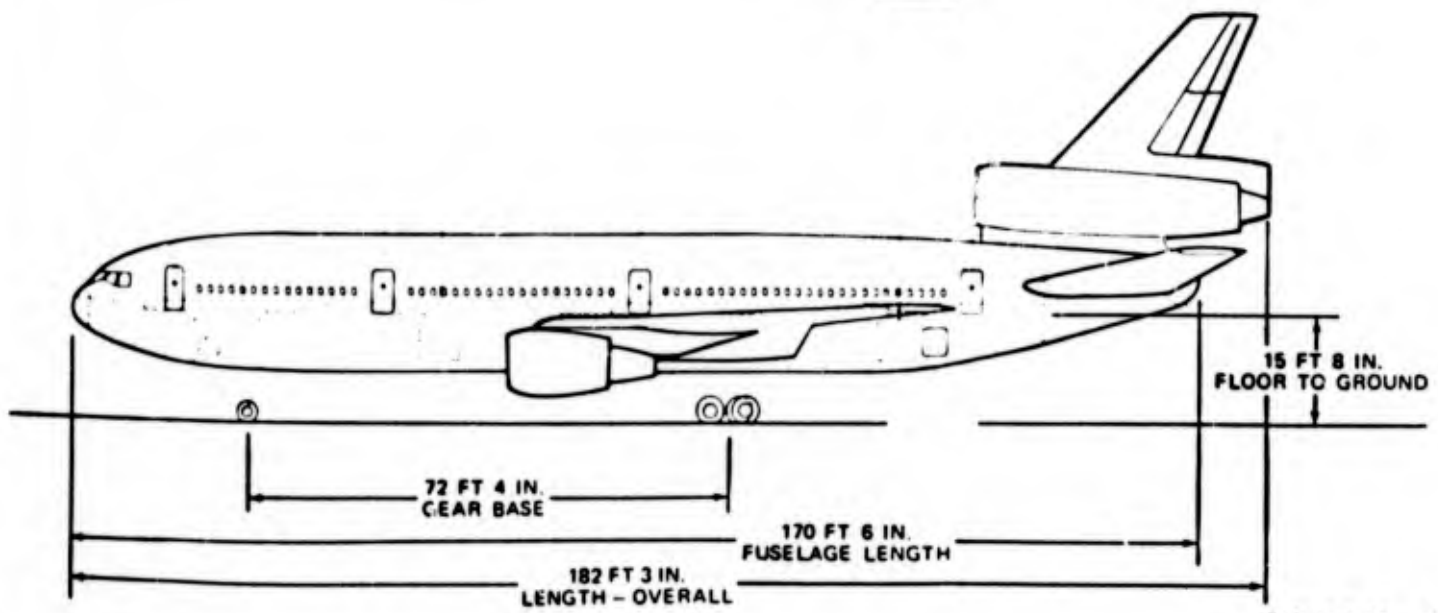
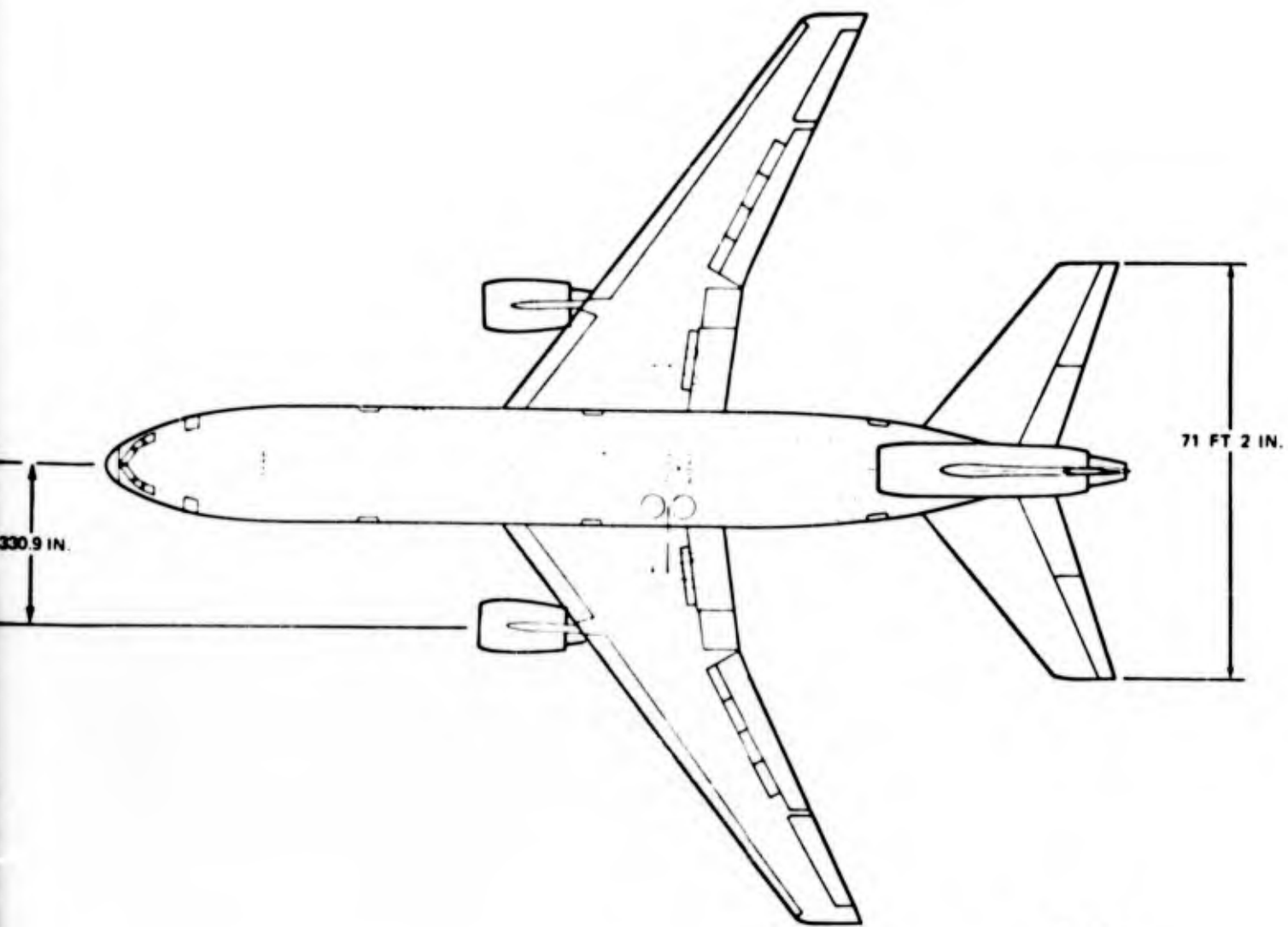


FIGURE 89. DC-10-40

B

DATE AUGUST 30 1973

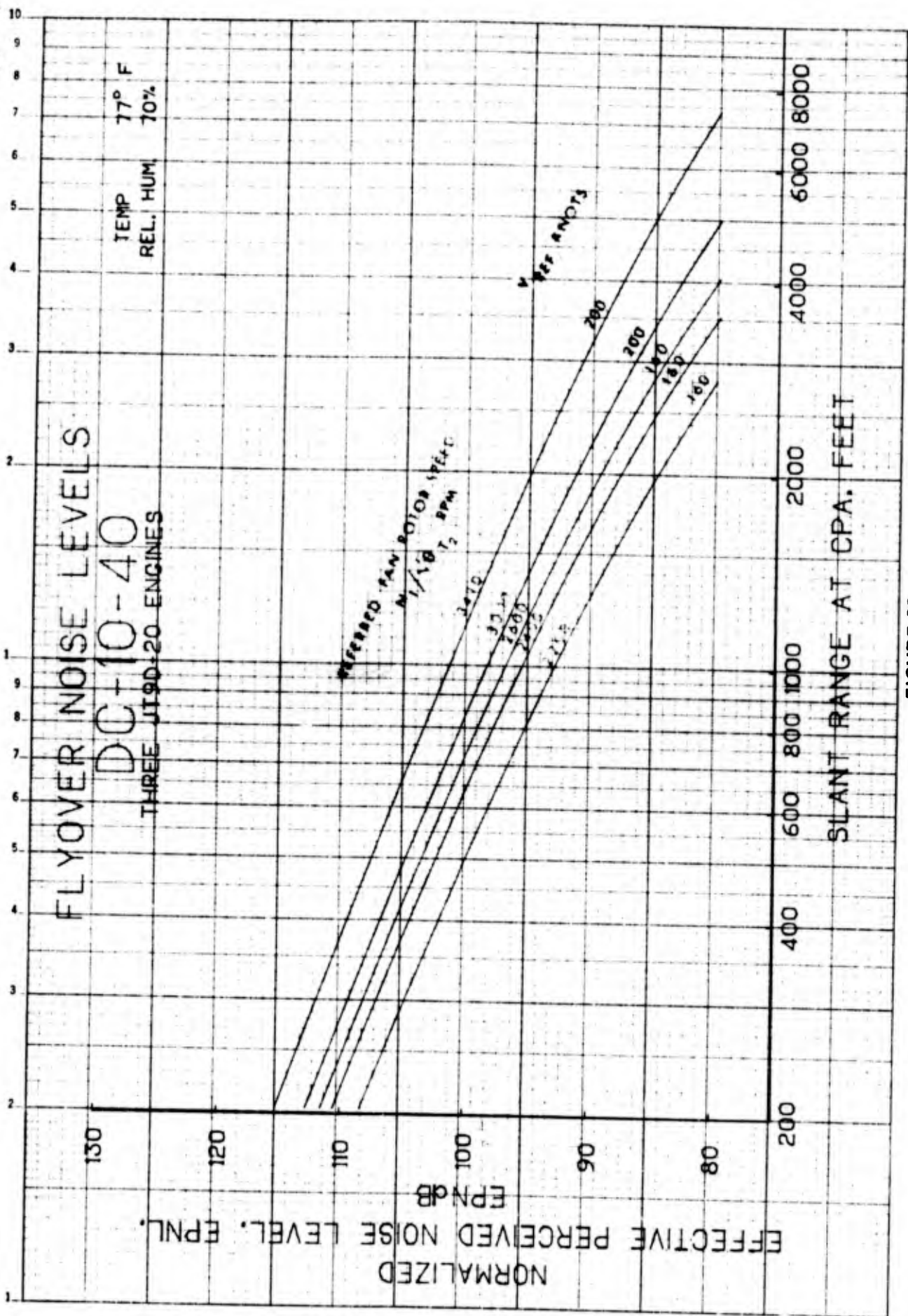


FIGURE 90.

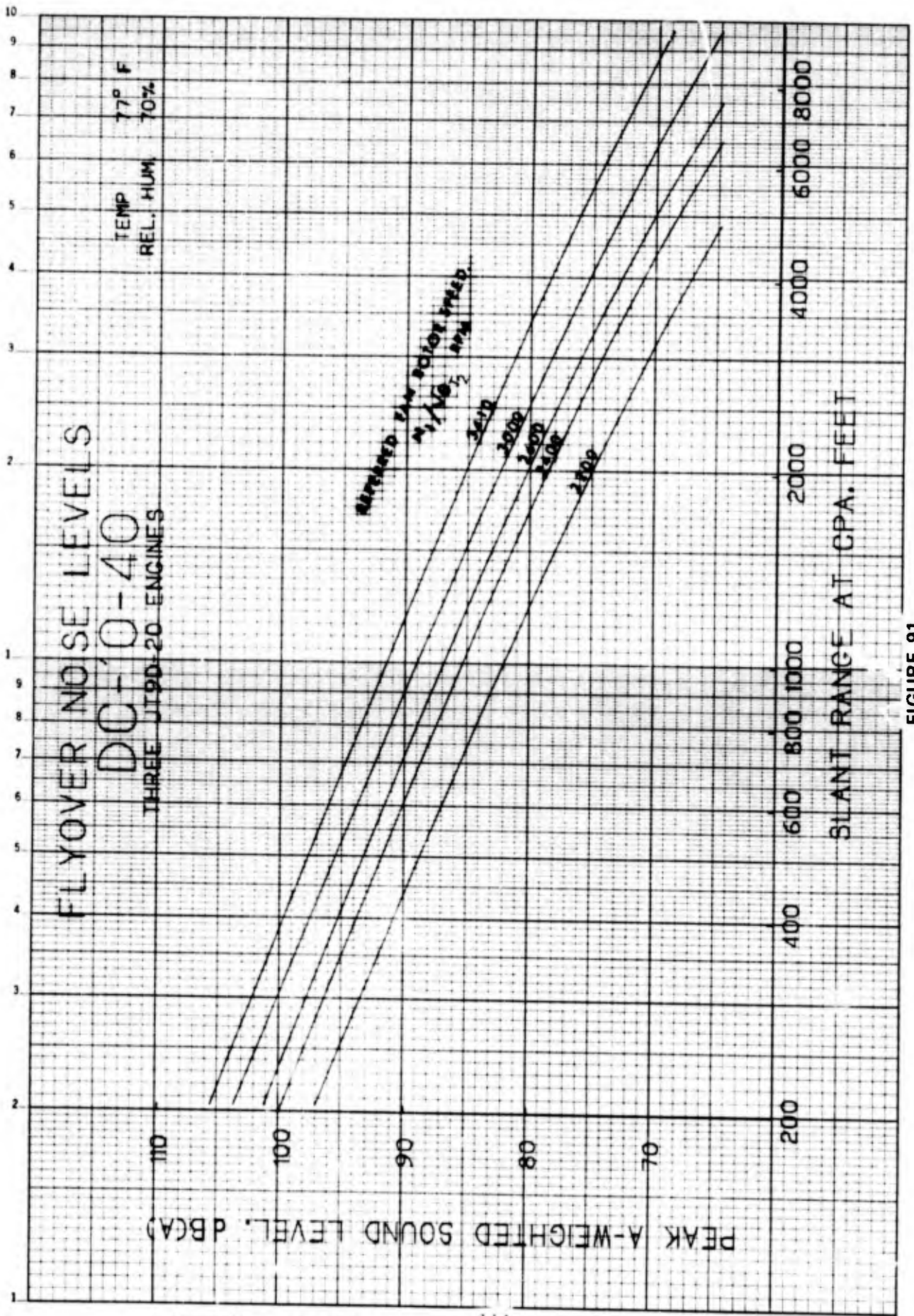
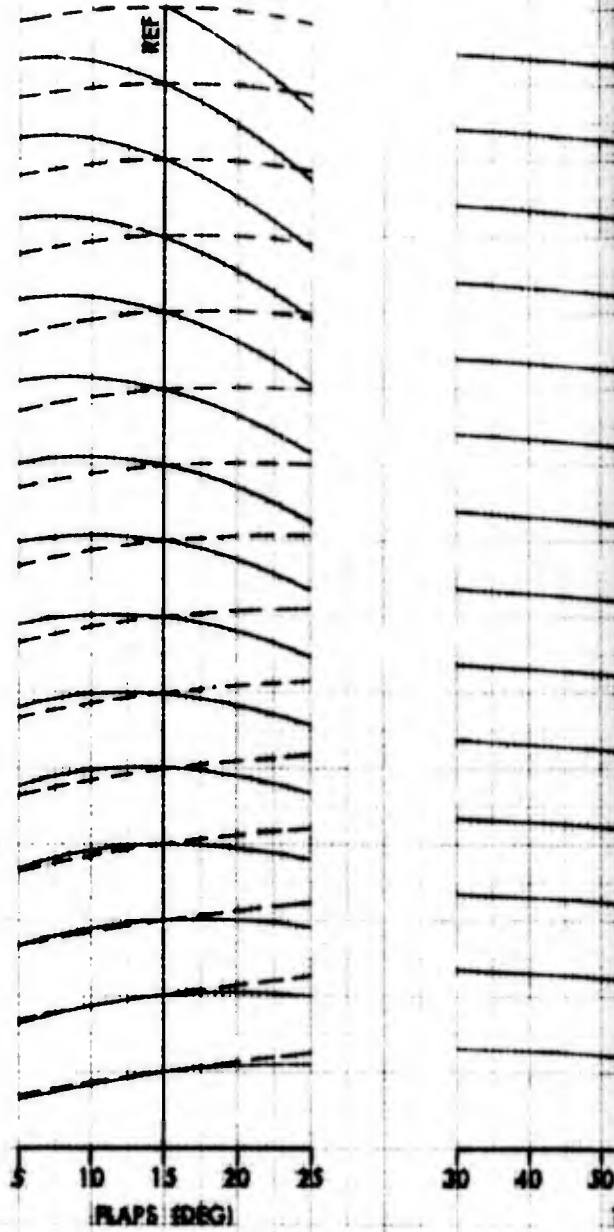
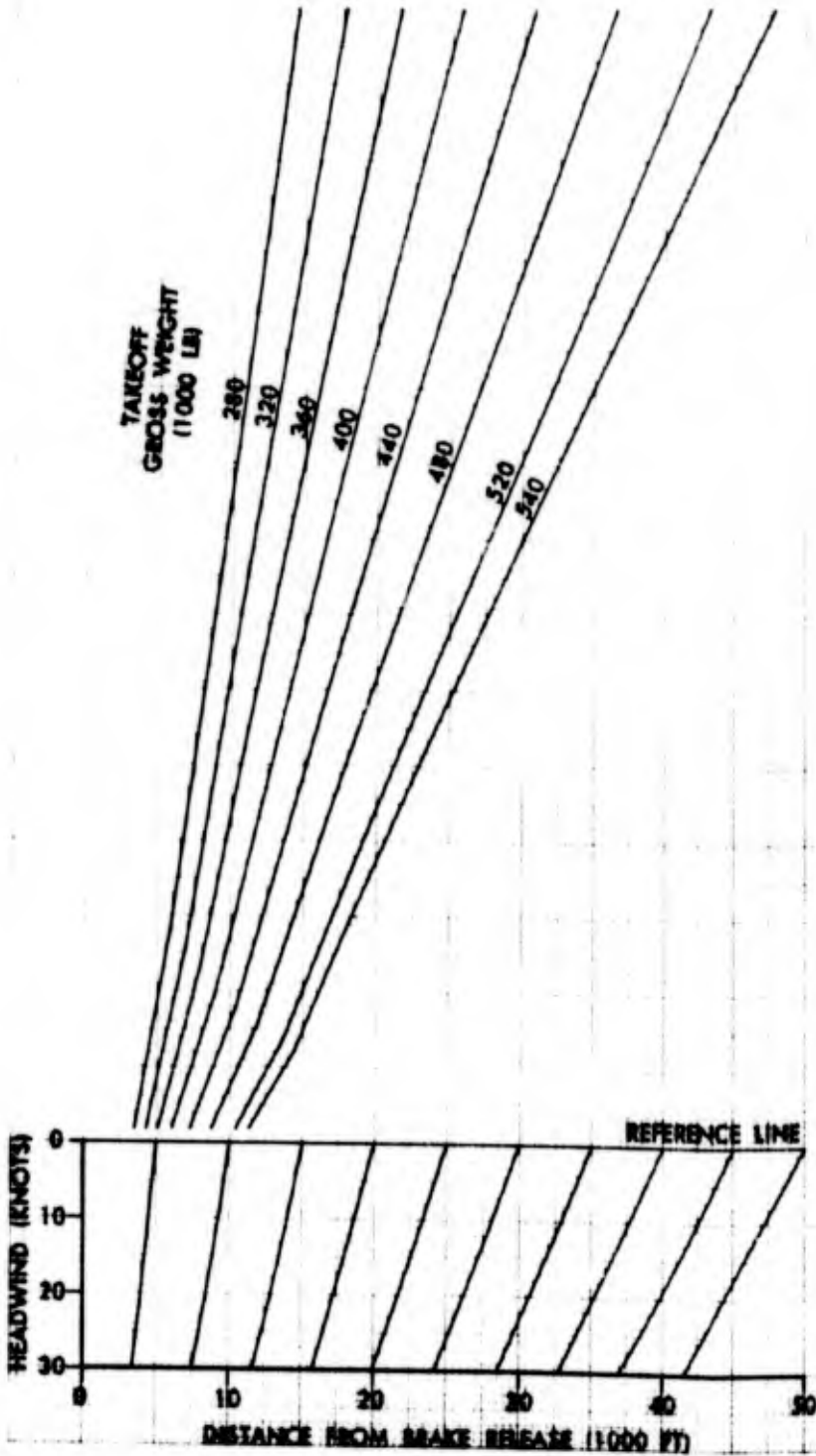
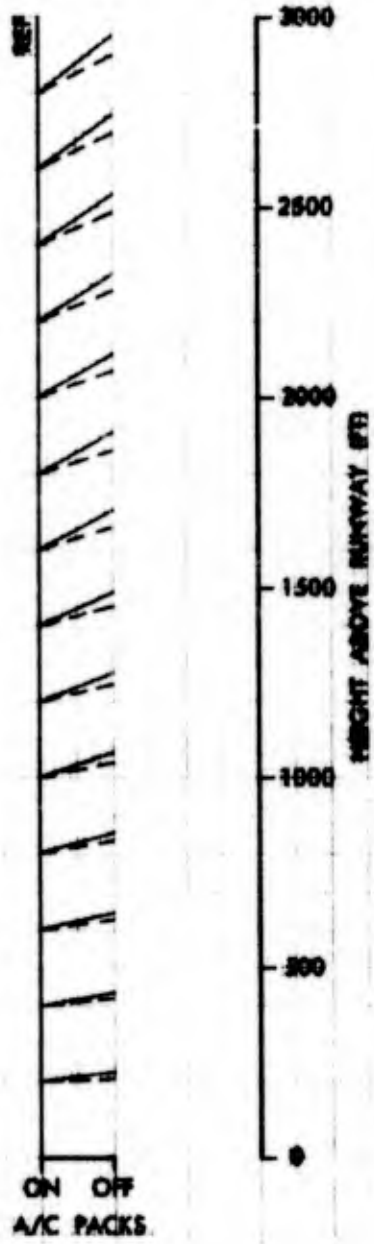
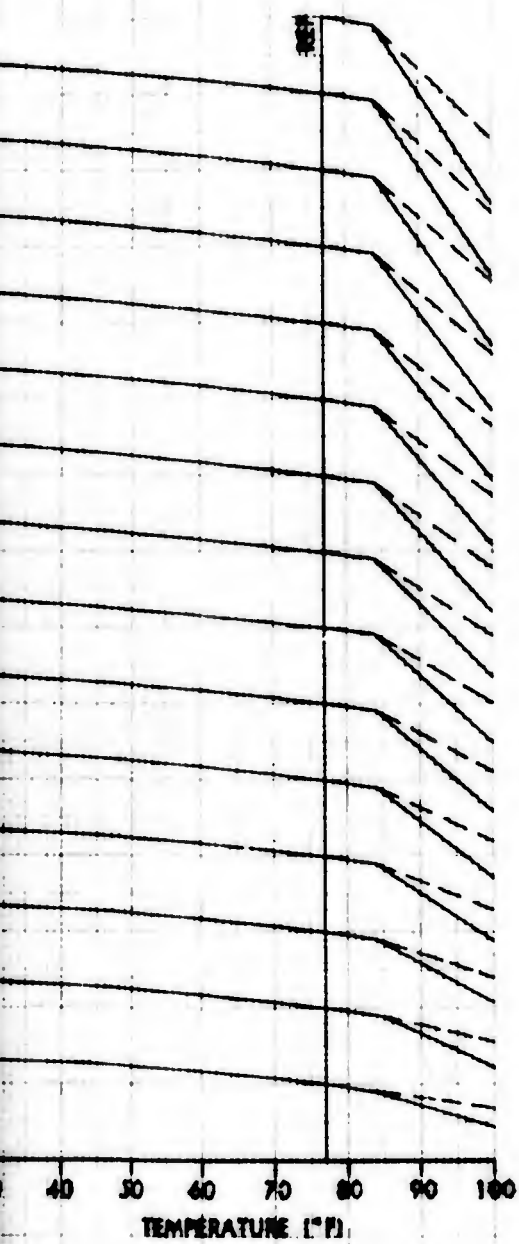


FIGURE 91.

DC-10 SERIES 40
 ALL ENGINE FLIGHT PA
 SEA LEVEL AIRPORT ALTITUDE
 JT9D-20 ENGINES
 5°-25° FLAPS
 CLIMB AT $V_2 + 10$



SERIES NO
FLIGHT PATH
PORT ALTITUDE
ENGINES
FLAPS
V₂ + 10



— 540,000 LB
- - - 280,000 LB

FIGURE 92.

13

DC-10 SERIES 40
 ALL ENGINE FLIGHT PATH
 SEA LEVEL AIRSPEED ALTITUDE
 790 TO 800 KIAS
 5°-25° FLAP
 CLIMB AT V_2 .. 10

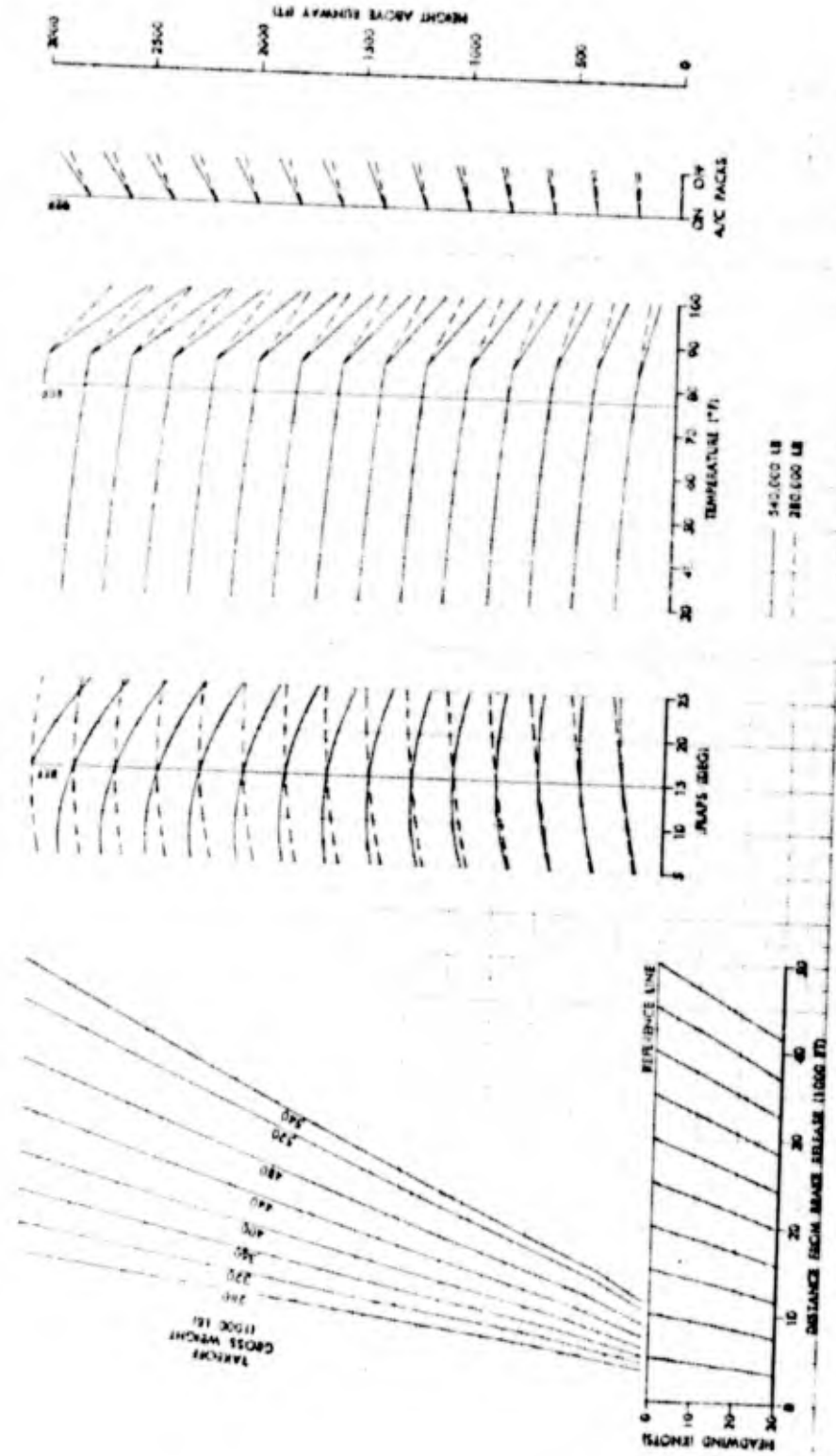


FIGURE 92

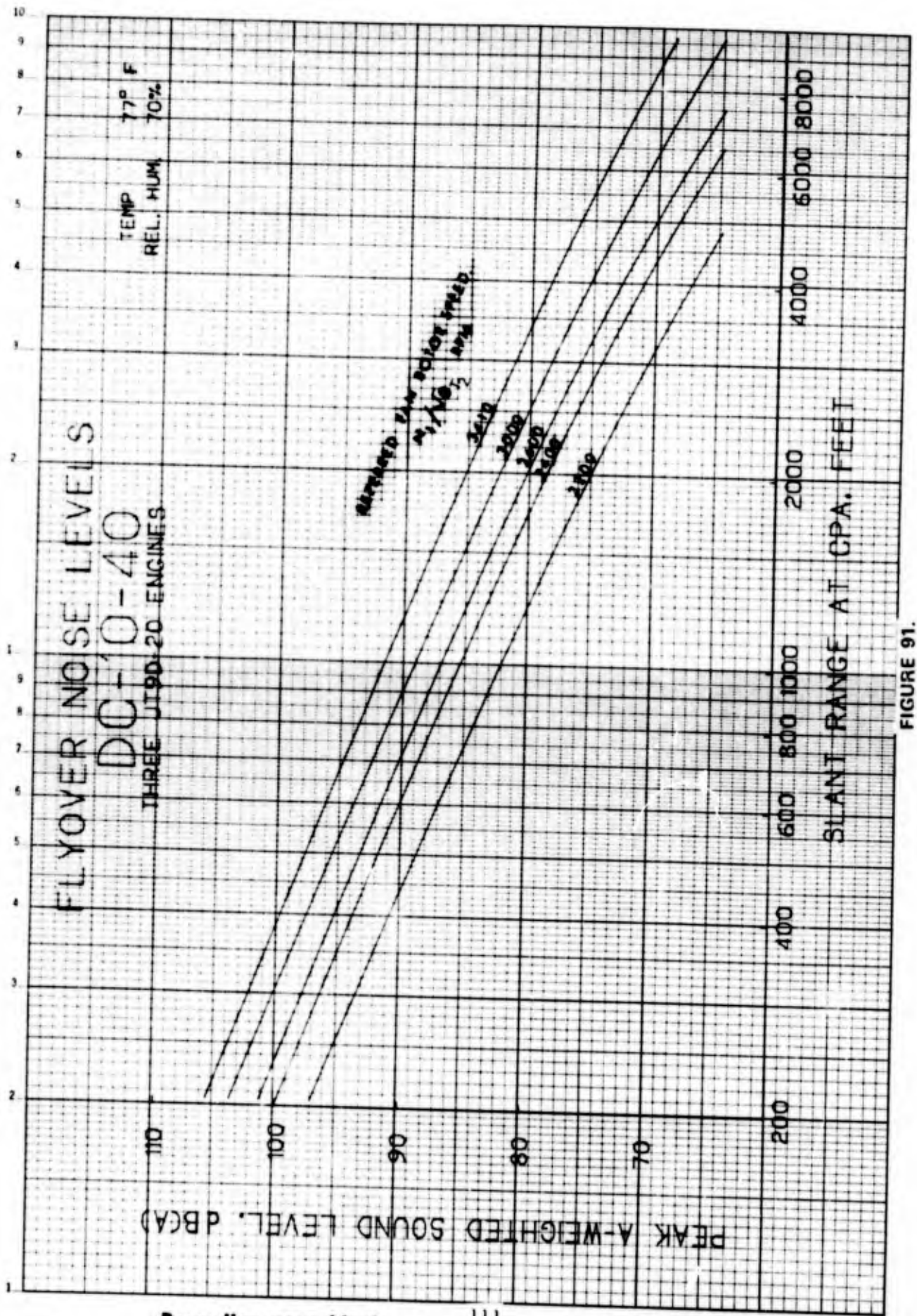


FIGURE 91.

DC-10 SERIES 40
 ALL ENGINE FLIGHT PATH
 SEA LEVEL AIRPORT ALTITUDE
 TWO 20 ENGINES
 5°-25° FLAPS
 CLIMB AT $V_2 - 10$

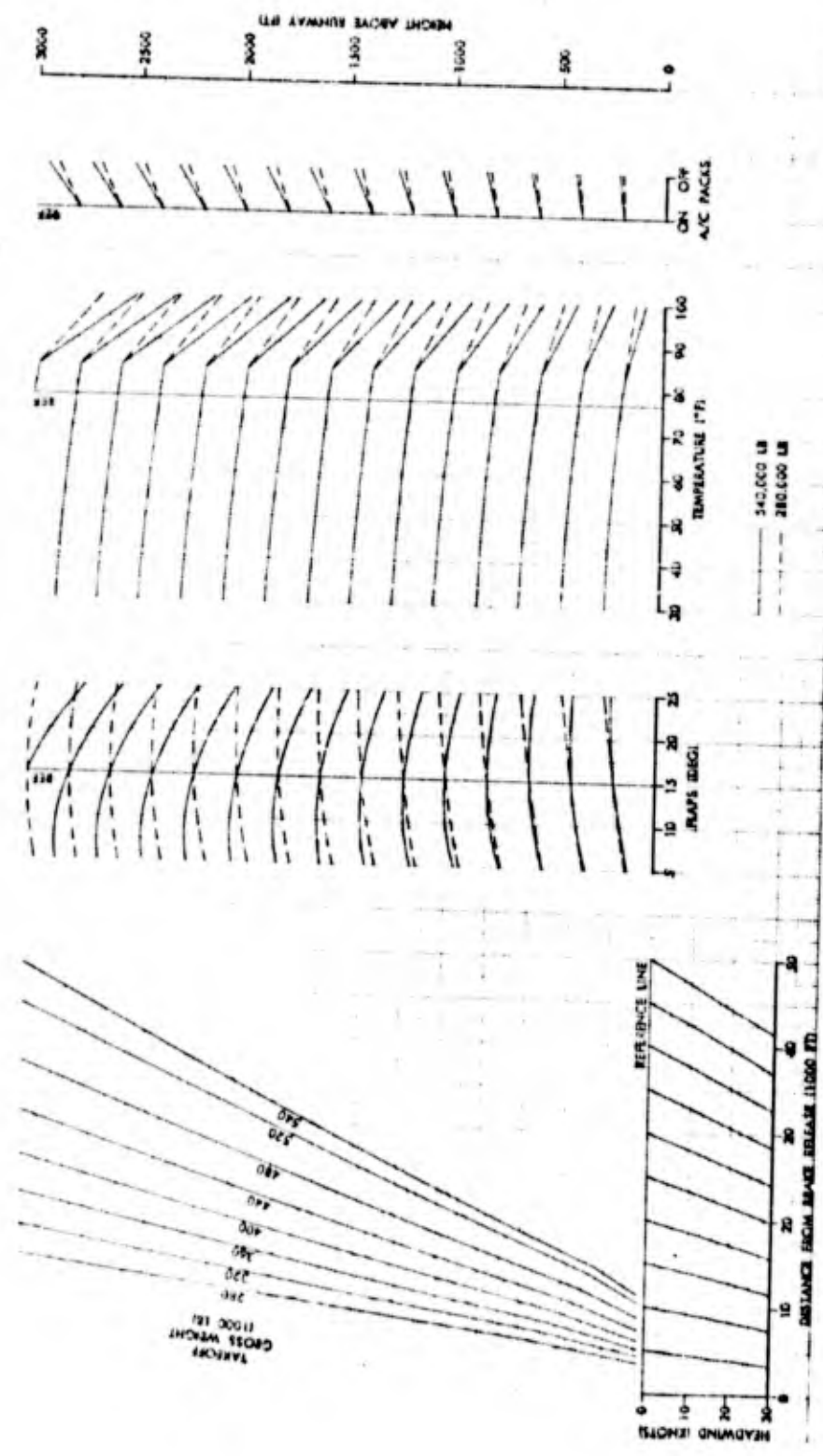


FIGURE 92

DC-10 SERIES 40
 ALL ENGINE FLIGHT PATH
 3000 FT AIRPORT ALTITUDE
 JT9D-20 ENGINES
 5°-25° FLAPS
 CLIMB AT $V_2 + 10$

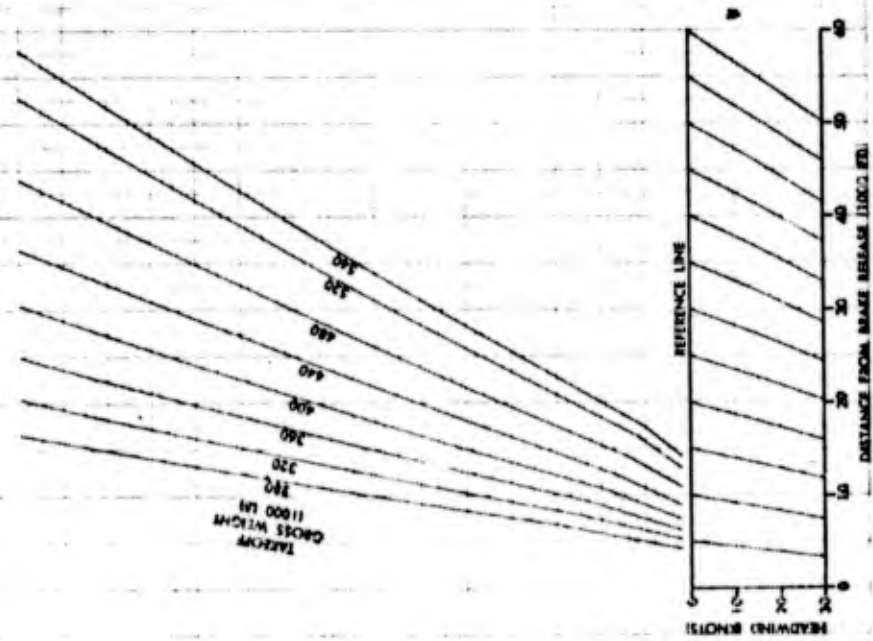
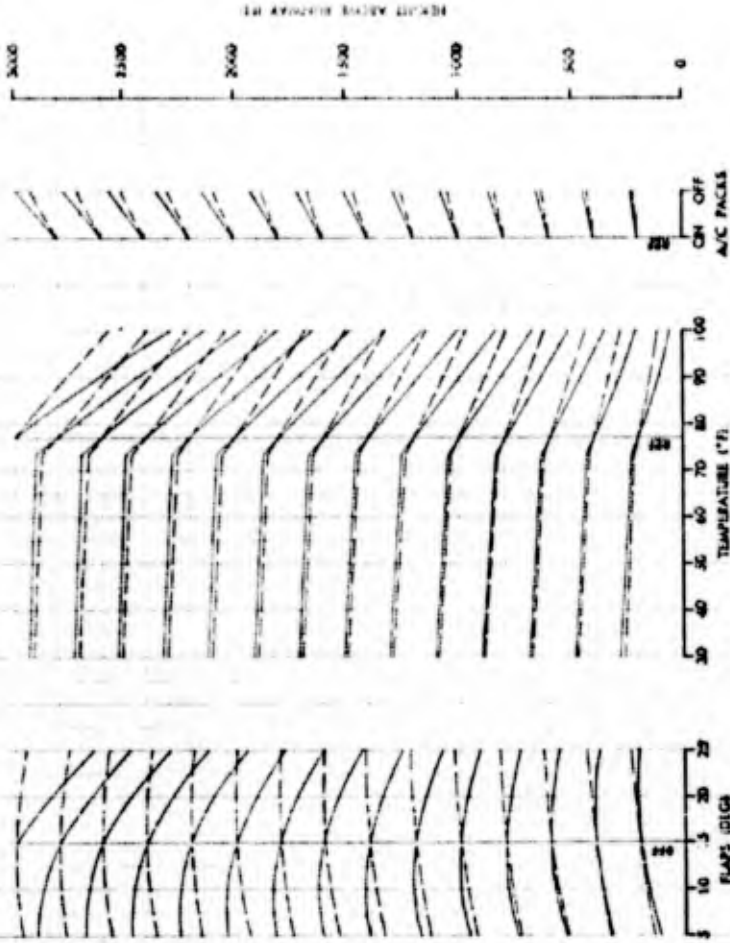
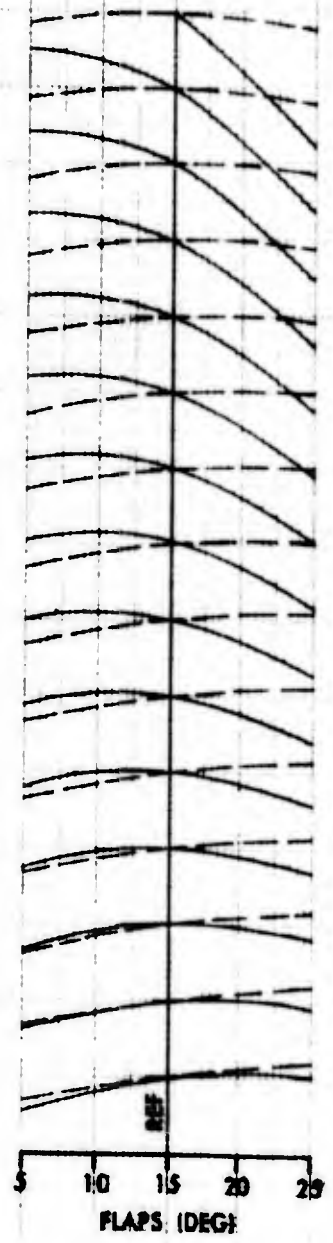
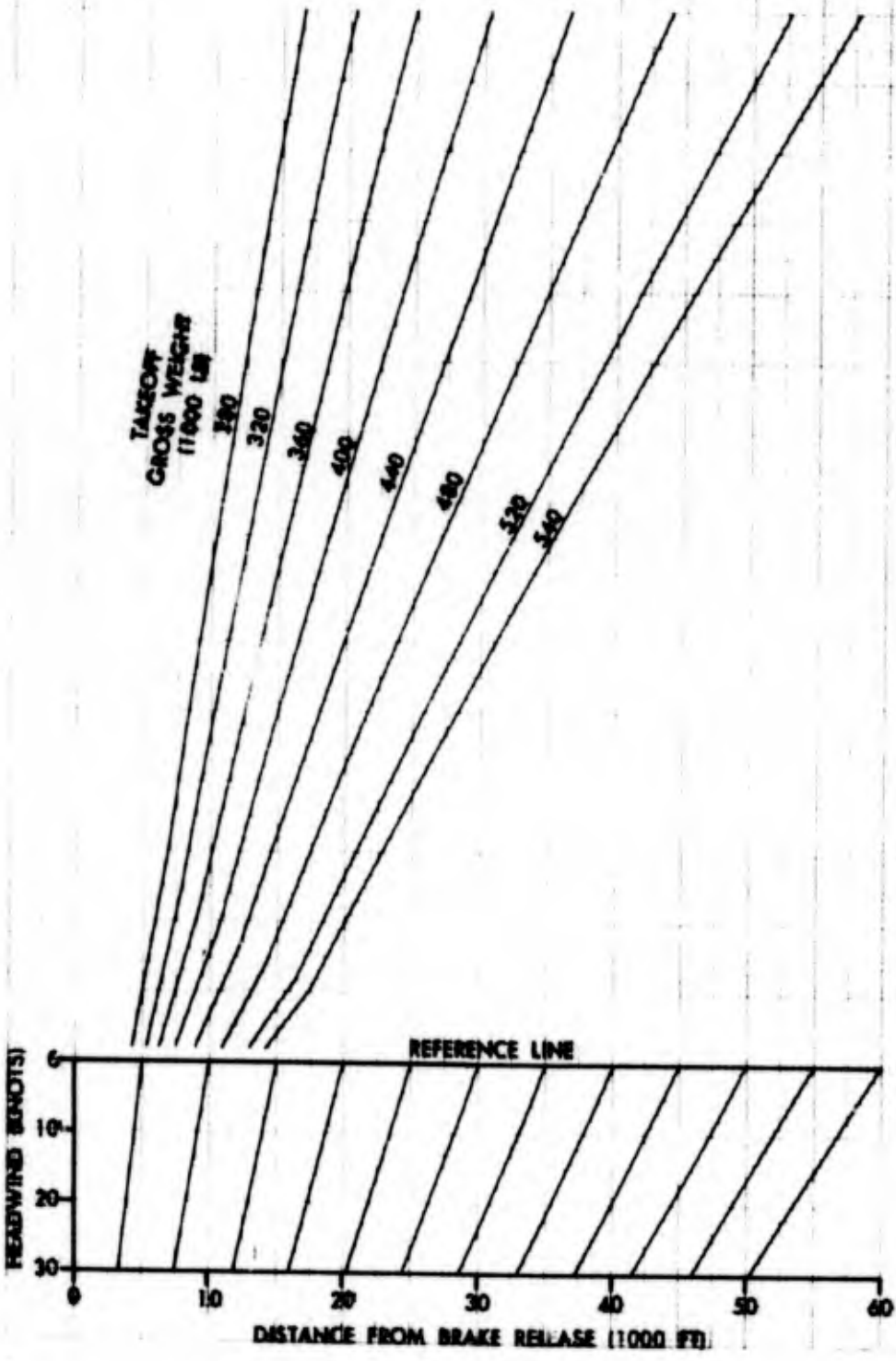


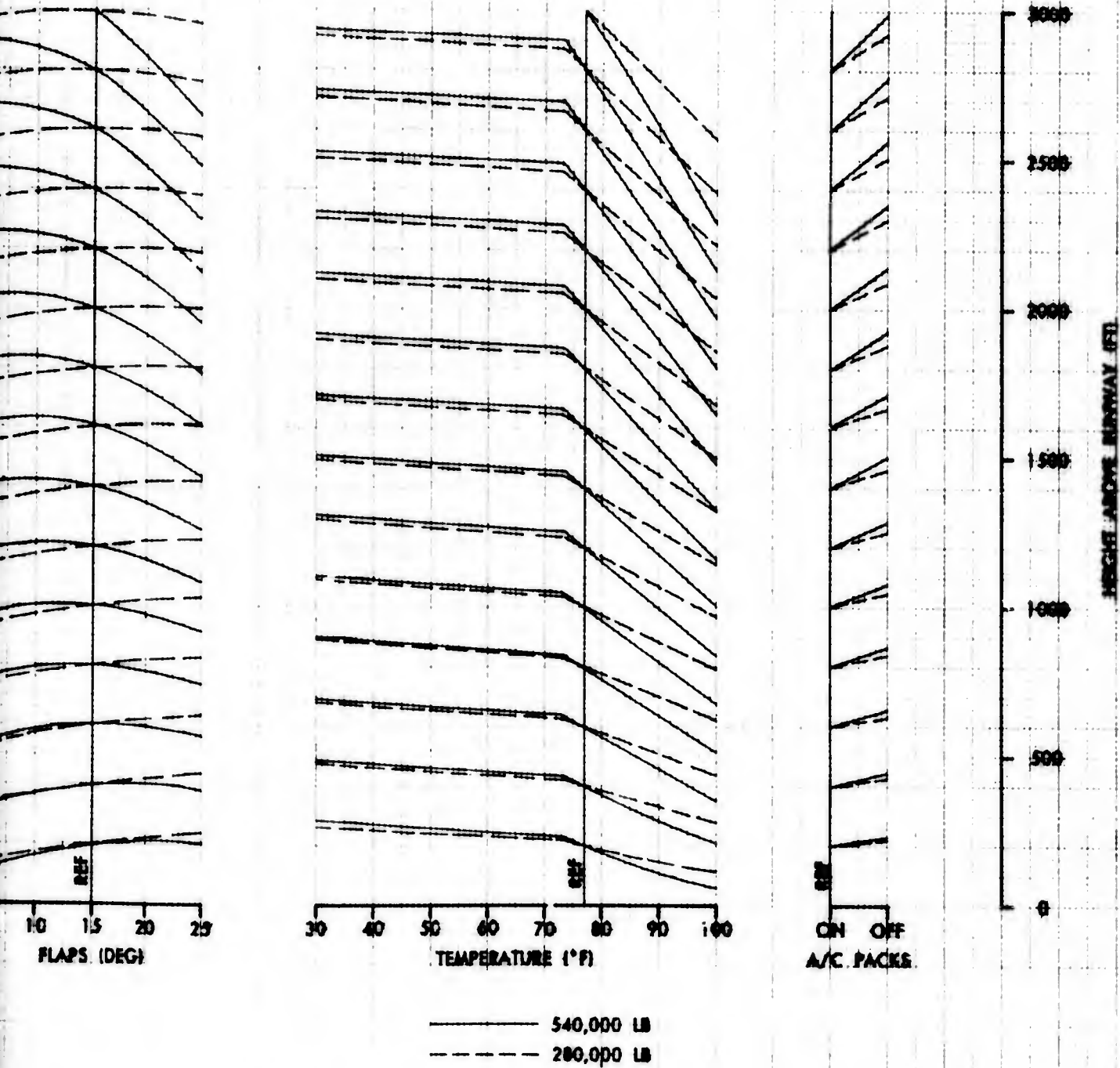
FIGURE 93

DC-10 SERIES 40
ALL ENGINE FLIGHT PAT
 3000 FT AIRPORT ALTITUDE
 JT9D-20 ENGINES
 5°-25° FLAPS
 CLIMB AT $V_2 + 10$

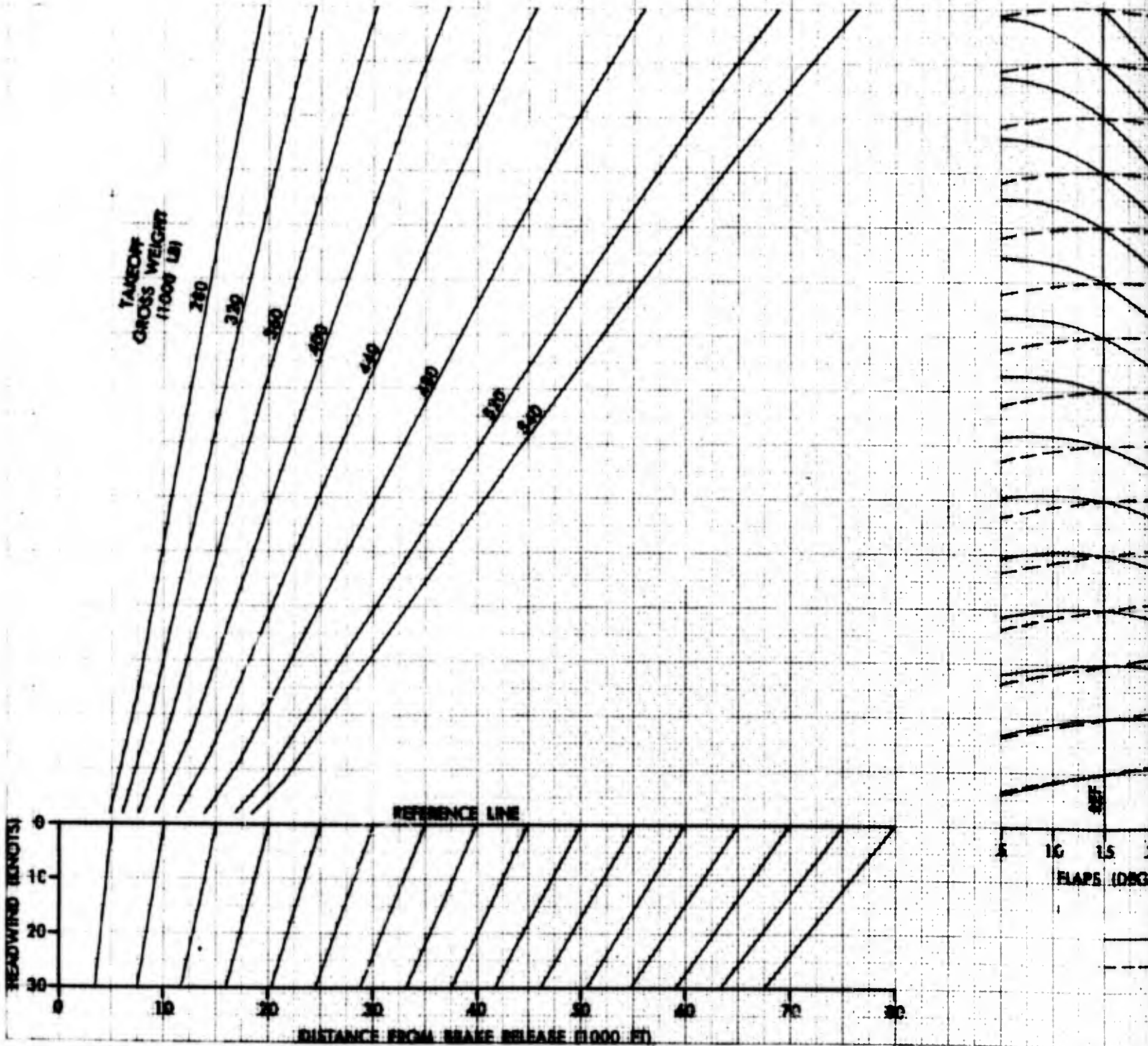


8

DC-10 SERIES 40
ALL ENGINE FLIGHT PATH
 3000 FT AIRPORT ALTITUDE
 JTD-20 ENGINES
 5°-25° FLAPS
 CLIMB AT $V_2 + 10$

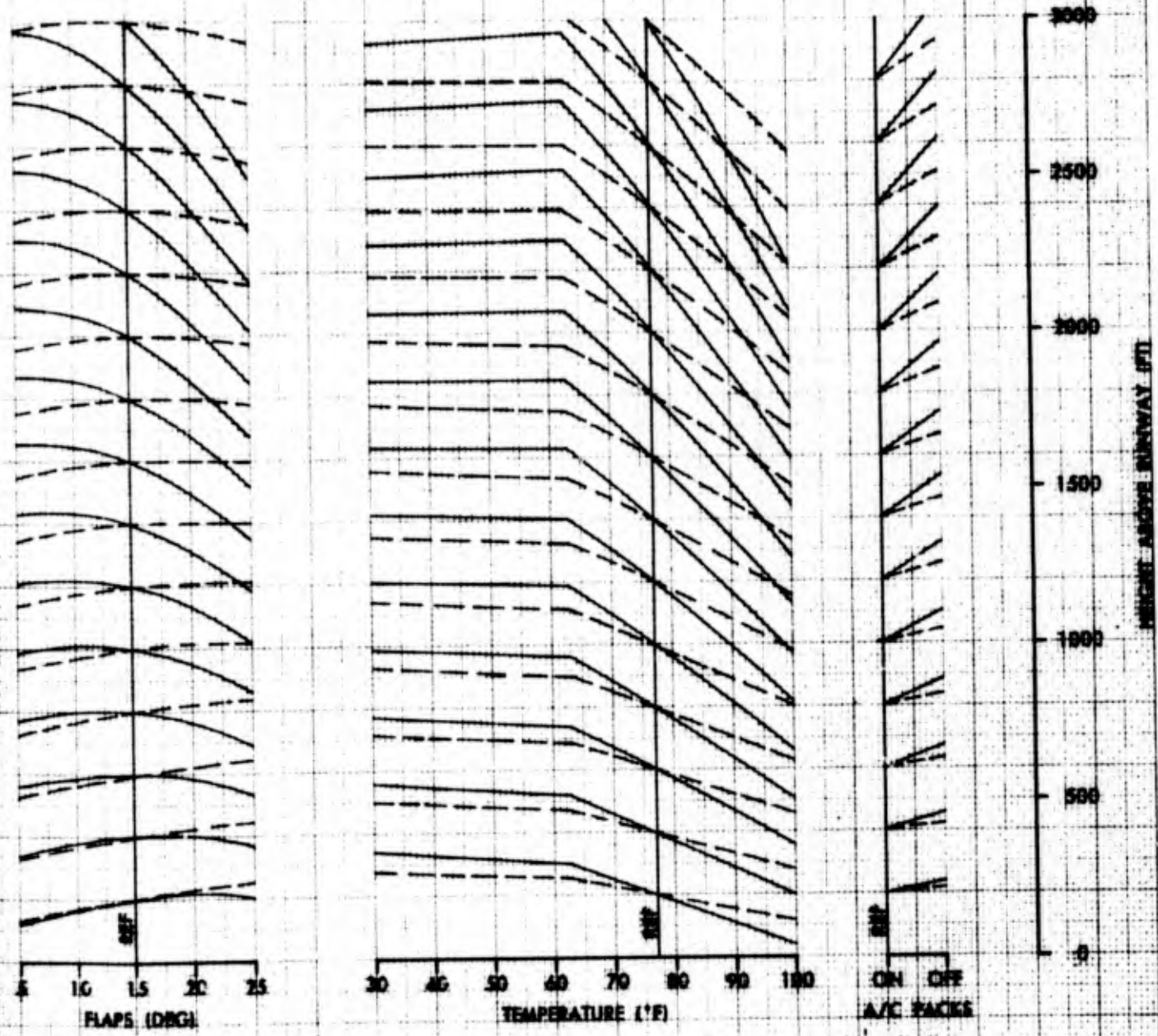


DC-10 SERIES 40
ALL ENGINE FLIGHT PATH
 4000 FT AIRPORT ALTITUDE
 JT9D-20 ENGINES
 5°-25° FLAPS
 CLIMB AT $V_2 + 10$



R

SERIES 40
 E FLIGHT PATH
 REPORT ALTITUDE
 0 ENGINES
 5° FLAPS
 AT $V_2 + 10$



— 540,000 LB
 - - - 290,000 LB

FIGURE 94.

B

DC-10 SERIES 40
 ALL ENGINE FLIGHT PATH
 6000 FT AIRPORT ALTITUDE
 JTJ-20 ENGINES
 5°-25° FLAPS
 CLIMB AT $V_2 + 10$

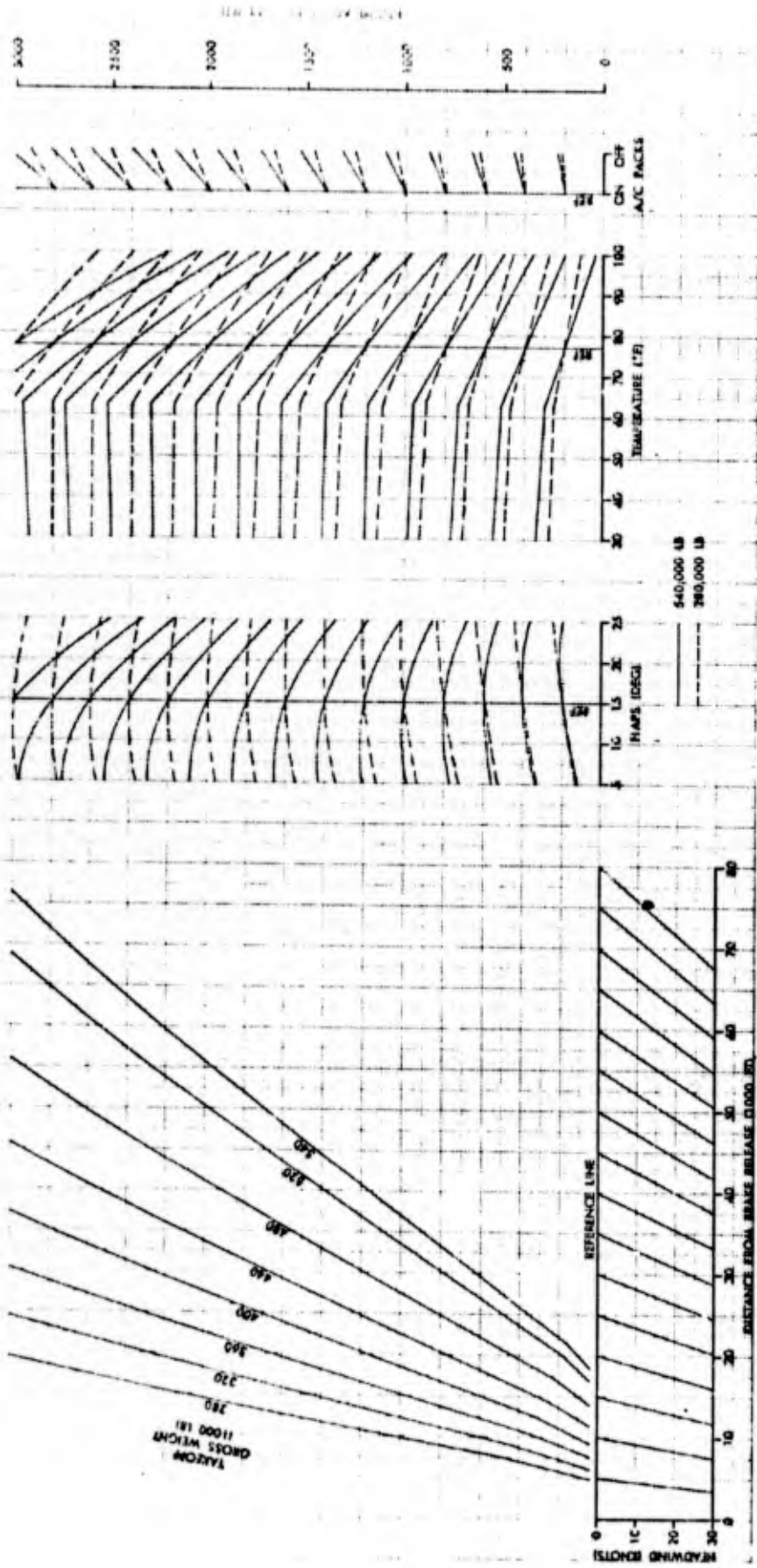


FIGURE 94

DC-10 SERIES 40
 N_1/V_{T_1} AT CLIMAX
 J775-38 ENGINES

100% N_1/V_{T_1} @ 2400 RPM

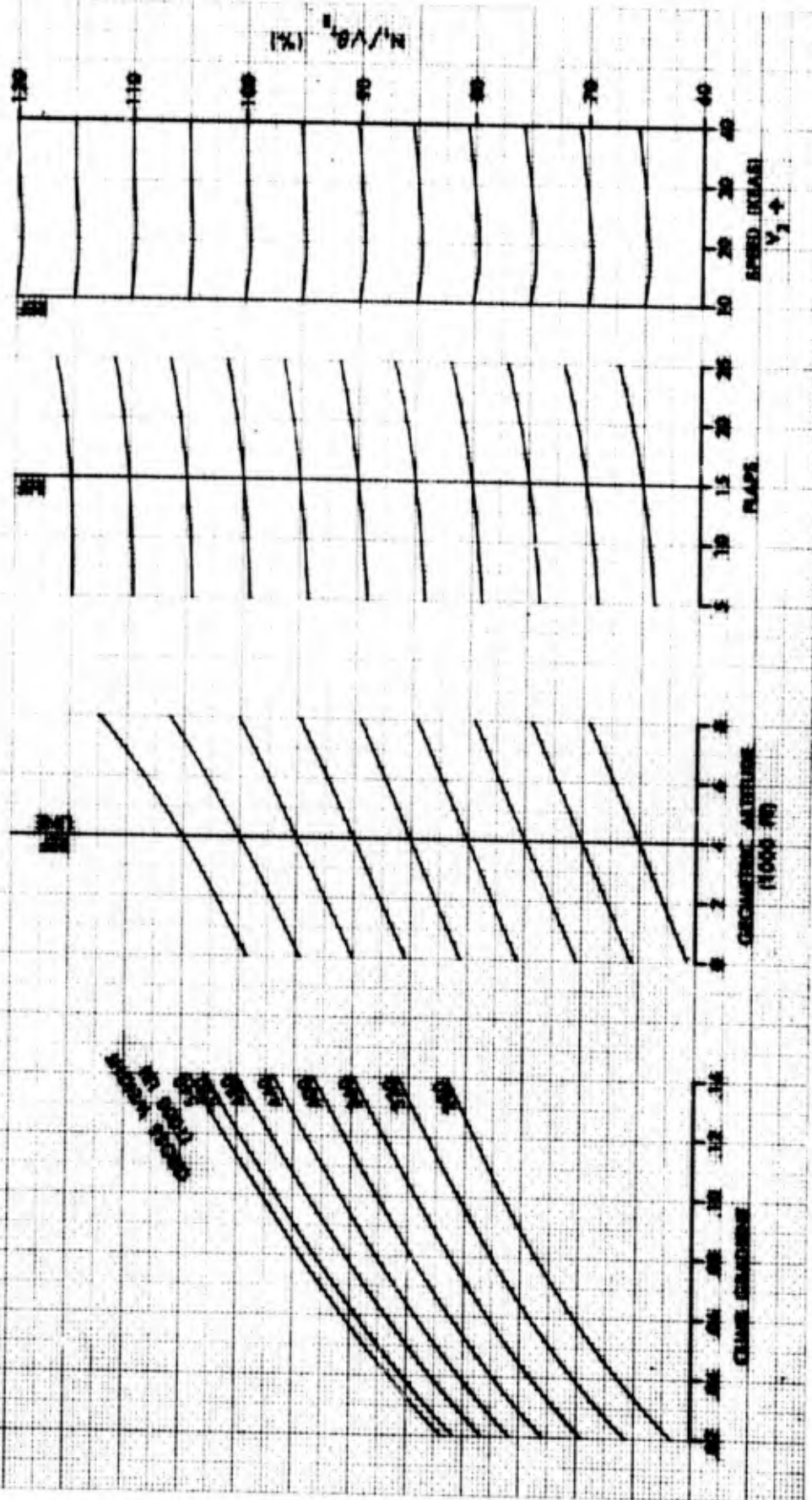


FIGURE 95.

DC-10 SERIES 40
 $N_1 / \sqrt{\theta_{T_2}}$ AT CUTBACK

JT9D-20 ENGINES
 CLEAN CONFIGURATION
 250 KNOTS IAS

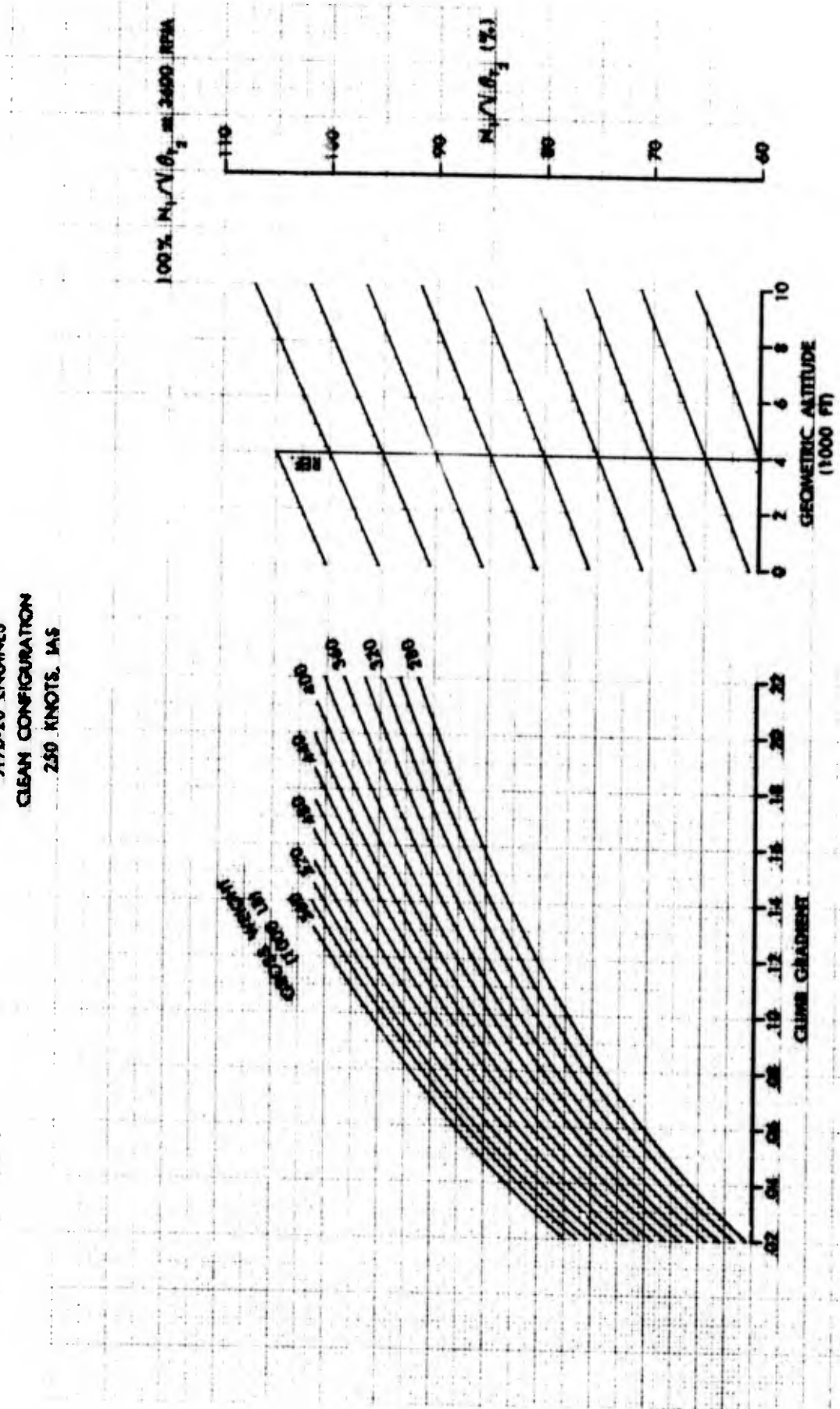


FIGURE 96.

**DC-10 SERIES 40
REFERRED FAN SPEED VS GLIDE SLOPE**
JT9D-20 ENGINES
50° FLAPS

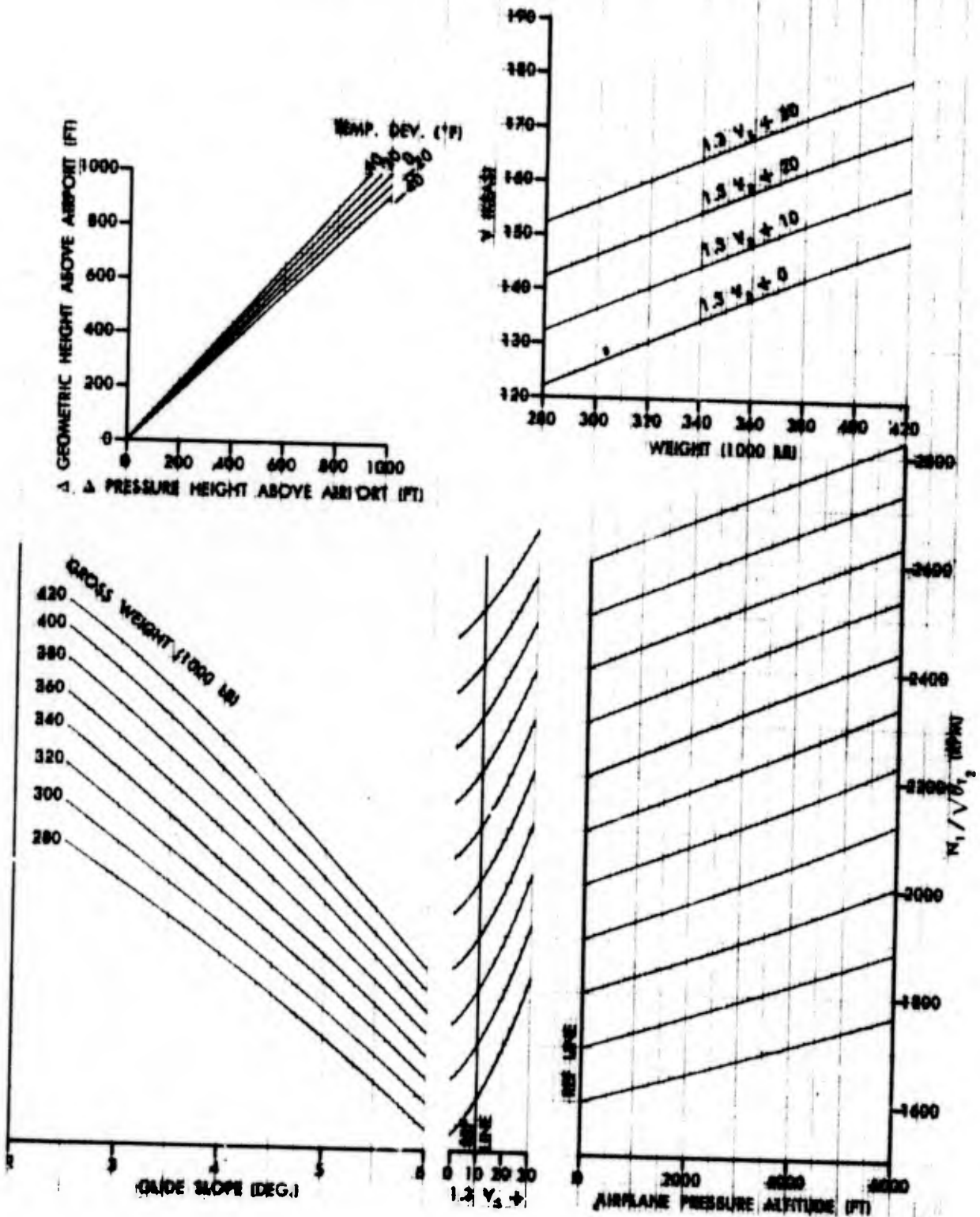


FIGURE 97.

**DC-10 SERIES 40
REFERRED FAN SPEED VS GLIDE SLOPE
JT9D-20 ENGINES
35° FLAPS**

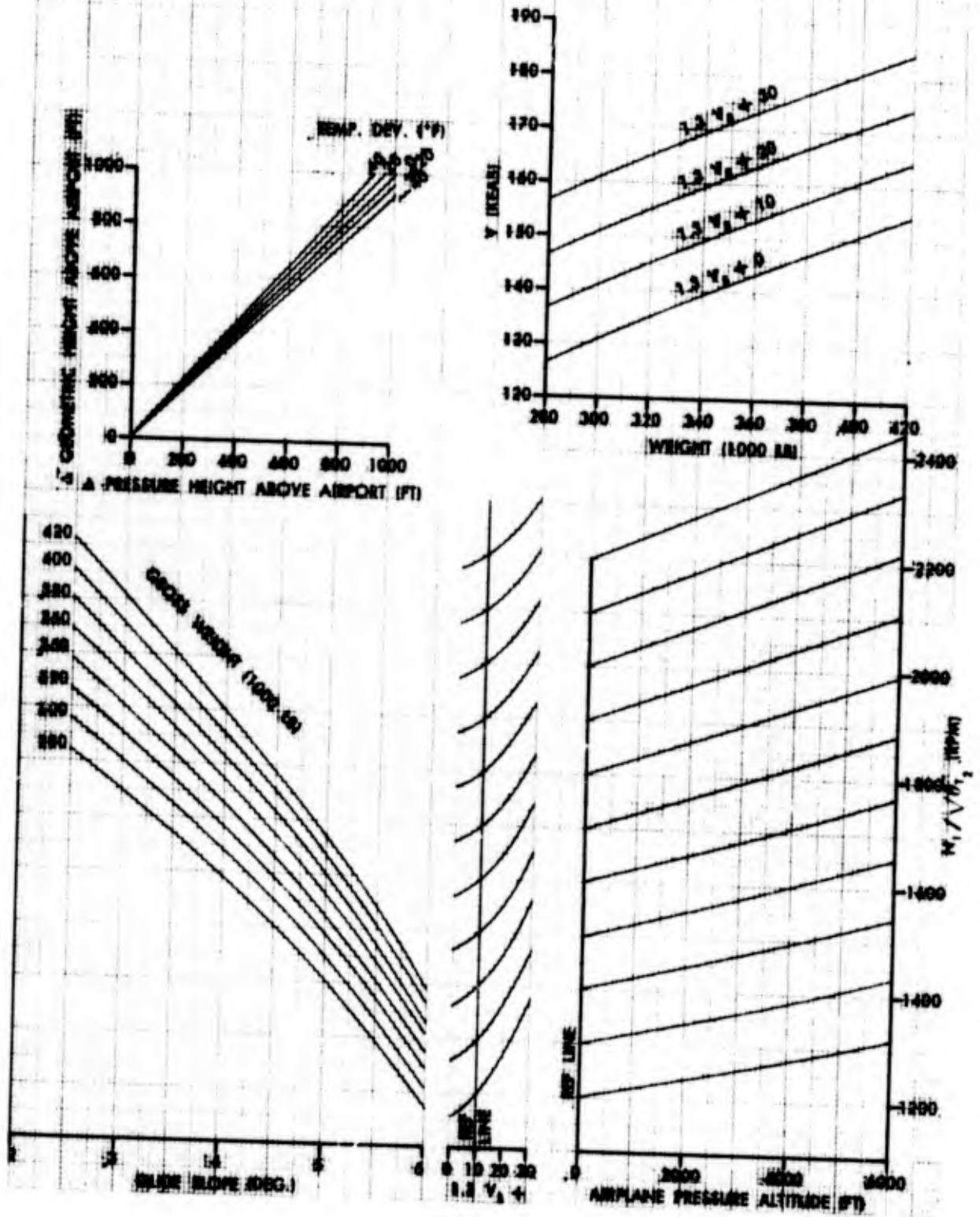


FIGURE 98.

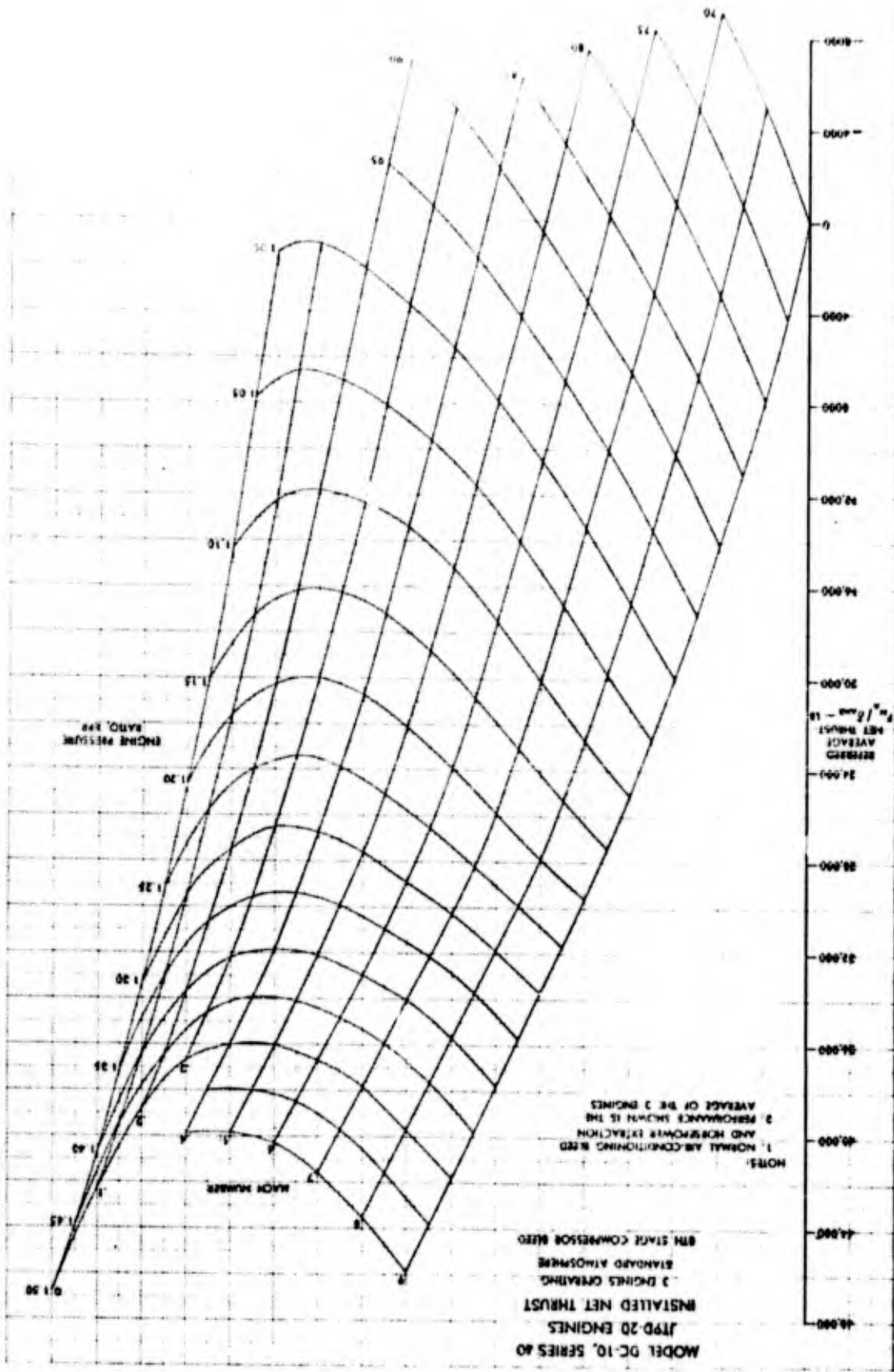
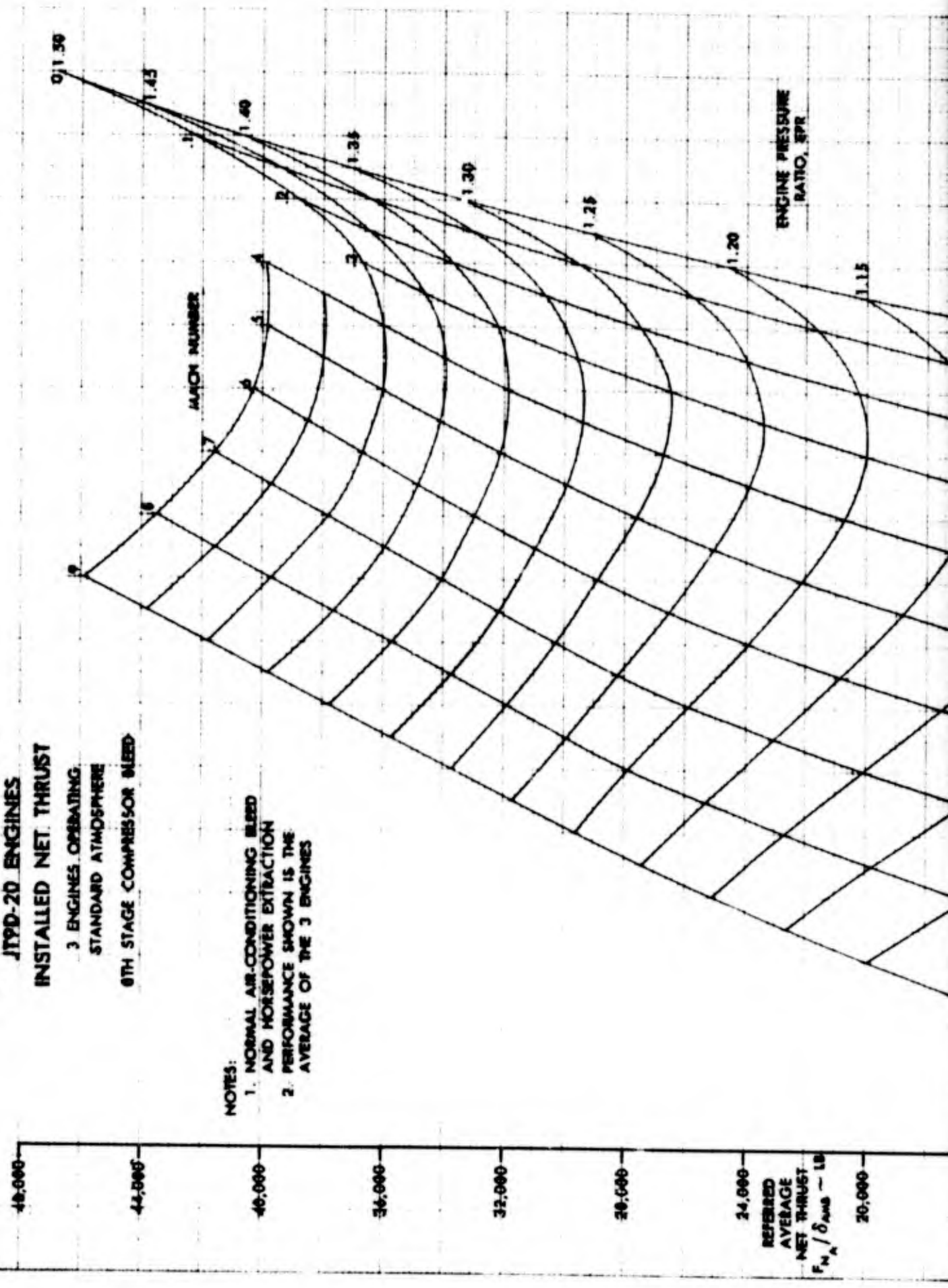


FIGURE 99

**MODEL DC-10, SERIES 40
JTD-20 ENGINES
INSTALLED NET THRUST
3 ENGINES OPERATING
STANDARD ATMOSPHERE
8TH STAGE COMPRESSOR BLEED**

NOTES:

1. NORMAL AIR-CONDITIONING BLEED AND HORSEPOWER EXTRACTION
2. PERFORMANCE SHOWN IS THE AVERAGE OF THE 3 ENGINES



ENGINE PRESSURE RATIO, EPR

REFLECTED AVERAGE NET THRUST $F_{NA} / \delta_{AMB} - LB$

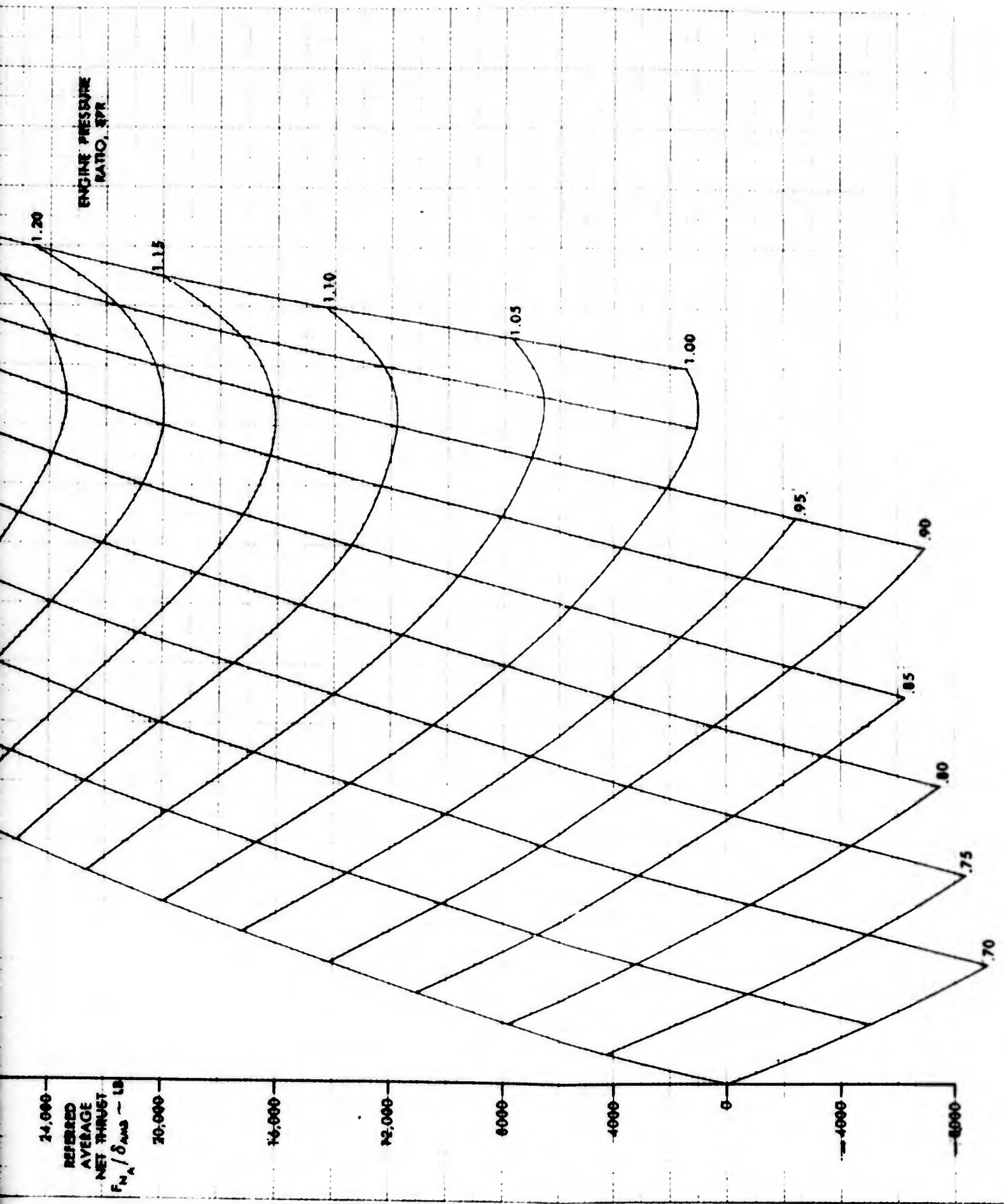


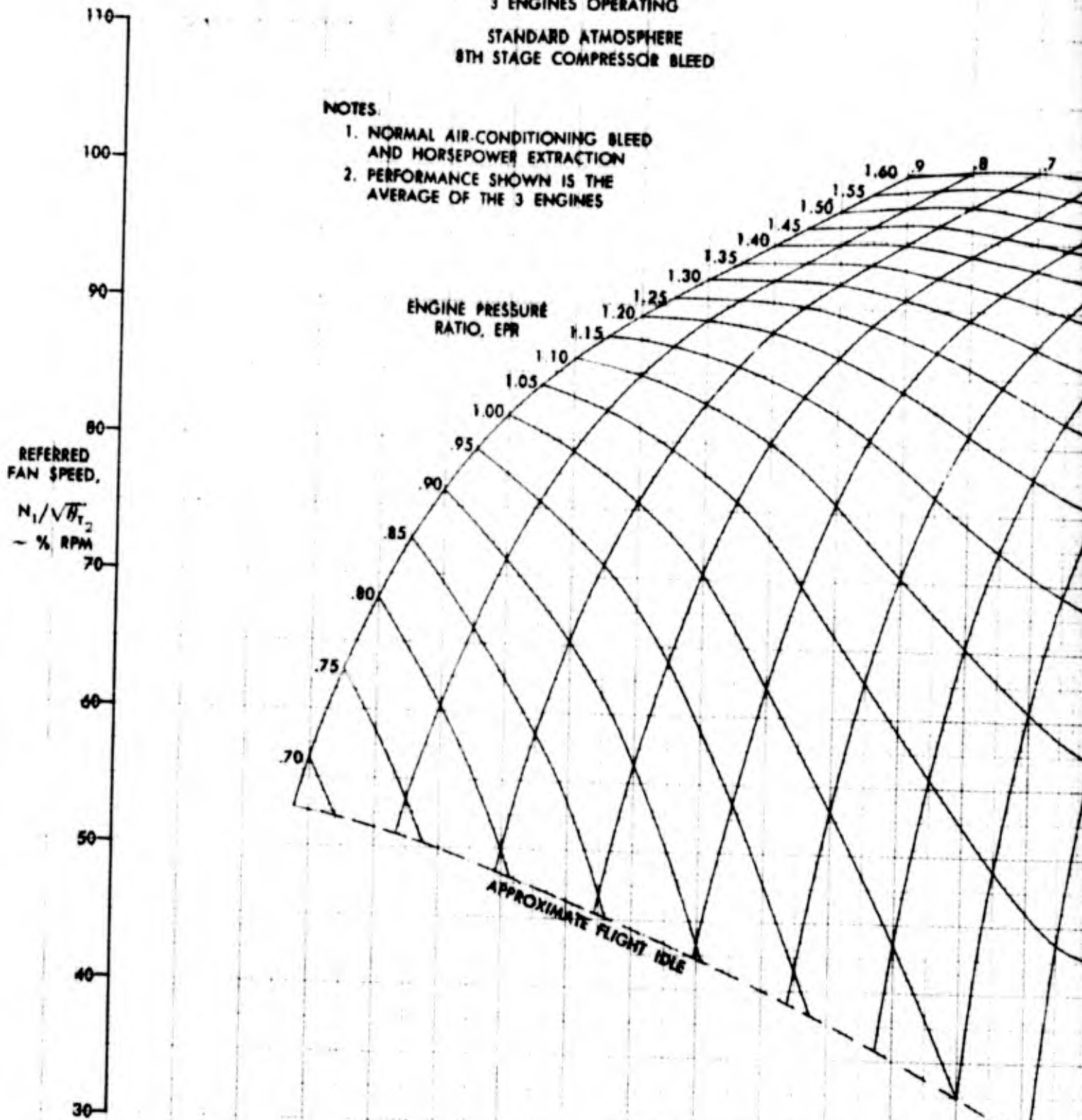
FIGURE 99.

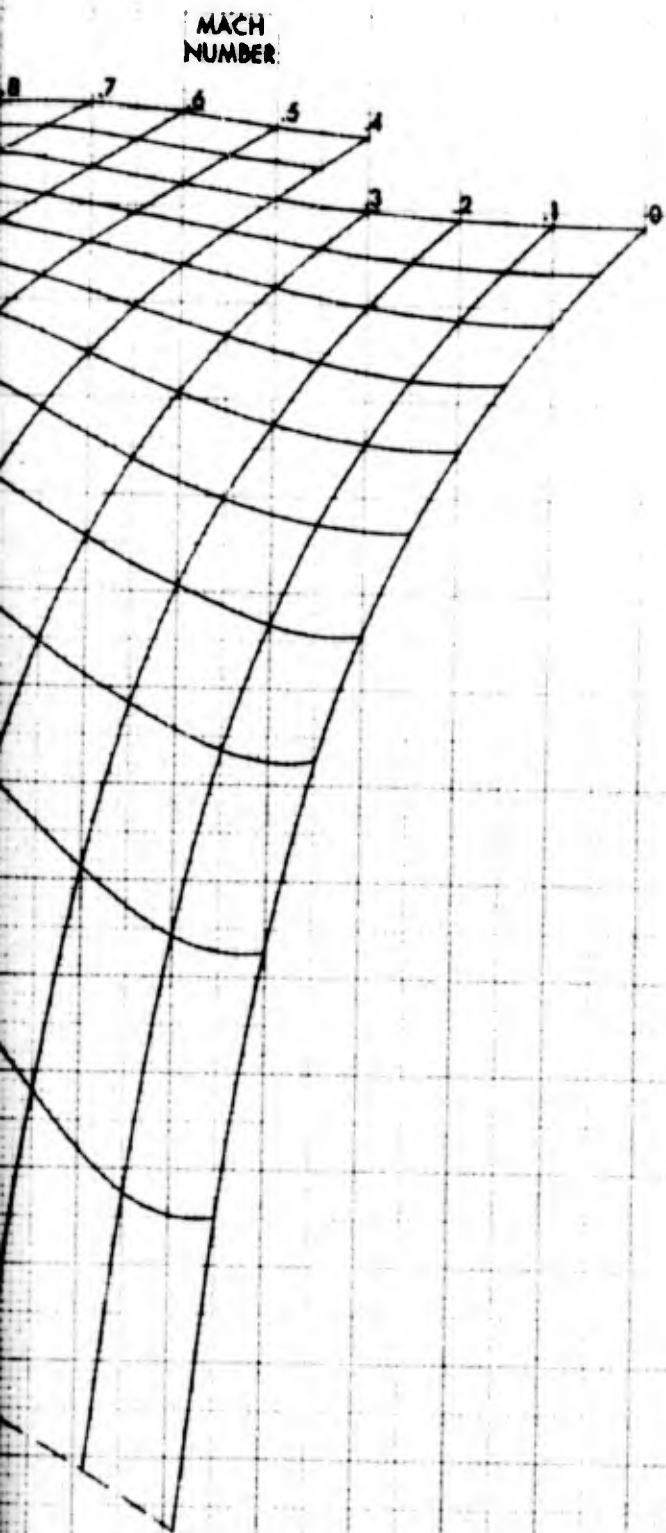
B

MODEL DC-10, SERIES 40
 JT9D-20 ENGINES
 INSTALLED FAN SPEED
 3 ENGINES OPERATING
 STANDARD ATMOSPHERE
 8TH STAGE COMPRESSOR BLEED

NOTES:

1. NORMAL AIR-CONDITIONING BLEED AND HORSEPOWER EXTRACTION
2. PERFORMANCE SHOWN IS THE AVERAGE OF THE 3 ENGINES





B

**MODEL DC-10, SERIES 40
JT9D-20 ENGINES
INSTALLED FAN SPEED**

3 ENGINES OPERATING
STANDARD ATMOSPHERE
8TH STAGE COMPRESSOR BLEED

NOTES

1. NORMAL AIR CONDITIONING BLEED AND MISTAKE EXHAUSTION
2. PERFORMANCE SHOWN IS THE AVERAGE OF THE 3 ENGINES

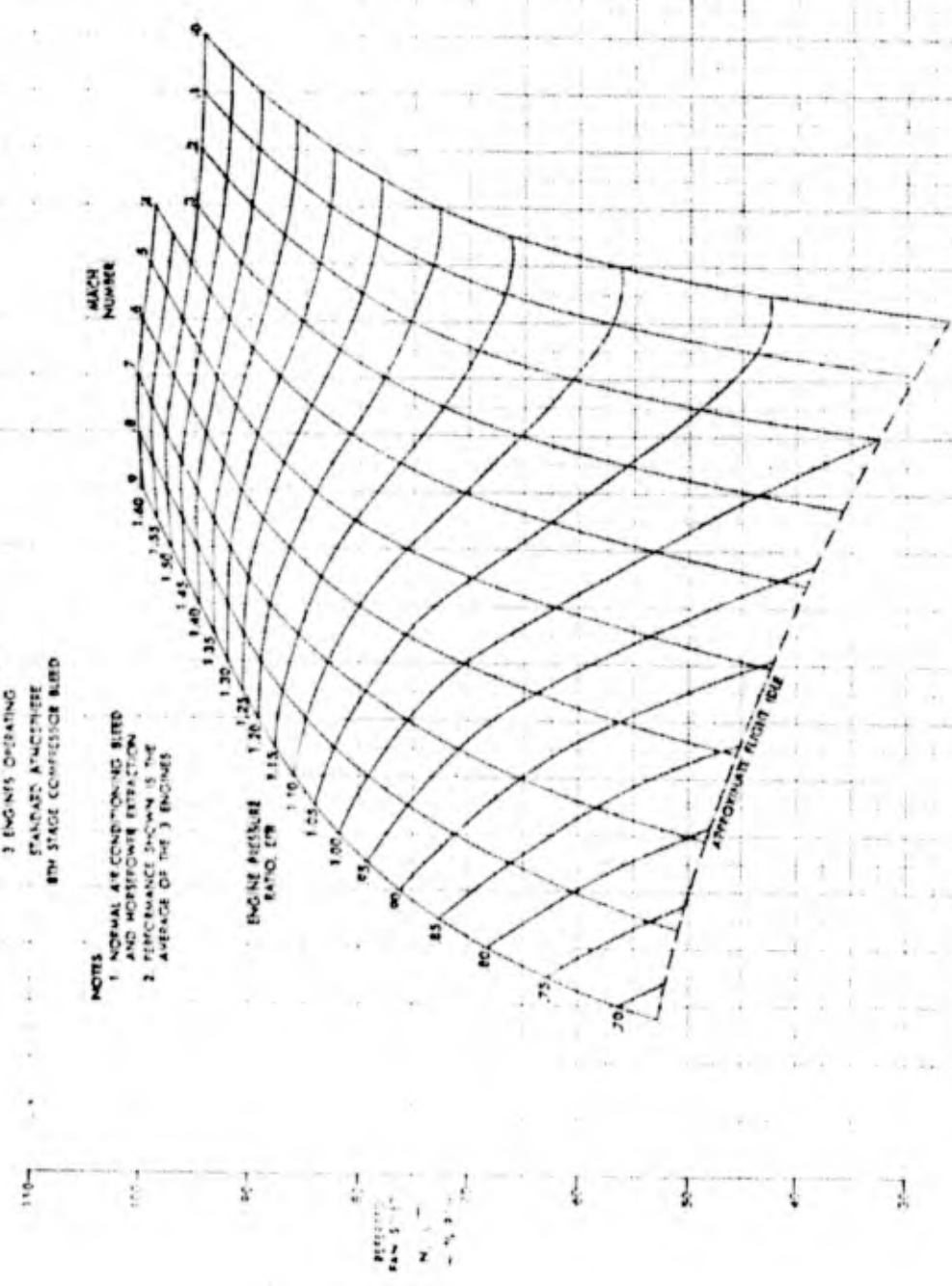


FIGURE 100

SECTION 3 CORRECTION CURVES

This section contains curves for adjusting the values of EPNL and A-weighted sound level obtained from the noise level versus distance maps for a variation in ambient temperature from the reference-day temperature of 77°F for several slant ranges, corrections for variation of runway pressure altitude from sea level to 6000 feet, and discussion on the changes in atmospheric absorption with ambient pressure as applied to noise levels measured at various pressure altitudes.

3.1 TEMPERATURE CORRECTION CURVES

Figures 101-103 show corrections to be applied to the reference-day EPNLs or A-weighted sound levels for the DC-8, DC-9, and DC-10, for temperatures from 30° to 100°F with the relative humidity held constant at 70 percent and slant ranges up to 10,000 feet. The curves at 450, 1000, and 2500 feet were derived empirically from measured data adjusted for the temperature change for three thrusts representative of full thrust, approximately 70-percent thrust and a typical approach thrust, by the computer program M9QA, which utilizes atmospheric absorption from Reference 4. The curves for 5000 and 10,000 feet were derived by extrapolating measured data by means of a computer program combining the capabilities of E2QA and M9QA using inverse-square and absorption data from Reference 4.

The computer programs were used to adjust the 1/3-octave-band SPLs at the time of maximum tone-corrected perceived noise level (PNLTM) to the various conditions and a new PNLTM was determined from the adjusted spectrum. The difference between the reference-day and adjusted PNLTM is the Δ EPNL. It was assumed that the duration correction remained constant for a given slant range. The changes in A-weighted sound levels were determined in a similar manner.

Linear interpolation may be used for slant ranges between those shown. The curves include effects such as change in noise source with altitude and change in atmospheric attenuation with temperature.

DC-8-61, -63

RELATIVE HUMIDITY HELD CONSTANT AT
70-PERCENT RUNWAY AT SEA LEVEL

SLANT RANGE AT CPA
10,000 FT

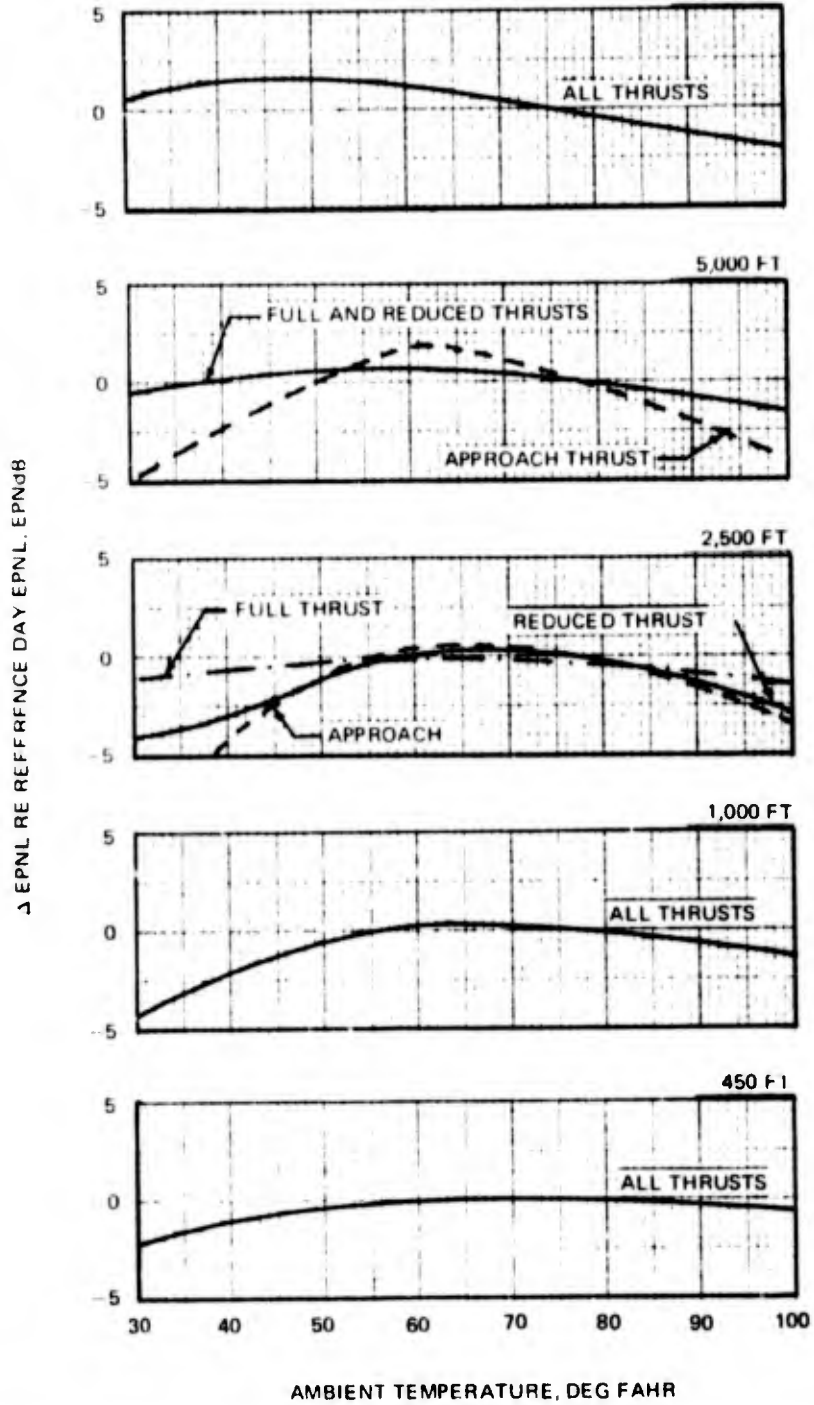


FIGURE 101. VARIATION IN EPNL WITH CHANGE IN AMBIENT SURFACE TEMPERATURE AND SLANT RANGE REFERRED TO 77°F

DC 9 30 WITH JT8D-7/9 ENGINES
 RELATIVE HUMIDITY HELD CONSTANT AT 70 PERCENT
 RUNWAY AT SEA LEVEL

SLANT RANGE AT CPA

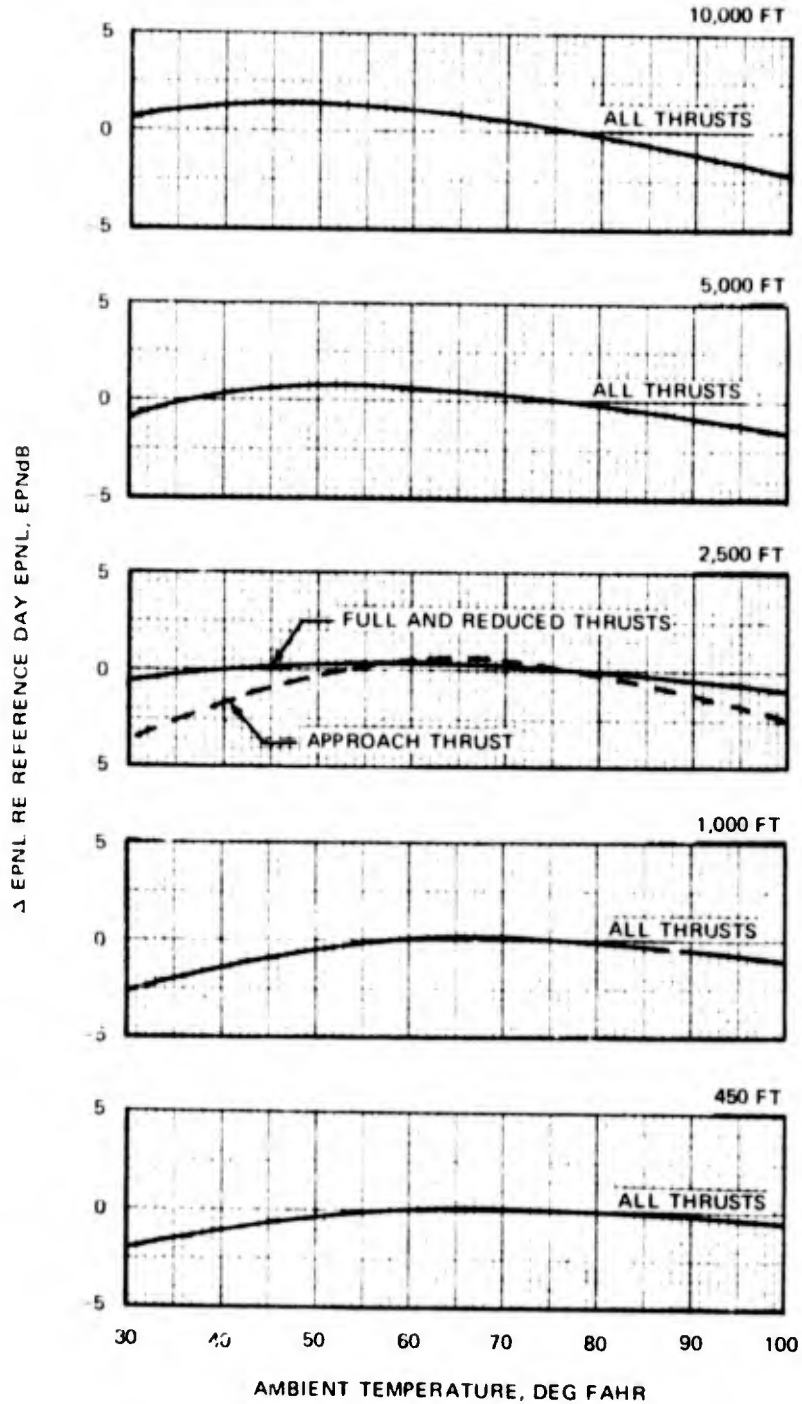
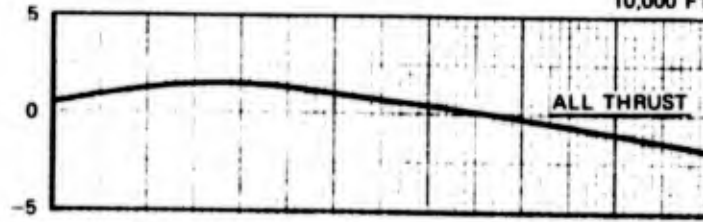


FIGURE 102. VARIATION IN EPNL WITH CHANGE IN AMBIENT SURFACE TEMPERATURE AND SLANT RANGE REFERRED TO 77°F

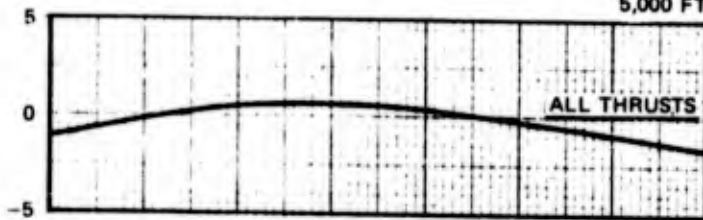
DC-10-10, -40

RELATIVE HUMIDITY HELD CONSTANT AT
70-PERCENT RUNWAY AT SEA LEVEL

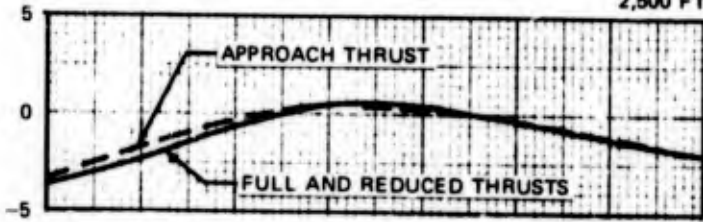
SLANT RANGE AT CPA
10,000 FT



5,000 FT



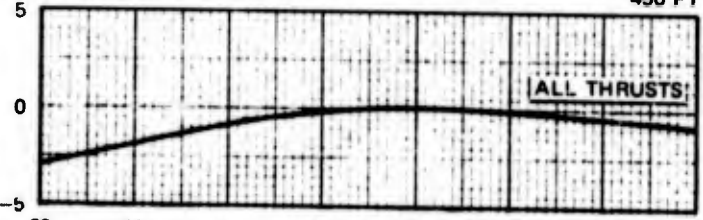
2,500 FT



1,000 FT



450 FT



AMBIENT TEMPERATURE, DEG FAHR

FIGURE 103. VARIATION IN EPNL WITH CHANGE IN AMBIENT SURFACE TEMPERATURE AND SLANT RANGE REFERRED TO 77°F

Figures 104-106 present similar curves for adjustment of the A-weighted sound levels for temperature and slant range.

3.2 CORRECTION FOR AIRPORT PRESSURE ALTITUDE

Figure 107 presents correction curves from sea level to 6000 feet pressure altitude for a range of ambient temperatures from 30° to 100°F; 77°F is the reference temperature.

The curves are based on the premise that for a free, progressive sound wave, the mean-square sound pressure equals the product of the sound intensity and ρc , the characteristic resistance of the medium or

$$P_{\text{rms}}^2 = I \rho c.$$

From this it follows that

$$\text{SPL} = 20 \log_{10} \frac{P_{\text{rms}}}{P_{\text{ref}}} = 10 \log_{10} \frac{I \rho c}{(I \rho c)_{\text{ref}}}$$

Assuming the sound intensity remains constant, the change in SPL will depend only on the variation of ρc with altitude and temperature from the reference ρc for sea level, 77°F day, which is 410 mks rays. A change of surface temperature and altitude would result in a change in ρc and corresponding change in SPL that applies to each frequency band and would therefore be approximately equal to the change in PNL (hence EPNL) or A-weighted sound level. The curves were derived from data based on Reference 5.

3.3 ATMOSPHERIC ABSORPTION VARIATION WITH AMBIENT PRESSURE

Based on work performed by Harris, described in Reference 6, and an analysis performed by Shapiro in Reference 7, there is evidence that flyover noise measurements taken at altitudes above sea level, and therefore at reduced ambient pressures relative to sea level, result in higher noise levels for the relative humidities of usual interest than would be measured at sea level for the same temperature and relative humidity. Measurements by Harris at reduced pressures down to 0.4 atmospheres indicated that the peak absorption

DC-8-61, -63

RELATIVE HUMIDITY HELD CONSTANT AT
70-PERCENT RUNWAY AT SEA LEVEL

SLANT RANGE AT CPA

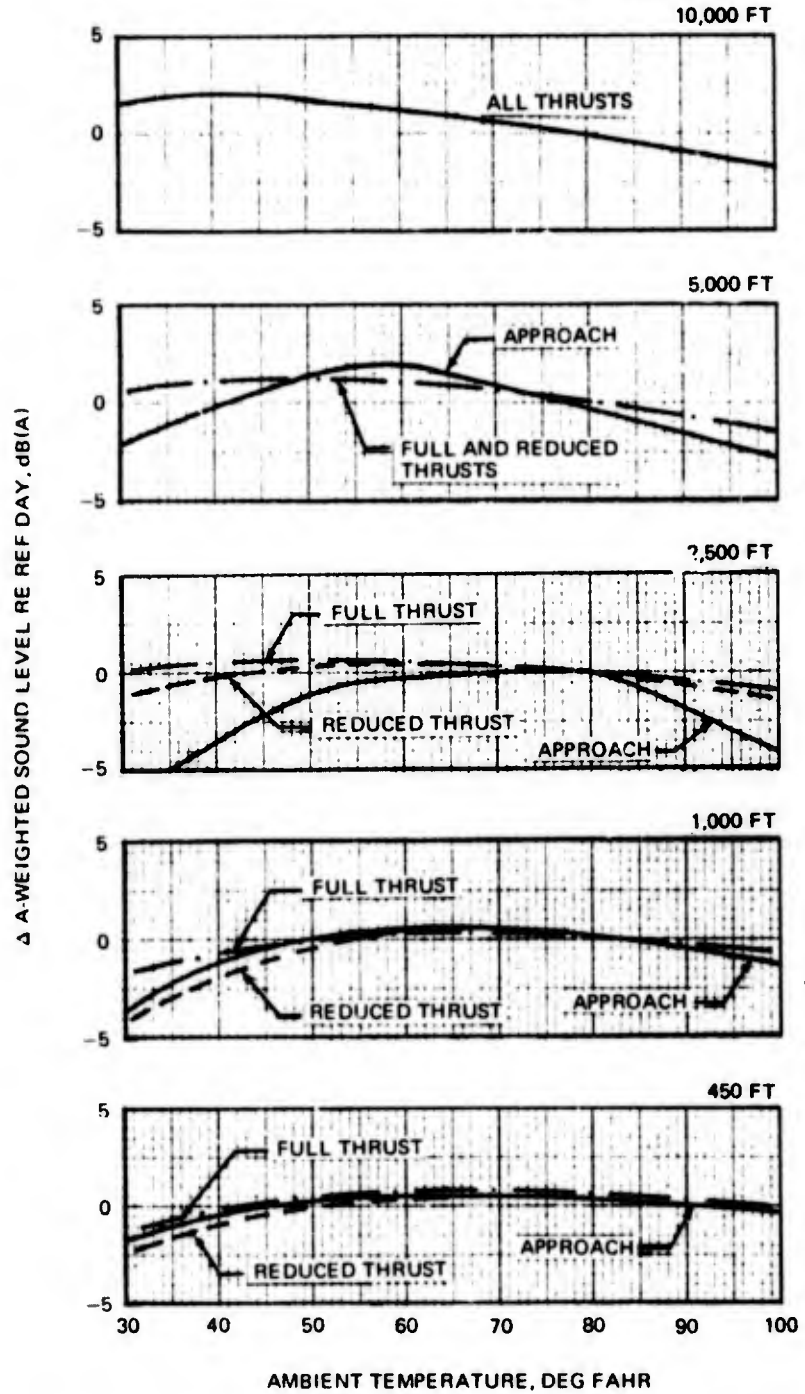


FIGURE 104. VARIATION IN A-WEIGHTED SOUND LEVEL WITH CHANGE IN AMBIENT SURFACE TEMPERATURE AND SLANT RANGE REFERRED TO 77°F

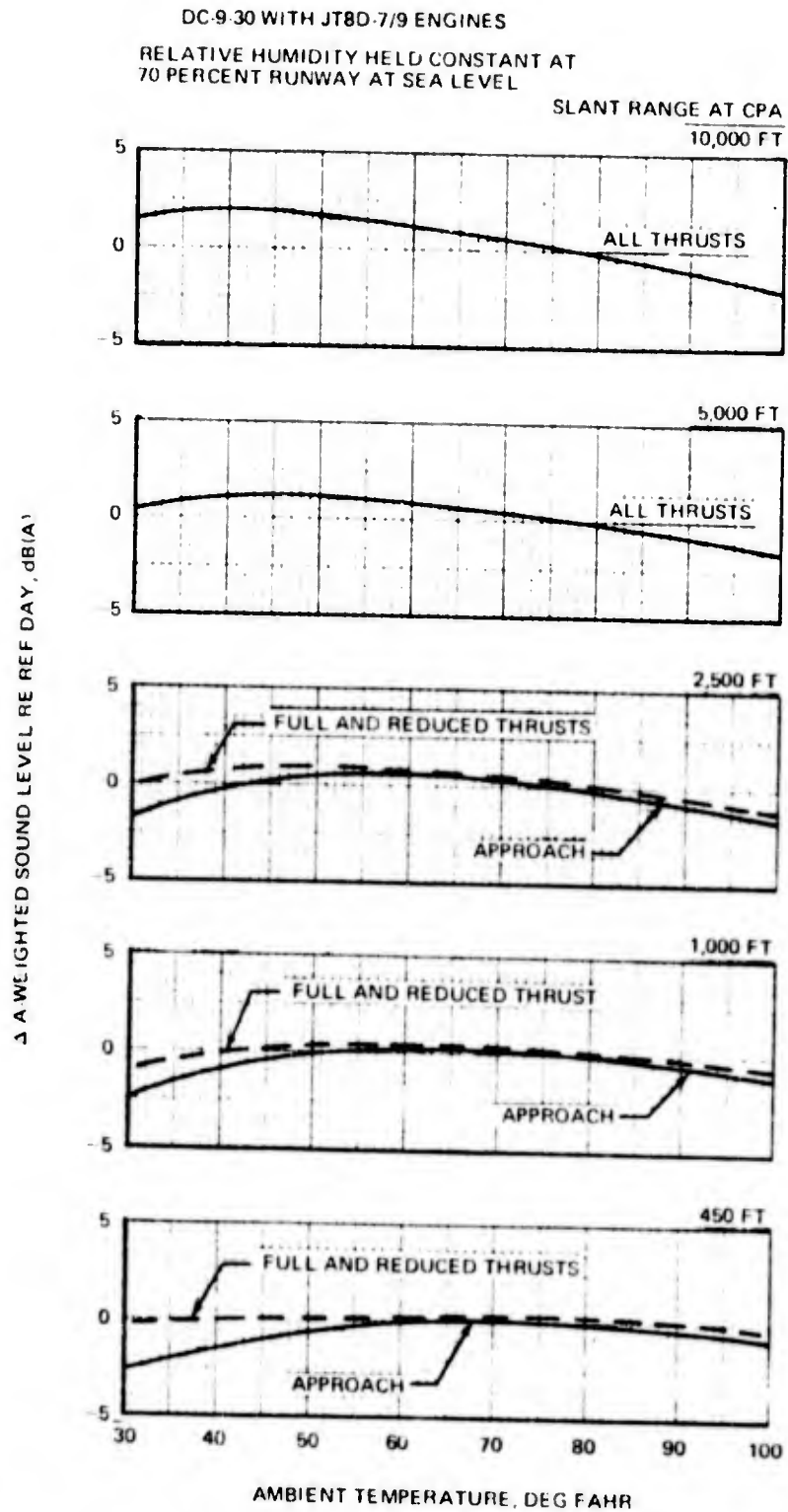


FIGURE 105. VARIATION IN A-WEIGHTED SOUND LEVEL WITH CHANGE IN AMBIENT SURFACE TEMPERATURE AND SLANT RANGE REFERRED TO 77°F

DC-10-10, 40

RELATIVE HUMIDITY HELD CONSTANT AT
70-PERCENT RUNWAY AT SEA LEVEL

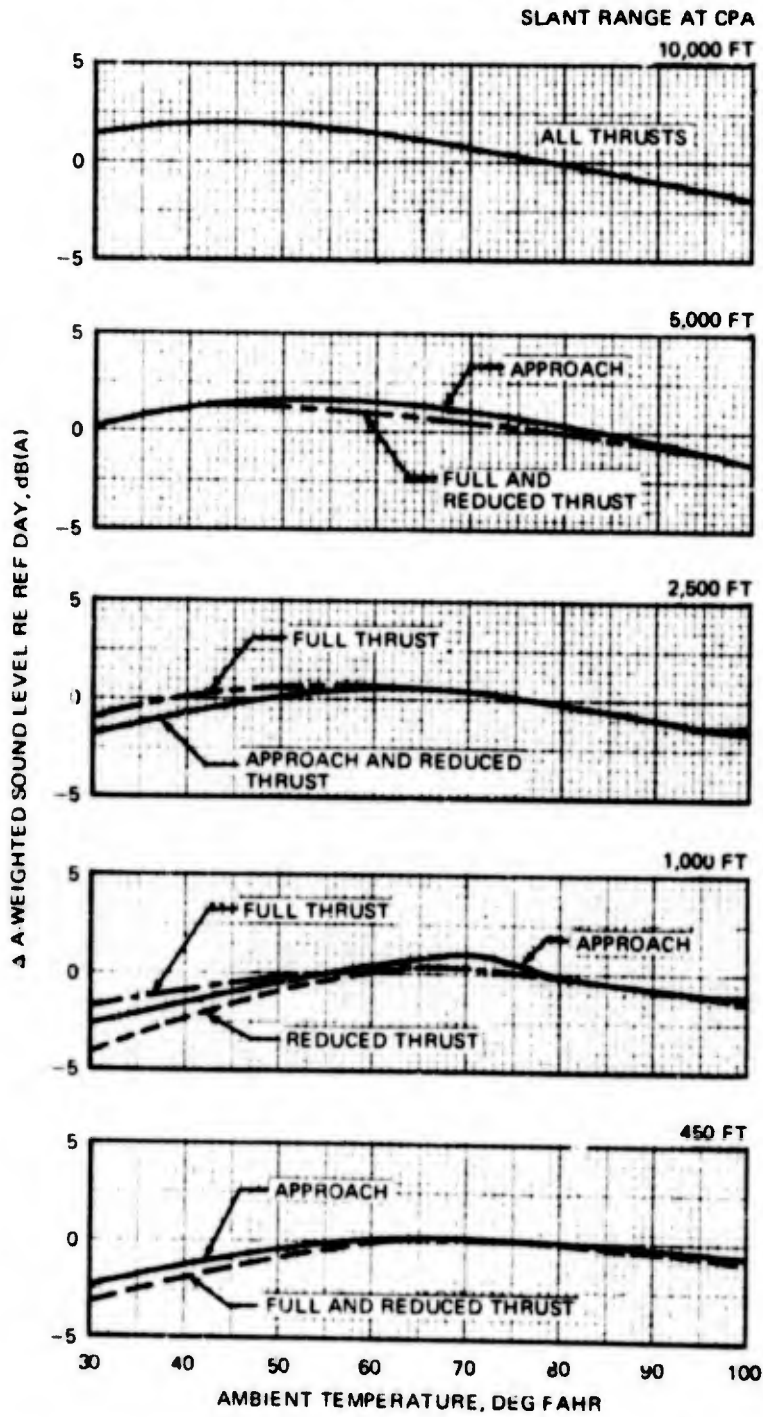


FIGURE 106. VARIATION IN A-WEIGHTED SOUND LEVEL WITH CHANGE IN AMBIENT SURFACE TEMPERATURE AND SLANT RANGE REFERRED TO 77°F

$$\Delta \text{ NOISE LEVEL} = 10 \text{ LOG}_{10} \frac{\rho C}{(\rho C)_{\text{SEA LEVEL, } 77^{\circ}\text{F}}}$$

ρC (SEA LEVEL, 77°F) = 410 RAYLS

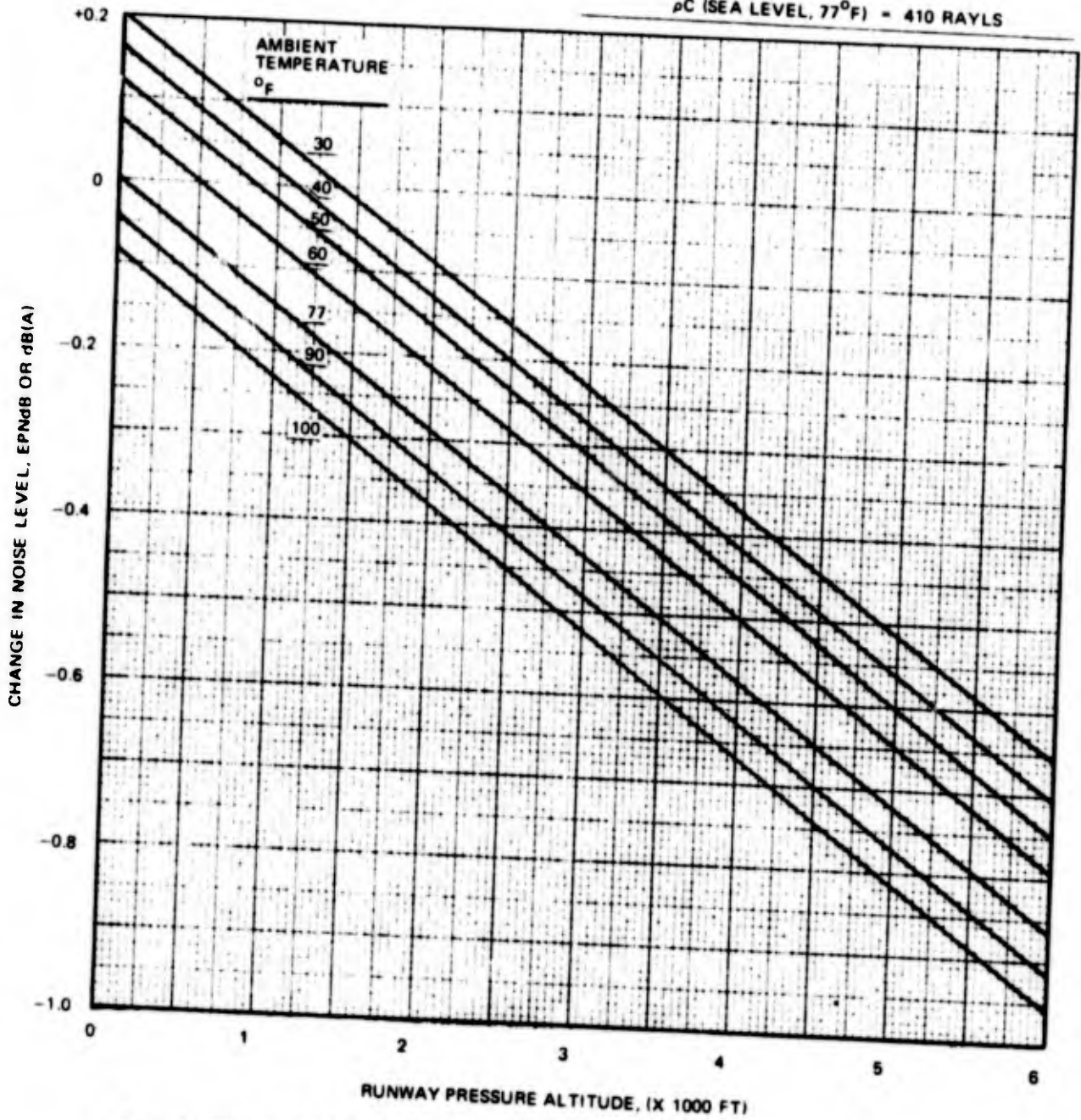


FIGURE 107. CHANGE IN NOISE LEVEL WITH CHANGE IN RUNWAY PRESSURE ALTITUDE AND AMBIENT TEMPERATURE

does not change in level but does shift to lower humidities at all frequencies. A plot of atmospheric absorption coefficient versus relative humidity showing the curves for sea level, 0.4 atmospheres and interpolated curves for 0.9 and 0.8 atmospheres, the values of δ_{amb} for 3000 and 6000 feet pressure altitudes, respectively, indicate that the absorption coefficients would be approximately one-half and seven-tenths dB lower than for sea level. Since this change applies at all frequencies, the resulting increase of one-half to seven tenths dB in sound pressure level would result in approximately the same increase in PNL (hence EPNL) or A-weighted sound level.

SECTION 4 DATA ACCURACY

4.1 GENERAL

The statistical accuracy of the data used in this report was defined for the basic reference day EPNLs from which the final curves were derived in terms of 90 percent confidence limits. Table 2 presents the confidence limits for each power setting of each aircraft and the altitude range of the data points. Where feasible, data points were grouped by altitude for analysis. For DC-8's and -9's the power settings are identified by referred thrust and in terms of referred fan speed for the DC-10's.

4.2 PROCEDURE

The procedure for determining the confidence limits is illustrated for the takeoff power setting of the DC-9 with JT8D-9 engines in Figure 108. The reference day EPNLs, normalized to V_{ref} and average thrust, were plotted with a best fit, least-square curve faired through the points.

The confidence limits were determined for the data group shown by adjusting each point to the slant range of 3000 feet, applying the EPNL change to each data point as determined in the example in Figure 108. The confidence limits for this data group were determined to be ± 0.72 using the formula on page 244 of Reference 8 for small sample confidence limits. Where two data points could not be included in a data group, no confidence limit could be established, since at least three data points are required to determine confidence limits by this method.

4.3 RESULTS

Based on this procedure for determining statistical accuracy, 84 percent of the data groups are within 90-percent confidence limits of ± 1.5 EPNdB, and 68 percent, within ± 1.0 EPNdB. The areas of poorest statistical accuracy, i. e., in excess of ± 1.5 EPNdB, are observed to be for the DC-8-63 at the reduced thrusts of 11,300 and 9170 pounds and the approach thrust of 5053 pounds; for the DC-8-61, at 8706 pounds - high altitude, and 5308 pounds at the altitude range of 770-1260 feet.

TABLE 2
CONFIDENCE LIMITS

AVE Pwr Setting	Approx Alt Range, Feet	90% Conf Limits
DC-8-61/JT3D-3B		
15,000 lb	485-560	±0.71
	895-1250	±0.98
	1880-4225	±0.66
10,723 lb	340-1555	±0.74
	1925-3750	±1.0
8706 lb	295-935	±0.89
	1300-1910	±0.65
	2090-4170	±1.57
5307 lb	145-480	±0.96
	770-1260	±1.61
	2500-2690	-*
4800 lb	470-2855	±0.62
4293 lb	230-490	±0.31
	760-1235	±1.02
DC-8-63/JT3D-7		
15,800 lb	440-790	±1.92
	1450-2570	±1.12
	3450-5150	±0.55
11,300 lb	475-620	±1.9
	1220-1840	±1.89
	2570-3550	±3.82
9170 lb	450-580	±1.89
	910-1080	±0.56
	1320-1880	±0.79
7300 lb	370-530	±0.7
	790-1470	±0.71
5053 lb	200-215	±0.54
	370-535	±1.97
	690-745	±1.66
	1295-1380	-*
4530 lb	195-210	±1.19
	400-575	±0.57
	645-1285	±1.18
*Indeterminate		

TABLE 2
CONFIDENCE LIMITS (Cont)

AVE Pwr Setting	Approx Alt Range, Feet	90% Conf Limits
DC-8-63 (Cont)		
3726 lb	185-220	±0.88
	355-535	±0.79
DC-9-30/JT8D-1		
11,820 lb	585-1750	±0.71
9960 lb	990-2000	±1.04
4865 lb	145-425	±1.02
	650-1630	±1.05
DC-9-30/JT8D-9		
12,500 lb	570-980	±0.54
	1600-4440	±0.72
9150 lb	365-3870	±0.74
6900 lb	725-1965	±0.58
5800 lb	370-615	±0.71
4000 lb	725-1065	±1.43
1800 lb	425-450	±0.89
	885-1295	±1.37
DC-10-10/CF6-6D		
3390 rpm	410-770	±1.21
	970-1410	±0.47
	1930-2460	±0.46
3124 rpm	290-600	±0.3
	710-1830	±0.41
2860 rpm	380-760	±0.58
	1010-2210	±0.43
2686 rpm	420-460	±0.76
	760-1200	±0.46

TABLE 2
CONFIDENCE LIMITS (Cont)

AVE Pwr Setting	Approx Alt Range, Feet	90% Conf Limits
DC-10-10 (Cont)		
2377 rpm	450-470	±0.57
	740-1150	±0.53
DC-10-40		
3373 rpm	800-1200	±0.5
2500 rpm	400-410	±0.5

In general, the statistical accuracy of the data is better for the aircraft models for which updated methods of data acquisition, space positioning, and data processing were used. This was done for the DC-10 aircraft and the DC-9 with JT8D-9 engines. For other models, older techniques were used such as using a camera to determine the aircraft altitude as it passed overhead, less reliable means of recording engine parameters which were not time correlation with aircraft noise and space position. Based on the results of data processed from recent tests, the variation in noise level between the minimum distance to aircraft (slant range at CPA) and overhead distance is from 0.0 to 0.2 EPNdB.

DC-9-15/JT8D-9 FLYOVER NOISE
 BASELINE SURVEY
 77°F 70% RH

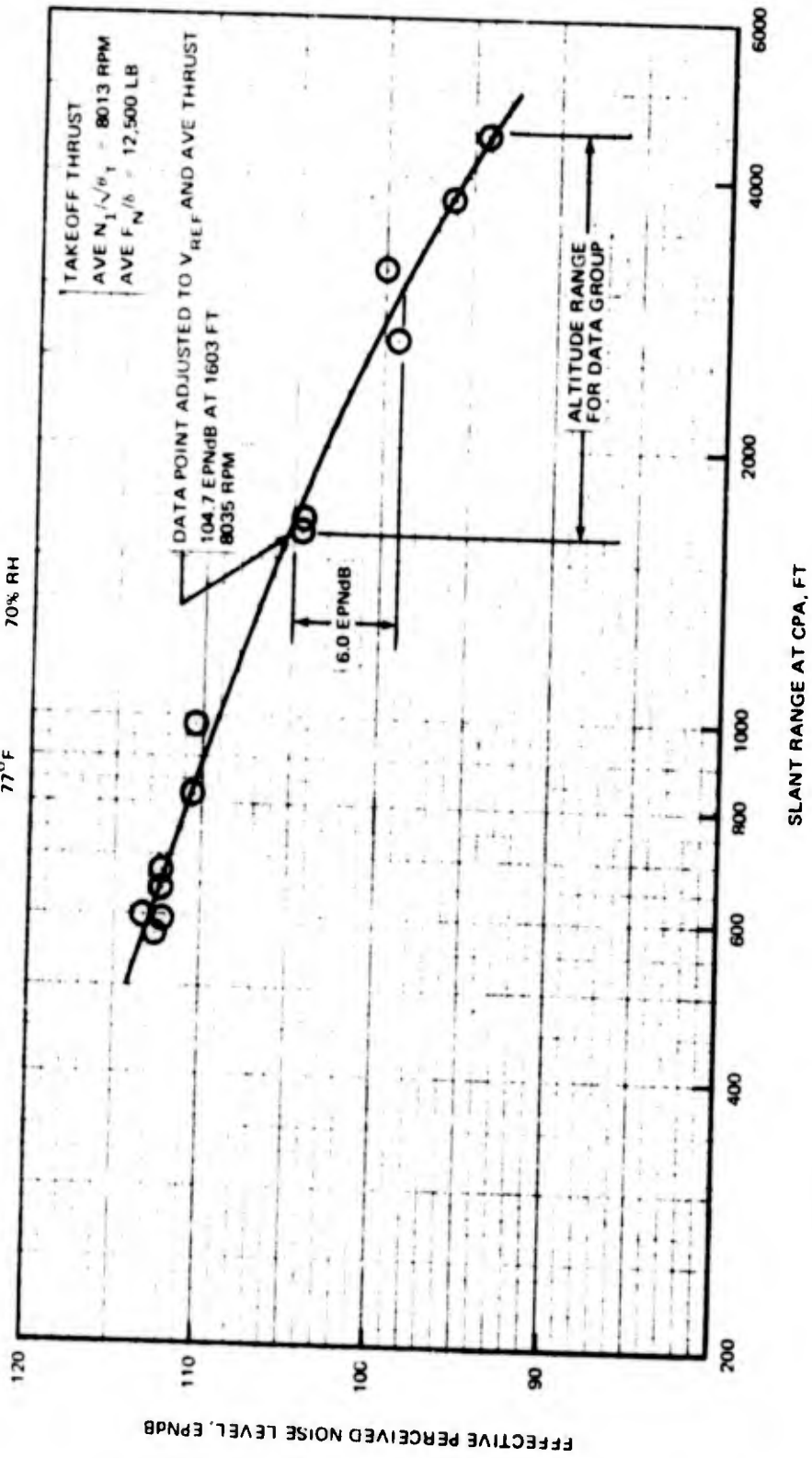


FIGURE 108. DATA POINT ALTITUDE ADJUSTMENT

REFERENCES

1. E. L. Zwieback, E. M. Lowder, E. A. Ilkcagla, et al., Part IV, Investigation of DC-8 Nacelle Modifications to Reduce Fan-Compressor Noise in Airport Communities, Report No. NASA CR-1708, December 1970.
2. Noise Certification Report for the DC-10 Series 40, Douglas Report MDC-J0462, 10 October 1972.
3. Noise Certification Report for the DC-10 Series 10, Douglas Report DAC 67386, 15 July 1971.
4. Anon., Standard Values of Atmospheric Absorption as a Function of Temperature and Humidity for Use in Evaluating Aircraft Flyover Noise, Aerospace Recommended Practice ARP 866, Society of Automotive Engineers, New York, 31 August 1964.
5. Anon., U. S. Standard Atmosphere, 1962; U. S. Government Publication, December 1962, Washington, D. C.
6. Harris, Cyril M., On the Absorption of Sound in Humid Air at Reduced Pressures, Journal of Acoust. Society of America, Vol. 43, 530-532, 1968.
7. N. Shapiro, Atmospheric Absorption Considerations in Airplane Flyover Noise at Altitudes Above Sea Level, Paper presented at the Acoustical Society of America, April 1973.
8. Freund and Williams, Elementary Business Statistics, Prentice Hall, 1964.

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APPENDIX A
PROCEDURE FOR NOISE CURVE DEVELOPMENT

Determination of a mean curve fit to a set of experimental noise level data has long been a problem in establishing the relationship between noise level and distance from a source. Numerous techniques, such as least-square curve fit to a polynomial of a desired degree or simple usage of French curves, have been used.

The dependence of noise level on distance from the source, in this report, is based on a least-square curve fit using an expression accounting for the noise level decrease with distance according to a logarithmic decay term and a term for atmospheric losses having a linear coefficient. Thus it can be expressed as

$$L_o - a \log (X/X_o) - b [(X - X_o)/1000] = L$$

where

L_o = noise level at reference distance, EPNdB or dB

a = coefficient of logarithmic decay term for given noise level quantity

X = distance between source and receiver, ft

X_o = reference distance of 250 ft

b = coefficient of linear decay term for given noise level quantity,
EPNdB/1000 ft or dB/1000 ft

L = noise level at distance X , EPNdB or dB

(A variable coefficient was included for the logarithmic term because there was not a priori reason for the EPNL or the A-weighted level to decay exactly as the inverse-square law. The value of the coefficient should be approximately 20.)

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It is necessary to find L_0 , a , and b such that a curve through the data points minimizes the error. There are, in general, N data points and the form of the equation, for a general data point at X_i , Y_i , becomes

$$L_0 - a \log (X_i/X_0) - b [(X_i - X_0)/1000] = L_i$$

To simplify,

$$\text{let } \log (X_i/X_0) = W_i$$

$$\text{and } (X_i - X_0)/1000 = Z_i$$

giving

$$L_0 - a W_i - b Z_i = L_i$$

For the six airplanes included in this study, the coefficients, (L_0 , a , and b) were determined by the use of a regression method and the noise level as a function of distance for each power setting was generated. Due to insufficient data points, some of the noise curves were in conflict in relation to the other power setting noise data. When this happened curves were readjusted using (noise versus power setting at a desired altitude) cross plots.

APPENDIX B

METHOD FOR OBTAINING $N_1/\sqrt{\theta_{T_2}}$ (RPM) FOR LEVEL FLIGHT

To obtain $N_1/\sqrt{\theta_{T_2}}$ for level flight (0-deg Glide Slope) for any given speed, gross weight and altitude the following procedures may be used:

1. Obtain C_L using the formula $C_L = \frac{W}{q S_w}$, where S_w = wing area and $q = 0.0033855 V^2$.
(V, KEAS, can be obtained from existing referred fan speeds versus glide slope curves.)
2. $C_{D_{TOTAL}} = C_{D_O} + C_I C_L^2 + C_{D_G}$. These drag coefficients are listed in Table B-1.
3. Using the formula $\text{Drag} = C_{D_{TOTAL}} q S_w$, obtain drag.
4. For level flight, thrust = drag.
5. Divide thrust by the No. of engines to obtain F_N .
6. With δ_{Amb} (pressure ratio) being a function of altitude, using F_N/δ_{Amb} and the Mach No., enter the appropriate thrust chart and obtain the EPR.
7. Using the EPR obtained in step 6 and same Mach No., enter rotor speed chart to obtain final answer of $N_1/\sqrt{\theta_{T_2}}$ (rpm).

NOTE: For G. E. engines, EPR is not used. Enter installed net thrust chart with F_N/δ_{Amb} and Mach No. and read $N_1/\sqrt{\theta_{T_2}}$ (rpm) directly.

TABLE B-1
LOW-SPEED DRAG

AIRPLANE	δ_{FLAPS}	C_{D0}	C_I	C_{DG}	S_W
DC-8-61	50	0.07630	0.05785	0.00601	2883.6
DC-8-63	50	0.06763	0.0552777	0.00591	2926.8
DC-9-30	50	0.15200	0.03594	0.01049	1000.7
DC-10-10	50	0.13463	0.04980	0.0076	3550
	35	0.06830	0.05900	0.0118	3550
DC-10-40	50	0.12603	0.04791	0.0125	3647
	35	0.07528	0.04750	0.0166	3647

APPENDIX C
COMPUTER PROGRAM, D3AA, FOR DETERMINING FLYOVER NOISE LEVELS

This program was developed in compliance with FAA Contract No. DOT-FA73WA-3161.

The purpose of this program is to calculate EPNL and A-weighted sound level values for a specific aircraft at a desired power setting and altitude.

The FAA noise definition digital computer program is written in Fortran IV language for use on a IBM 360/370 computer system.

The program has a built-in data bank to define EPNL and A-weighted sound level curves for six aircraft, namely DC-8-61, DC-8-63, DC-9-30 with JT8D-7 engines, DC-9-30 with JT8D-9 engines, DC-10-10, and DC-10-40.

No library routines are required for program operation because of a built-in linear interpolation routine.

The inputs required to calculate EPNL and A-weighted sound levels are: model (see program listing for code numbers), power setting, $F_N/6$ for DC-8 and DC-9, or $N_1/\sqrt{\theta T_2}$ for DC-10; and altitude in feet. Any number of cases can be input and calculated without a sentinel in the data cards to terminate program execution.

The program will check each data input to verify that the desired power setting and altitude are within the range of the defined curves for the applicable model. If either of the values are outside of the range, a message to that effect will be printed along with the model, engine, and input power setting and altitude.

Output is on a 11 x 17 page but can be modified to any format desired. A sample of the output format is shown on Figure C-1 of this appendix. Note that EPNL values are representative of fixed aircraft velocities. Determination of the EPNL for other velocities can be made by the formula

$$10 \log V/V_{REF}$$

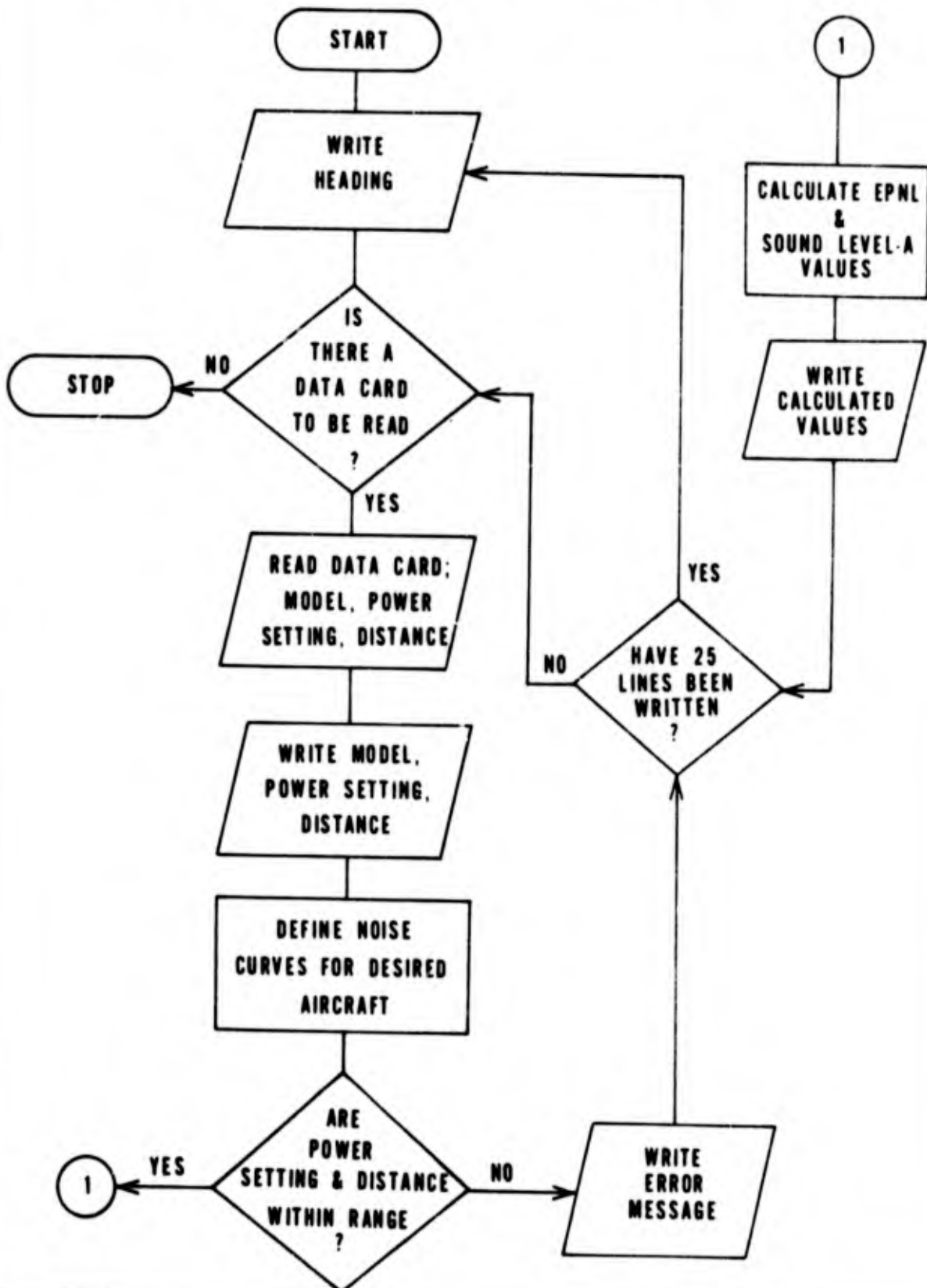
A flow chart, input format loading sheet and program listing are attached to this appendix.

SAMPLE OUTPUT FROM D3AA COMPUTER PROGRAM

FAA - AIRCRAFT NOISE DEFINITION

MODEL	ENGINE	POWER SETTINGS	AIRCRAFT ALTITUDE	AIRCRAFT VELOCITY	EPNL, EPNDB	SOUND LEVEL-A
7C-8-61	JT3D-3B	10539.0 LBS	905.0 FT.	180 KNOTS	113.4	100.4
DC-8-61	JT3D-3B	5196.0 LBS	370.0 FT.	155 KNOTS	117.1	106.3
7C-8-62	JT3D-7	10962.0 LBS	850.0 FT.	190 KNOTS	111.1	99.1
7C-8-63	JT3D-7	5295.0 LBS	370.0 FT.	155 KNOTS	114.5	104.6

FLOWCHART FOR COMPUTER PROGRAM D3AA



INPUT FORMAT FOR COMPUTER PROGRAM D3AA/F4A NOISE
 DEFINITION PROGRAM



ALTITUDE, F7.1. FORMAT

POWER SETTING, F7.1. FORMAT

MODEL CODE, 12 FORMAT

CODE	MODEL	ENGINE
1	DC-8-6	JT3D-3B
2	DC-8-63	JT3D-7
3	DC-9-30	JT8D-7
4	DC-9-30	JT8D-9
5	DC-10-10	CF6-6D
6	DC-10-60	JT9D-20

C FAA NOISE PROGRAM

C

C

C

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C

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C

C

C

C

C

THE CODE NUMBERS FOR THE 6 AIRCRAFT INCLUDED IN THIS PROGRAM ARE

LISTED BELOW

MODEL ENGINE CODE NO.

DC-8-61 JT3D-3A 1

DC-8-63 JT3D-7 2

DC-9-30 JT9D-7 3

DC-9-30 JT3D-9 4

DC-10-10 CF6-6D 5

DC-10-40 JT9D-2G 6

INPUT DATA IS TO INCLUDE, AIRCRAFT CODE, RPM OR THRUST, AND ALTITUDE.

DIMENSION EPNL(24), DBA(24), POWER(9)

10 WRITE (6,100)

100 FORMAT (1H1, //, 5IX, 'FAA - AIRCRAFT NOISE DEFINITION')

WRITE (6,110)

110 FORMAT(140, 5IX, 'POWER AIRCRAFT AIRCRAFT EPNL,

1 SOUND')

WRITE (6,120)

120 FORMAT(1H ,24X, 'MODEL', 8X, 'ENGINE', 7X, 'SETTING ALTITUDE

VELOCITY EPNDR LEVEL-A')

K=0

20 K=K+1

IF (K.GT.25) GO TO 10

```

      READ (5,30,END=999) MODEL,THRUST,ALT
30  FORMAT (I2,2X,F7.1,2X,F7.1)
      GO TO(1,2,3,4,5,6),MODEL
1  WRITE (6,201) THRUST,ALT
201  FORMAT (1H0,23X,'DC-R-61
      1 IX,'FT.')
```

```

      GO TO 500
2  WRITE (6,202) THRUST,ALT
202  FORMAT (1H0,23X,'DC-R-63
      1 IX,'FT.')
```

```

      GO TO 500
3  WRITE (6,203) THRUST,ALT
203  FORMAT (1H0,23X,'DC-R-30
      1 IX,'FT.')
```

```

      GO TO 500
4  WRITE (6,204) THRUST,ALT
204  FORMAT (1H0,23X,'DC-9-30
      1 IX,'FT.')
```

```

      GO TO 500
5  WRITE (6,205) THRUST,ALT
205  FORMAT (1H0,23X,'DC-10-10
      1 IX,'FT.')
```

```

      GO TO 500
6  WRITE (6,206) THRUST,ALT
206  FORMAT (1H0,23X,'DC-10-40
      1 IX,'FT.')
```

```

500  CONTINUE
      INDEX=0

```

```

JT30-3R',4X,F7.1,1X,'LBS',3X,F7.1,
JT30-7 ',4X,F7.1,1X,'LBS',3X,F7.1,
JT80-7 ',4X,F7.1,1X,'LBS',3X,F7.1,
JT80-9 ',4X,F7.1,1X,'LBS',3X,F7.1,
CF6-6D ',4X,F7.1,1X,'RPM',3X,F7.1,
JT90-20',4X,F7.1,1X,'RPM',3X,F7.1,

```

```

GO TO (11,12,13,14,15,16),MODEL
11 CALL JT303H (ALT,THRUST,EPNL,DBA,POWER,NCURVE)
TOVEL= 180.
APPVEL= 155.
IF(THRUST.GT.6000.) GO TO 800
VTRUE = APPVEL
GO TO 903
800 VTRUE= TOVEL
801 IF(THRUST.GT.6000.)AND.THRUST.LT.8000.) GO TO 802
GO TO 803
802 CTRUE = 155. + ((THRUST-6000.)/(8000.-6000.))* (180.-155.)
INDEX=1
803 CONTINUE
GO TO 501
12 CALL JT307 (ALT,THRUST,EPNL,DRA,POWER,NCURVE)
TOVEL= 190.
APPVEL= 155.
IF(THRUST.GT.6000.) GO TO 805
VTRUE = APPVEL
GO TO 809
805 VTRUE= TOVEL
806 IF(THRUST.GT.6000.)AND.THRUST.LT.8000.) GO TO 807
GO TO 808
807 CTRUE = 155. + ((THRUST-6000.)/(8000.-6000.))* (190.-155.)
INDEX=1
808 CONTINUE
GO TO 501
13 CALL JT307 (ALT,THRUST,EPNL,DBA,POWER,NCURVE)

```

```

TOVEL= 170.
APPVEL= 140.
IF(THRUST.GT.6000.) GO TO 810
VTRUE = APPVEL
GO TO 812
810 VTRUE= TOVEL
811 IF(THRUST.GT.6000..AND.THRUST.LT.8000.) GO TO 812
GO TO 813
812 CTRUE = 140. + ((THRUST-6000.)/(8000.-6000.))*(170.-140.)
INDEX=1
813 CONTINUE
GO TO 501
14 CALL JT809 (ALT,THRUST,EPNL,DBA,POWER,NCURVE)
TOVEL= 165.
APPVEL= 140.
IF(THRUST.GT.6000.) GO TO 815
VTRUE = APPVEL
GO TO 818
815 VTRUE= TOVEL
816 IF(THRUST.GT.6000..AND.THRUST.LT.8000.) GO TO 817
GO TO 818
817 CTRUE = 140. + ((THRUST-6000.)/(8000.-6000.))*(165.-140.)
INDEX=1
818 CONTINUE
GO TO 501
15 CALL CF66D (ALT,THRUST,EPNL,DBA,POWER,NCURVE)
TOVEL= 180.
APPVEL= 150.

```

```

IF(THRUST.GT.2600.) GO TO 920
VTRUE = APPVEL
GO TO 823
820 VTRUE= TOVEL
821 IF(THRUST.GT.2600..AND.THRUST.LT.3000.) GO TO 822
GO TO 823
822 CTRUE = 150. + ((THRUST-2600.)/(3000.-2600.))*(180.-150.)
INDEX=1
923 CONTINUE
GO TO 501
16 CALL JTD20 (ALT,THRUST,EPNL,DBA,POWER,NCURVE)
TOVEL= 200.
APPVEL= 160.
IF(THRUST.GT.2600.) GO TO 830
VTRUE = APPVEL
GO TO 933
830 VTRUE= TOVEL
831 IF(THRUST.GT.2600..AND.THRUST.LT.3000.) GO TO 832
GO TO 833
832 CTRUE = 160. + ((THRUST-2600.)/(3000.-2600.))*(200.-160.)
INDEX=1
833 CONTINUE
501 IF (ALT .GT. 10000..OR. ALT .LT.200) GO TO 150
IF (THRUST .GT.POWER(NCURVE).OR. THRUST .LT. POWER(1))GO TO 150
ITPUE = VTRUE
I = 0
J = 0
510 I = I + 1

```

```

J = I + 1
IF (THRUST .GE. POWER(I) .AND. THRUST .LE. POWER(J)) GO TO 520
GO TO 510
520 LC3 = I*3
    LC2 = LC3-1
    LC1 = LC2-1
    MC3 = J*3
    MC2 = MC3-1
    MC1 = MC2-1
    BTEPNL = EPNL(LC1) - EPNL(LC2)* ALOG10(ALT/250) - EPNL(LC3)*((ALT-250
1)/1000)
    HTEPNL = EPNL(MC1) - EPNL(MC2)* ALOG10(ALT/250) - EPNL(MC3)*((ALT-250
1)/1000)
    DELTA = (HTEPNL-BTEPNL) / (POWER(J)-POWER(I))
    REPNL = ((THRUST - POWER(I))*DELTA+BTEPNL)
    BTDBA = DBA(LC1)-DBA(LC2)*ALOG10(ALT/250)-DBA(LC3)*((ALT-250)/1000
1)
    HTDBA = DBA(MC1)-DBA(MC2)*ALOG10(ALT/250)-DBA(MC3)*((ALT-250)/1000
1)
    DELTA = (HTDBA-BTDBA)/(POWER(J)-POWER(I))
    RDBA = ((THRUST -POWER(I))*DELTA+BTDBA
IF (REPNL .LT.90.0.OR.RDBA.LT.65.0) GO TO 150
GO TO 360
360 IF (INDEX.GT.0) GO TO 900
GO TO 380
900 REPNL = REPNL +(10.*ALOG10(CTRUE /TOVEL))
GO TO 390
150 WRITE (6,160)

```

```

160 FORMAT (1H+,20X,'DATA NOT AVAILABLE')
GO TO 20
380 WRITE (6,370) I,TRUE,REPNL,0DBA
370 FORMAT(1H+,77X,I3,' KNOTS',4X,F5.1,7X,F5.1)
GO TO 20
999 STOP
END
SUBROUTINE JT3D3B(ALT,THRUST,EPNL,DBA,POWER,NCURVE)
DIMENSION EPN (24),DB (24),POME (3)
DIMENSION EPNL(24),DBA(24),POWER(9)
DC-8-61
DATA EPN /119.9705334,21.6520745,1.2011736,120.5610135,21.3508698
1,.9709602,121.9577316,20.8232218,.8928845,124.039488,21.8016773,
2.6444195,125.4324906,21.6035265,.5044168,126.2382768,20.5446163,
3.4717406,126.3142651,18.6608243,.3441188/
DATA DB /108.5158763,25.7084131,1.296015,110.5382854,25.8783868,
11.1580191,112.0334876,26.5758053,.8905113,114.1741842,27.7749538,
2.7311630,115.4654004,27.1350987,.6035052,116.2253674,25.5349924,
3.458088,116.9574844,22.7741999,.1191151/
NCURVE= 7
DATA POME /4000.,5000.,6000.,8000.,10000.,12000.,15000./
I=0
K=NCURVE #3
DO I I=1,K
EPNL(I) = EPN(I)
1 DBA(I) = DB(I)
DO2 I=1,NCURVE
2 POWER(I) = POME(I)

```

```

RETURN
END
SUBROUTINE JT307 (ALT, THRUST, EPNL, DBA, POWER, NCURVE)
DC-9-63
DIMENSION EPN (24), DB (24), PCWE (8)
DIMENSION EPNL(24), DBA(24), POWER(9)
DATA EPN /116.2015334,17.8508311,1.9636556,117.6406613,10.4305009
X,1.354968
1,119.9385393,20.3626042,.999097,120.6706822,21.3139896,.669031,
2122.0411726,21.0191591,.5290993,122.8409945,20.3791149,.4097281,
3123.1084982,19.7594291,.3620374/
DATA DB /107.777249,23.5651919,3.817515,109.7592479,23.22105,
13.3674734,103.2998101,22.7791267,3.1209339,110.5663154,22.6494376,
22.7512298,112.7314942,25.7649804,1.1567588,113.7496859,25.0492832,
3.8169379,114.0636897,22.0788925,.1358417/
DATA PCWE /4000.,5000.,6000.,6000.,10000.,12000.,15800./
NCURVE = 7
I=0
K=NCURVE *3
DO 1 I=1,K
EPNL(I) = EPN(I)
1 DBA(I) = DB(I)
DO2 I=1,NCURVE
2 POWER(I) = PCWE(I)
RETURN
END
SUBROUTINE JT807 (ALT, THRUST, EPNL, DBA, POWER, NCURVE)
DC-9-30 JT80-7

```

```

DIMENSION EPN (24), DB (24), POWE (8)
DIMENSION EPNL(24), DBA(24), POWER(8)
DATA EPN /107.7365905,15.2117029,5.7243363,109.1577931,16.0758876
1,4.7582917,110.6403505,15.5547735,4.2379371,113.3739774,17.8990752
2,2.331492,115.9244657,18.6871147,1.3994396,119.1539035,15.7181709,
3,1.2003763/
DATA DB /99.9974476,24.2954308,1.3595693,100.8723999,23.710776,
1.9371943,101.8010088,23.176648,.7180562,104.5339605,22.6427425,
2.3634632,107.9663487,22.1785275,.3202538,112.2530262,22.5769483,
3.1293639/
DATA POWE /4000.,5000.,6000.,8000.,10000.,12000./
NCURVF = 6
I=0
K=NCURVE #3
DO I I=1,K
EPNL(I) = EPN(I)
1 DBA(I) = DB(I)
DO2 I=1,NCURVE
2 POWER(I) = POWE(I)
RETURN
END
SURROUTINE JT809 (ALT,THRUST,EPNL,DBA,POWER,NCURVE)
C DC-9-30 JT8D-9
DIMENSION EPN (24),DB (24),POWE (8)
DIMENSION EPNL(24),DBA(24),POWER(8)
DATA EPN /106.7747823,24.5805386,1.0507625,108.8771964,23.6312537,
11.0264455,110.912801,22.9996420,1.0687718,111.6593222,21.1363096,
21.2605920,112.9378978,19.0291336,1.1580916,115.3559494,17.1262407,

```

```

31.1574715,119.0321571,15.3745634,,9620392/
DATA DB /38,4191154,79.7874452,,2533370,100.4599875,23.8707379,
11.1191554,101.0324615,23.6155922,,3425569,102.0014597,23.3752032,
2.5561929,104.7354544,21.7005190,,5042993,108.3076426,21.6258370,
3.4027599,112.2530257,22.5769463,,1292639/
DATA POWER /2000.,4000.,5000.,6000.,8000.,10000.,12500./
NCURVE = 7
I=0
K=NCURVE #3
DO 1 I=1,K
  EPNL(I) = EPN(I)
  1 DBA(I) = DB(I)
  002 I=1,NCURVE
  2 POWER(I) = POWER(I)
RETURN
END
SUBROUTINE CF650 (ALT,THRUST,EPNL,DBA,POWER,NCURVE)
C
DC-10-17 CF6-5
DIMENSION EPN (24),DB (24),POWER (8)
DIMENSION EPNL(24),DBA(24),POWER(3)
DATA EPN /103.7261218,18.9464005,4.0651013,107.2929061,19.0950553
1,3.1247029,100.7152039,18.1525332,2.4749923,111.5543991,19.5025163
2,1.6584951,112.9260759,19.3826905,,9614804/
DATA DB /38.5465822,23.1494174,4.2475261,100.1441999,26.1333453,
12.2367238,101.2015576,24.976477,7.1745128,103.5394435,24.5281831,
21.5627329,105.7389054,24.9929879,,7198043/
DATA POWER /2000.,4000.,2600.,3000.,3420./
NCURVE = 5

```

```

I=0
K=NCURVE #3
DO I I=1,K
  EPNL(I) = EPN(I)
  1 DBA(I) = DB(I)
  DO2 I=1,NCURVE
    2 POWER(I) = PWE(I)
  RETURN
END

```

```

C
SUBROUTINE JTD020 (ALT,THRUST,EPNL,DBA,POWER,NCURVE)
DC-10-40 JTD0-20
DIMENSION EPV (24),DB (24),PWE (8)
DIMENSION EPNL(24),DBA(24),POWER(8)
DATA EPV /106.5595563,19.6210165,2.3004363,108.7894025,19.2529155
1,2.0595723,109.3254798,19.0505574,1.7993489,111.0344371,19.2848073
2,1.2752513,113.5667699,18.9540695,.7925663/
DATA DB /95.315871,20.7579802,.7784318,93.1349274,19.958301,
1.7604243,99.5772533,19.3299594,.7168077,101.9740671,20.6277486,
2.4257521,103.9659649,19.9326951,.3373154/
DATA PWE /2200.,2400.,2600.,3000.,3410./
NCURVE = 5

```

```

I=0
K=NCURVE #3
DO I I=1,K
  EPNL(I) = EPN(I)
  1 DBA(I) = DB(I)
  DO2 I=1,NCURVE
    2 POWER(I) = PWE(I)

```

APPENDIX D PROGRAM F2SA

Computer program F2SA calculates all engine takeoff and flight paths for a wide variety of takeoff and cleanup procedures to investigate noise level and obstacle clearance problems. This program is quite frequently used to optimize special flight paths for minimum fuel burned or minimum noise techniques. Computing accuracy is well within the accuracy of pilot technique.

Program F2SA will produce about 80 lines of output on two pages for each flight path. This printout includes the accumulated time, distance at 5 winds, and aircraft weight as a function of pressure and geometric altitude. The program prints out thrust per engine, (F_N) , F_N/δ_{amb} , EPR, and $N_1/\sqrt{\theta T_2}$ for accurate noise correlation along the flight path. The program automatically calculates the thrust required, at each 500 feet in altitude, to maintain 250, 500, 750, and 1000 feet/minute rates of climb. Special effort has been made to keep the load sheet as simple as practical (only three cards), yet provide maximum flexibility and capability to calculate as many different types of flight paths as possible.

The program is controlled by means of two input cards. The first selects airport temperature and altitude. It also selects altitudes at which configuration or flight path changes are initiated and selects limiting pitch attitudes, climb power settings, or rates of climb. The second input card controls the takeoff weights, the flight path speeds, and engine bleed conditions. It also selects airplane model, takeoff flap setting, and engine type.

PROGRAM ACCURACY

Program F2SA was designed to calculate flight paths as close as practical to the actual aircraft performance. Using this design criteria, all conservative factors required for FAA certification have been removed. The more important FAA takeoff factors removed include the 15-percent increase in all engine takeoff distance and the 50-percent decrease in headwinds and 150-percent increase in tailwinds.

Takeoff calculation methods are very similar to those used in the actual certification, and the takeoff data are derived from the certification flight

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tests. Average engine thrust and fuel flow levels are used throughout except for DC-8 and DC-9 takeoff thrust, which are based on FAA minimum engine levels. For the latter, the thrust differentials are small and differences from average airplane performance should be minimal.

TAKEOFF CALCULATIONS

Takeoff aircraft weights, speeds, and times are calculated with no wind. The computer program then uses the no wind speeds and corrects the distances for takeoff in -10, 0, 10, 20, and 30-knot actual winds. This simplification saves computer time and the distance with wind answers compare favorably to certification results.

Takeoff performance is calculated for level runways. The variations in takeoff performance due to runway slope are considered minor compared to the large distances travelled during the flight path.

Takeoff performance, including the climbout until the gear is fully retracted, is calculated at maximum takeoff thrust regardless of how the load sheet is filled in.

Aircraft performance between liftoff and gear retracted is based on internal program curves. Flight test results show that this flight path is better than calculated by free air gradients because of the favorable influence of ground effect. These internal curves are based on normal takeoff procedures.

Takeoff air run calculations between liftoff and 35-foot altitude are based on certification level air run curves. The program will calculate takeoff distances to other all engine takeoff speeds, stated as $V_2 + X$, by entering this X as a load sheet item.

If it is desired to accelerate while retracting the gear to a speed beyond that obtained during normal takeoff procedures, then this speed is entered on the load sheet as a minimum increase in speed above the V_2 speed, ΔV_{GU} . This means that if the normal takeoff speed were faster than $V_2 + \Delta V_{GU}$, then the aircraft speed would not be changed, but if it were lower than $V_2 + \Delta V_{GU}$, then the gear retracted speed would be increased in a level flight acceleration to $V_2 + \Delta V_{GU}$.

FLIGHT PATH CALCULATIONS

Flight paths are constructed from climb and acceleration segments as shown in Figure D-1.

Climb segments are calculated at constant calibrated airspeed unless limited by a maximum pitch angle input on the load sheet. If the computer program has determined that, at a constant CAS climb speed, the pitch angle is above the maximum pitch angle, the flight path will be calculated at the maximum pitch angle while accelerating. The computer program will again try to climb at a constant CAS speed at the next altitude.

If the airport altitude is the only altitude entered on the load sheet, the program will climb to 2000 feet above the airport altitude. This helps the program user to obtain flight path data to check input cards.

Flight paths for noise determination are normally calculated as a function of geometric altitude. However, even geometric or pressure altitude increments can be calculated depending on whether the altitude type flag is 0 or 1. After the gear is fully retracted, the printout also contains the interpolated altitudes at even 1000-foot distance increments from brake release.

Climb segments before the flap and slat retractions are usually calculated in 100-foot increments, while climb segments after these retractions will usually be calculated in 1000-foot increments.

Takeoff thrust for earlier DC-8 and DC-9 airplanes is calculated assuming the pilot set the throttle statically. Takeoff thrust for DC-8-63 and DC-10 airplanes is calculated assuming the pilot set the throttle at 60 knots, EAS. This is consistent with the certifications of these aircraft.

Basically, takeoff thrust is then lapsed from this speed and airport altitude until after the airplane has retracted any flaps and slats and has reached 250 knots, CAS. Any remaining portions of the flight path, such as climb to 10,000 feet pressure altitude, are calculated at maximum climb thrust. This thrust schedule can only be altered, after the gear is fully retracted, by use of this input Special Altitude.

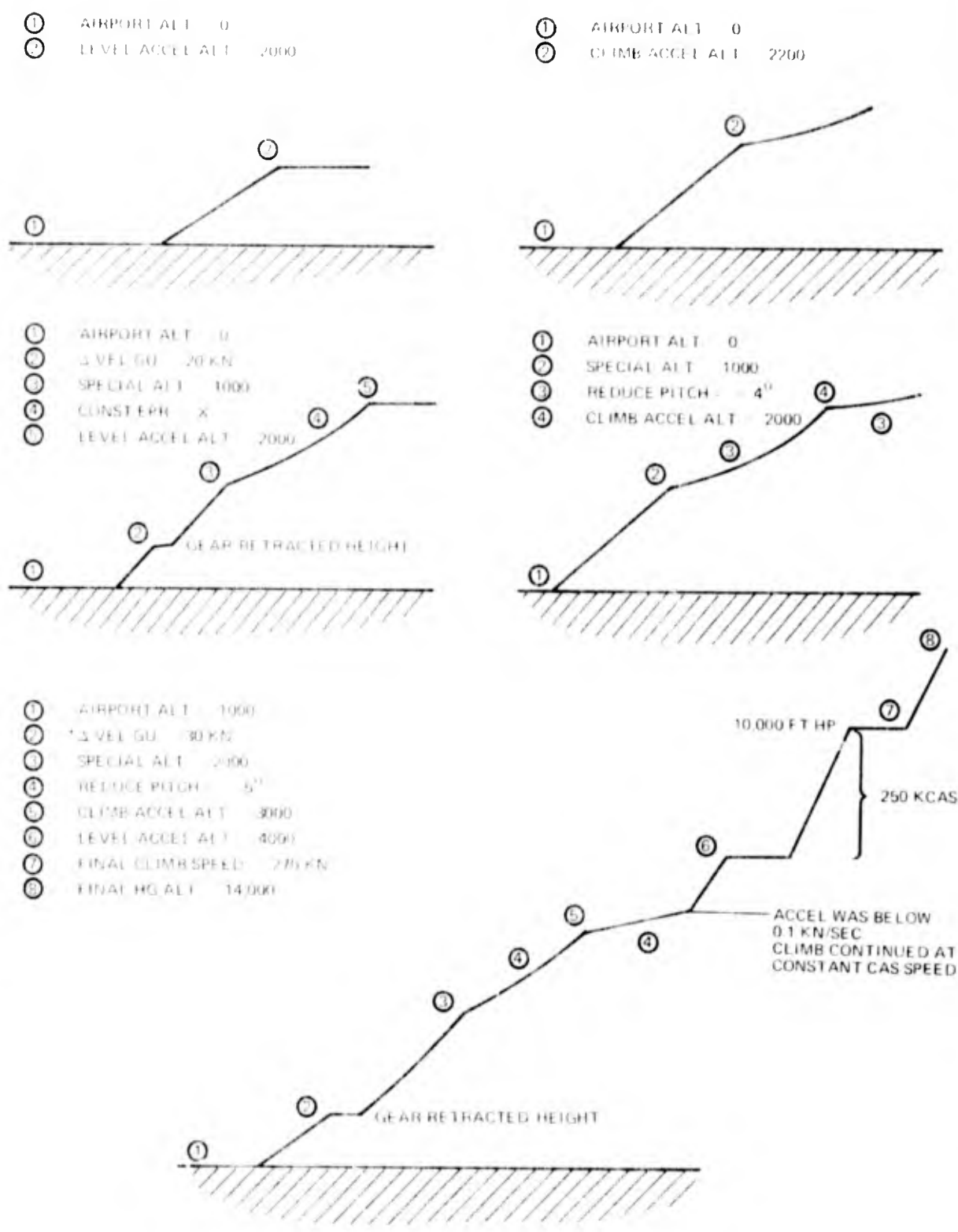


FIGURE D 1 EXAMPLES OF VARIOUS FLIGHT PATHS

At the Special Altitude (if input on load sheet) the engine thrust level can be reduced. If the Reduce Pitch Angle or the constant rate of climb is filled in, the flight path will continue at constant CAS at the thrust required to maintain the reduced pitch angle or constant rate of climb until the acceleration altitude is obtained. If constant EPR is input, then the constant EPR climb would continue at constant CAS unless limited by maximum pitch attitude. The Special Altitude must be above the altitude at which the gear is fully retracted and below both the level-accel and the climb-accel altitude.

Flap and slat retractions and acceleration to 250 knots, CAS, are calculated in level flight or while climbing at a constant pitch attitude, depending on whether the level flight or the climb-accel altitude is filled in on the load sheet. After flap and slats are retracted, points are calculated in even 10-knot, CAS increments. This acceleration is normally calculated at take-off thrust. If the Special Altitude is filled in, it will be calculated at maximum climb thrust following a reduced pitch angle or constant rate of climb segment, or calculated at constant EPR if so specified.

The constant pitch angle during flap and slat retraction is obtained by the following three steps:

1. Use the maximum pitch angle from the load sheet.
2. If there is no maximum pitch angle, use the actual pitch angle at the climb-accel altitude.
3. Reduce the pitch angle obtained from 1 and 2, as applicable, by any pitch angle decrement entered in the load sheet.

The C_D flap while retracting flaps and the C_D slat while retracting slats are assumed to be linear with time. This assumption is felt to provide slightly conservative answers. The clean C_L -alpha curve is used after flap retraction even if the slats are partially or fully extended. This assumption was made because the slat position affects the C_L -alpha curve less than the flap position during a normal all engine flight path. The computer program assumes a linear variation between the two C_L -alpha curves as the flaps are retracted.

If the Final HG altitude (a load sheet item) is higher than the current altitude, then the airplane will climb to that altitude at maximum climb thrust. If the Final HG altitude is above 10,000 feet pressure altitude, then the airplane will accelerate at 10,000 feet pressure altitude at even 10-knot, CAS, increments until the airplane reaches the climb speed (a load sheet item). If this speed is not input, this speed is assumed to be 300 knots, CAS.

PROGRAM EXTENDED CAPABILITIES

Program F2SA contains the flexibility and capabilities to calculate aircraft performance beyond the normal operating range of an aircraft. This increased performance is very desirable in calculation of special flight paths such as optimization studies. This capacity could also provide flight paths that may not be practical to fly.

The only constraints on aircraft performance are as follows:

1. If the climb gradient at the gear retracted height, speed, all engine configuration, and with one engine's thrust removed, is below the minimum required FAA Second Segment Climb Gradient, a warning is printed on the output page. However, calculation of the flight path is continued.
2. If the airplane is accelerating in level flight or while climbing at a constant pitch angle, and this acceleration is less than 0.1 knot/second, the program writes on the output page that acceleration is discontinued, and the program continues the climb to the altitude requested at the aircraft drag configuration and the constant calibrated airspeed obtained at the last successful point calibrated.

If the Level Flight and Climb-Accel Altitudes are both filled in and are the same, then the flap and slats will be retracted while climbing from those altitudes.

If the airplane is climbing while retracting flaps and slats and the acceleration is below the minimum allowable value, and if the Level Flight Acceleration Altitude is above this altitude, then the airplane will climb at constant CAS speed, limited by maximum pitch attitude, until the Level Flight

Acceleration altitude is reached. The airplane will then finish the flap and slat retractions in level flight.

PROGRAM EQUATIONS

Takeoff program equations are contained in Douglas Report Number DAC-33392, Methods Used in Determination to Show Compliance with Civil Air Regulation SR-422B, dated 18 February 1967. The certification substantiation report for each airplane contains the actual FAA approved flight test data, as well as any improvements in certification methods. All of these reports are company proprietary.

Some of the more important all-engine flight path climb and acceleration equations are listed below:

Lift Coefficient

$$C_L = \frac{\text{weight} \times \cos \gamma}{q \times \text{wing area}}$$

q = dynamic pressure (lb/ft²)

γ = climb angle (radians)

Vel_{True} (knots)

Drag (pounds)

$$\text{Drag} = q \times \left(f_p + \frac{C_L^2 \times \text{wing area}}{\pi e AR} \right)$$

f_p = parasite drag (ft²)

e = wing efficiency factor

AR = aspect ratio

Rate of Climb (R/C) (ft/minute)

$$R/C = \frac{Vel_{true} \times 101.2683 \times (\text{Total thrust-drag})}{Weight (1 + (1.6878)^2 \frac{Vel}{g} \frac{dv}{dhg})}$$

Acceleration (kn/sec)

$$Acc = \frac{19.06 \times (\text{Total thrust} - \text{drag} - \text{weight siny})}{Weight}$$

Time to Climb (hours)

$$\Delta Time = \frac{H_{g2} - H_{g1}}{60 (R/C_2 - R/C_1)} \log_e \frac{R/C_2}{R/C_1}$$

Time to Accelerate (hours)

$$\Delta Time = \frac{\Delta Vel_{True}}{3600 (Acc_2 - Acc_1)} \log_e \frac{Acc_2}{Acc_1}$$

Distance Travelled (n mi)

$$\Delta Dist = \Delta Time \times \text{Average True Air Velocity}$$

Fuel Burned (pounds)

$$\Delta Fuel Burned = \Delta Time \times \text{Average Total Fuel Flow}$$

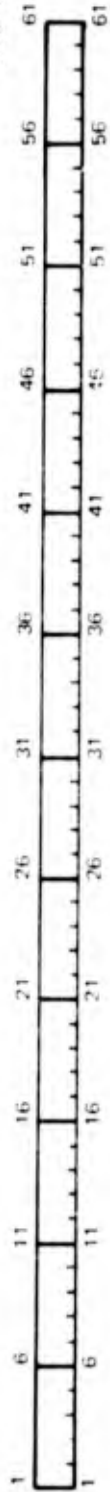
F2SA LOAD SHEET INSTRUCTIONS

This section explains how to fill in each item on the load sheet, see Figure D-2. However, the description of how the flight path altitude controls interact with each other is contained in the Flight Path Calculations section, which should be used as basic reference for the control of the program.

Only three input cards are required to operate computer program F2SA. The first card contains header information that is written at the top of each page. The next two cards contain the temperature, altitude, weight, speed,

HEADER APPEARS AT TOP OF EACH PAGE

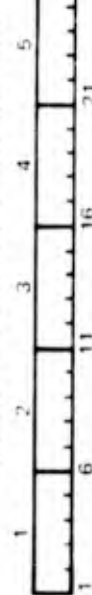
DATE
ENGINEER



TEMPERATURE CONTROLS
(KEEP RIGHT)

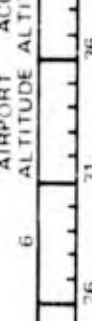
ALTITUDE CONTROLS
(KEEP RIGHT)

AMBIENT AIRPORT TEMPERATURES °CENT

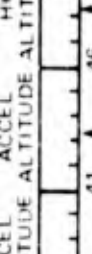


MAKE SURE = TEMPS ON NEXT CARD IS CONSISTENT

LEVEL

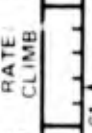


CLIMB



CONSTANT
EPR

N1



MAX
PITCH
ANGLE



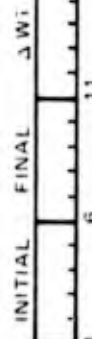
CLIMB AT
CONSTANT EPR,
N1, OR R/C FT/MIN
FROM SPECIAL ALT

REDUCE PITCH ANGLE
THIS MANY DEGREES AT
SPECIAL ALTITUDE OR
CLIMB-ACCEL ALTITUDE

HIGHEST DESIRED
GEOMETRIC ALTITUDE

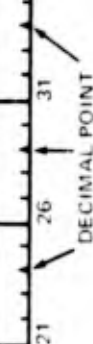
INITIAL ALTITUDE FOR
ACCELERATION WHILE
CLIMBING AT CONSTANT
PITCH ALTITUDE

WEIGHT CONTROLS
LB/1000
(KEEP RIGHT)



SPEED CONTROLS
(KNOTS, CAS)

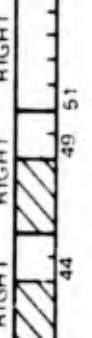
MIN GEAR TAKEOFF CLIMB
UP V₂ ΔV V₁ ΔV
ΔV GU



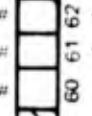
DECIMAL POINT

TYPE CONTROLS

MODEL TAKEOFF ENGINE
FLAP ANGLE



BLEED
ACT PACKS



- 1 NO ICE PROTECTION
- 2 ENGINE ICE PROTECTION
- 3 ENGINE + AIRFRAME

- DC-8 0 OR 2
- DC-9 0 OR 2
- DC-10 0 OR 3

FIGURE D-2 F2SA SHORT LOAD SHEET

and type controls necessary to define practical aircraft flight paths. Whenever all of the flight paths have been calculated from these three cards, the program will read in all remaining sets of three cards. The program ends by writing out "All Input Data Has Been Read In" on the output page when it has calculated all of the input data.

The set of three input cards can only control the input aircraft performance parameters. The three type controls are used to designate specific aircraft performance data from input data sets and equations. If the requested type controls are incorrect, then the program will print out why, and then it will stop. Engine deck data are selected by JCL (Job Control Language). Because JCL and input data are independent of each other, the user must make sure that he has both correct or he will get wrong answers.

DETAILED LOAD SHEET INSTRUCTIONS

Card 1 Header

This card may either be left blank or contain any printable character in any sequence. This one line will be printed out at the top of each page.

Card 2 Temperature Controls

Input from 1 to 6 airport ambient temperatures ($^{\circ}\text{C}$), using decimal points. Also enter number of temperatures on Card 3. Program will lapse temperature 1.9812°C per 1000 pressure feet above airport altitude.

Altitude Controls

Input altitudes are geometric (HG) if ALT TYPE = 0 or pressure (HP) if ALT TYPE = 1. The description of how the altitude controls work together is contained in the Flight Path Calculations section. All decimal points are rightly justified.

Airport Altitude Enter airport altitude.

Level Accel Altitude Enter altitude (if required) for
level flight acceleration.

Climb-Accel Altitude	Enter initial altitude (if required) for acceleration while climbing at constant pitch attitude.
Final HG Altitude	Enter final HG altitude if a climb after completion of acceleration is desired.
Special Altitude	Enter the altitude at which the change in flight path specified by the following two items is required.
Reduce Pitch Attitude	Enter the number of degrees that the flight path angle is to be reduced at the special altitude (if filled in) and/or the climb-accel altitude (if filled in).
Const EPR or Rate of Climb Ft/Min	Enter the engine EPR for Pratt & Whitney engines or percent N_1 for General Electric engines for climb at this constant engine level. Enter constant rate of climb in feet per minute if desired. Special altitude must be entered in all cases.
Altitude Type	0 climb at HG increments to HG altitudes. 1 climb at HP increments to HP altitudes.
Max Pitch Angle	This is the maximum total pitch angle of the aircraft while climbing. The total pitch angle is the sum of the flight path angle and the angle of attack. Read the "Flight Path Calculations" section of this write up carefully if it is desired to enter a limiting maximum pitch angle.

Card 3 Weight Controls

Initial Wt/1000

Brake release weight for lowest desired weight/1000

Final Wt/1000

Brake release weight for highest desired weight/1000

Δ Wt/1000

Weight increment/1000 by which brake release weights are incremented. Example: To calculate flight paths at 70,000, 80,000, 90,000 and 98,000 pounds enter as follows:

Initial Weight = 70

Final Weight = 98

Delta Weight = 10

Speed Controls

Min Gear Up ΔV_{GU}
(knots)

If the speed at the end of gear retraction is less than $V_2 + \Delta V_{ELGU}$ plane will accelerate in level flight to $V_2 + \Delta V_{ELGU}$ speed.

Takeoff $V_2 + \Delta V$ (knots)

If ΔV is filled in, the all engine takeoff speed at 35 feet above the runway is set equal to V_2 speed + ΔV .

Climb Speed (knots,
CAS)

This is the climb speed at the end of the level flight acceleration at 10,000 feet pressure altitude. If this location is left blank, then 300 knots, CAS is assumed.

Type Controls

These controls determine the aircraft performance parameters. Do not use decimal points and keep right.

All possible combinations are listed below in the format which should be used for input.

Only one model-flap angle-engine combination can be run on each three-card input data set.

<u>Model (keep right)</u>	<u>Flap Angle (keep right)</u>	<u>Engine (keep right)</u>	
8	15, 25	3D-3B	Series 61*
8	12, 23	3D-7	Series 63
9	5, 15	**	Series 30
10	0, 5, 10, 15, 20	F6-6D	Series 10
10	5, 10, 15, 20, 25	JT9D	Series 40

*Use DC-8-61 for DC-8-50 takeoff performance.

**The DC-9 engine can be omitted since both engines are run with the same airplane series and have the same aircraft performance parameters.

Number of:

Temperatures

Number of temperatures desired at each airport altitude for all aircraft weights.

A/C Packs

Number of A/C packs operating for DC-9 or DC-10, 1/2 number of turbo-compressors operating for DC-8.

Table of allowable numbers:

DC-8	0 or 2
DC-9	0 or 2
DC-10	0 or 3

Bleed

Engine bleed during flight path.

- 1 No ice protection.
- 2 Engine ice protection only.
- 3 Engine + airframe ice protection.

How to Run This Computer Program

This computer program was written, checked out, and documented by the Douglas Aircraft Company, Long Beach, California, for use by the FAA. The program has been transferred to disk pack storage at McDonnell Douglas Automation Company (McAUTO), St. Louis, Missouri. F2SA cannot run by itself because it contains no thrust data. The engine performance decks, which comprise separate programs to be run in conjunction with F2SA, are also stored on disk at the McAUTO facility. The Job Control Language necessary to call F2SA and the correct engine deck will be supplied by McAUTO.

Each engine deck has an identification date which is printed out in the header at the top of each flight path after the words THRUST DECK. The available thrust decks are as follows:

		<u>Type</u>	<u>Identification Date</u>
DC-8	Series 61	JT3D-3B	1/31/73-614
	Series 63	JT3D-7	5/23/68-872
DC-9	Series 30	JT8D-7	9/19/69-704
	Series 30	JT8D-9	5/29/68-904
DC-10	Series 10	CF6-6D	6D CABE02C2
	Series 40	JT9D-20	-20ICBCH01C9

APPENDIX E

COMPUTER PROGRAM A8RA - APPROACH NOISE LEVEL

The approach noise level program calculates the engine noise parameters N_1 , $N_1/\sqrt{\theta}$, $F_N/6$ and EPR for a given airplane configuration, approach gradient, gross weight, pressure altitude, and temperature at five approach speeds. Output is formatted for 11-x 8-1/2-inch paper at 8 lines per inch, as well as 11-x 17-inch paper at 6 lines per inch.

Input consist of two lines of alphanumeric data followed by numeric data. The alphanumeric data are provided so that the user may print any information in the heading of each output page as he sees fit.

The numeric data consist of 18 variables which cause the program to access internally stored data and to perform calculations over a given range of conditions. These 18 input parameters are described in detail in the load sheet instructions and are input into the program as shown on the load sheet.

The program has a refer-back capability which causes it to save the values read in on the first card of numeric data. These values are maintained throughout the program run as base case data. Each succeeding numeric data card causes the program to run another case. Data punched into each additional case card overlay the base case data until the completion of the case. It should be pointed out that a blank on a change case card will not be interpreted as a zero but as a refer-back to the base case. Any parameter may be changed on a case card except MODEL and SERIES which must be consistent with the program set up.

DC-8 Series 50, 61 and 63, DC-9 Series 30, and DC-10 Series 10 and 40 aircraft can be run with program A8RA for flap deflections of 0, 35, and 50 degrees. Any other aircraft or flap deflection will cause the program to terminate.

See sample run following this discussion.

PROGRAM A8RA

LOAD SHEET INSTRUCTIONS

MODEL	Load 10 for DC-10, 9 for DC-9, etc.	--
SERIES	Series designation (Example, load 40 for DC-10-40)	--
INITIAL WEIGHT	Initial gross weight	Lb
$\Delta W T$	Weight increment	Lb
FINAL WEIGHT	Final gross weight. Does not have to be an increment of initial weight and ΔW .	Lb
INITIAL ΔT	Initial temperature deviation from standard	$^{\circ}C$
$\Delta(\Delta T)$	ΔT increment	$^{\circ}C$
Final ΔT	Final temperature deviation from standard. Does not have to be an even increment of initial ΔT and $\Delta(\Delta T)$.	$^{\circ}C$
INITIAL HP	Initial pressure altitude	Ft
ΔHP	Pressure altitude increment	Ft
FINAL HP	Final pressure altitude. Does not have to be an even increment of initial pressure altitude and ΔHP	Ft
BLEED	= 1, Anti-ice off = 2, Cowl anti-ice only = 3, Cowl and airframe anti-ice on	

A8RA

LOAD SHEET INSTRUCTIONS (Continued)

No. A/C	Input value used to determine number of air conditioning units operating	
	DC-10; load number operating	
	DC-9; load number operating	
	DC-8; load half number of turbocompressors operating	
APPROACH GRADIENT	Approach gradient to be calculated. Down is positive	Deg
INITIAL	Initial ratio of V_e to V_e STALL	--
V_e/V_e STALL	Defined start of speed loop (default is 1.0)	
CAS	Speed increment (default is 10 kn)	kn
F	Flap deflection	Deg
GEAR	Landing gear flag	--
	0; landing gear retracted	
	1; landing gear extended	

A8RA

DESCRIPTION OF OUTPUT

WT LB	Aircraft gross weight	Lb
CAS KN	Calibrated airspeed	kn
TAS KN	True airspeed	kn
DELTA CAS KN	Difference between CAS and initial CAS	kn
VE/VES	Ratio of equivalent airspeed and equivalent stalling speed	
R/S FPM	Rate of sink (down position)	fpm
DRAG LB	Total airplane drag	Lb
FN LB	Average thrust required per engine	Lb
FN/DELTA LB	Average thrust per engine over the ratio of ambient P to P_o	Lb
N_1	Low pressure rotor speed	Percent
$N_1/\text{ROOT } \theta$	Percent low pressure rotor speed over the square root of the ratio of absolute total ram temperature to the absolute ambient temperature	Percent
EPR	Engine pressure ratio	

HOW TO RUN THIS COMPUTER PROGRAM

This computer program was written, checked out, and documented by the Douglas Aircraft Company, Long Beach, California, for use by the FAA. The program has been transferred to disk pack storage at McDonnell Douglas Automation Company (McAUTO), St. Louis, Missouri. A8RA cannot run by itself because it contains no thrust data. The engine performance decks, which comprise separate programs to be run in conjunction with A8RB, are also stored on disk at the McAuto facility. The Job Control Language necessary to call A8RA and the correct engine deck will be supplied by McAuto.

Each engine deck has an identification date which is printed out in the header at the top of each page after the words THRUST DATA. The available thrust decks are as follows:

		<u>Type</u>	<u>Identification Date</u>
DC-8	Series 50	JT3D-3B	1/31/73/614
	Series 61	JT3D-3B	1/31/73/614
	Series 63	JT3D-7	5/23/68-872
DC-9	Series 30	JT8D-7	9/19/69-704
	Series 30	JT8D-9	5/29/68-904
DC-10	Series 10	CF6-6D	6D CABE02C2
	Series 40	JT9D-20	-20ICBCH01C9

SAMPLE RUN

The following sample run of Program A8RA is typical of those made for DC-10 type aircraft. The sample filled-in load sheet and resultant output is presented for several cases. Preceding each case is a printout of the input data.

TEST CASE (3 CASES)
 BTBB 8-2-73

FORTRAN DATA LOAD SHEET
 A8RA

PAGE OF
 PREPARED BY:
 DATE:

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	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00
---	---	---	---	---	---	---	---	---	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----

HEADER 1																																																																																																			
HEADER 2																																																																																																			

MODEL	SERIES	INITIAL WEIGHT (LB)	Δ W.T. (LB)	FINAL WEIGHT (LB)	INITIAL ΔT (DEG.C)	Δ(ΔT) (DEG.C)	FINAL ΔT (DEG.C)	INITIAL h _P (FT)	Δ h _P (FT)	FINAL h _P (FT)	BLEED NO. %	APPROACH GRADIENT (DEG) DOWN POS.	INITIAL V _e /V _e STALL	Δ CAS (KN)	δ F ₀ (DEG)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	0402	70000	20000	340000	-20.0	20.0	20.0	50.00	300.0	1.0000		3.0	1.6	10.0	0501
				290000			-20.0			8000		0.0			
												3.0			35

SPECIAL PRINT OUT OF INPUT DATA

MODEL DC-10-40

X

HEADER 1

X

X

HEADER 2

X

INITIAL WT = 270000 LB DELTA WT = 20000 LB FINAL WT = 340000

INITIAL DELTA TEMP = -20.00 DEG C DELTA (DELTA TEMP) = 20.00 DEG C FINAL DELTA TEMP = 20.00 DEG C

INITIAL ALT. = 5000 FT DELTA ALT. = 3000 FT FINAL ALT. = 10000 FT

BLEED FLAG = 0 NO. OF AIRCONDITIONING UNITS = 0

APPROACH GRADIENT = 3.000 DEG. (DOWN IS A POSITIVE INPUT)

INITIAL VE/VE STALL = 1.600 DELTA CAS = 10.0 KN

FLAP DEFLECTION = 50 DEG

LANDING GEAR FLAG = 1

08/29/73

DOUGLAS AIRCRAFT COMPANY

PAGE 1

APPROACH NOTISE LEVEL DEFINITION PROGRAM
MODEL DC-10-40 3 ENGINES OPERATING
FLAPS = 50 DEG.

ENGINE TYPE

THRUST DATA -20ICBCHOIC5

HEADER 1

HEADER 2

WT LB	CAS KN	TAS KN	DELTA CAS KN	VF/VES	R/S FPM	DELTA TEMP. = -20.0 DEG.C		FN LB	FN/DELTA LB	AMP. TEMP. = -14.9 DEG.C		EPR
						DRAG LB	FN			NI	NI/ROOT θ	
270000	148.3	153.7	0.0	1.600	814.9	37818	7733	9294	53.81	56.50	1.070	
270000	154.3	164.0	10.0	1.703	869.7	39021	8112	9749	55.44	58.17	1.073	
270000	168.3	174.4	20.0	1.815	924.5	40751	8665	10414	57.50	60.28	1.079	
270000	178.3	184.7	30.0	1.923	979.2	42936	9368	11259	59.89	62.73	1.087	
270000	188.3	195.0	40.0	2.030	1034.0	45525	10204	12264	62.55	65.45	1.098	
290000	154.7	160.4	0.0	1.600	850.4	40724	8325	10006	55.79	58.55	1.077	
290000	164.7	170.7	10.0	1.703	905.2	42021	8733	10495	57.46	60.25	1.081	
290000	174.7	181.0	20.0	1.806	959.5	43838	9312	11191	59.38	62.83	1.087	
290000	184.7	191.4	30.0	1.909	1014.7	46110	10041	12060	61.94	64.83	1.096	
290000	194.7	201.7	40.0	2.012	1069.4	48784	10903	13103	64.55	67.49	1.107	
310000	160.7	166.5	0.0	1.600	882.9	43604	8908	10706	57.66	60.48	1.084	
310000	170.7	176.8	10.0	1.699	937.7	44973	9336	11221	59.35	62.20	1.088	
310000	180.7	187.2	20.0	1.798	992.4	46860	9936	11941	61.43	64.32	1.095	
310000	190.7	197.5	30.0	1.893	1047.1	49199	10685	12841	63.81	66.75	1.105	
310000	200.7	207.8	40.0	1.997	1101.8	51943	11567	13901	66.32	69.30	1.117	
330000	160.0	172.1	0.0	1.600	912.3	46446	9476	11389	59.42	62.30	1.091	
330000	170.0	182.4	10.0	1.696	967.1	47862	9918	11920	61.11	64.01	1.096	
330000	180.0	192.7	20.0	1.792	1021.3	49758	10531	12657	63.18	66.12	1.103	
330000	190.0	202.9	30.0	1.889	1076.5	52188	11294	13573	65.48	68.45	1.113	
330000	200.0	213.3	40.0	1.984	1131.2	54985	12190	14651	67.89	70.90	1.125	
340000	160.5	174.6	0.0	1.600	925.8	47847	9754	11723	60.25	63.16	1.094	
340000	170.5	184.9	10.0	1.695	980.6	49279	10199	12258	61.94	64.87	1.107	
340000	180.5	195.2	20.0	1.789	1035.3	51230	10816	12999	63.98	66.94	1.117	
340000	190.5	205.6	30.0	1.884	1090.0	53637	11583	13921	66.23	69.23	1.129	
340000	208.5	215.9	40.0	1.978	1144.6	56452	12484	15004	68.59	71.61	1.141	

08/29/73

PAGE 2

DOUGLAS AIRCRAFT COMPANY

MODEL DC-10-40

APPROACH CRUISE LEVEL DEFINITION PROGRAM

FLAPS = 50 DEG.

3 ENGINES OPERATING

ENGINE TYPE

THRUST DATA -20IC8CHOIC5

X

HEADER 1

X

HEADER 2

WT LB	CAS KN	TAS KN	DELTA CAS KN	VF/VES	R/S FPM	DRAG LB	FN LB	FN/DELTA LB	MI	MI/ROOT θ	EPR
270000	148.4	160.8	0.0	1.600	852.5	37818	7714	10385	56.12	59.57	1.081
270000	158.4	171.6	10.0	1.707	905.6	39016	8088	10889	57.82	61.32	1.085
270000	163.4	182.3	20.0	1.814	966.8	40740	3636	11627	59.96	63.54	1.092
270000	178.4	193.1	30.0	1.922	1023.8	42913	9333	12564	62.46	66.11	1.102
270000	188.4	203.8	40.0	2.029	1090.9	45488	10161	13679	65.11	68.84	1.114
290000	154.9	167.3	0.0	1.600	839.9	40724	8303	11178	58.19	61.74	1.089
290000	164.9	176.5	10.0	1.703	946.7	42015	8705	11720	59.93	63.52	1.093
290000	174.9	189.3	20.0	1.805	1003.9	43825	9279	12492	62.09	65.75	1.101
290000	184.9	200.1	30.0	1.908	1060.9	46084	10001	13464	64.52	68.24	1.112
290000	194.9	210.8	40.0	2.010	1117.9	48741	10853	14612	67.06	70.86	1.125
310000	160.8	174.2	0.0	1.600	923.6	43603	8881	11957	60.15	63.78	1.097
310000	170.8	185.0	10.0	1.699	930.7	44956	9305	12527	61.90	65.57	1.102
310000	180.8	195.7	20.0	1.798	1037.8	46843	9398	13325	64.02	67.75	1.111
310000	190.8	206.5	30.0	1.896	1094.8	49170	10639	14323	66.36	70.14	1.122
310000	200.8	217.2	40.0	1.995	1151.8	51896	11511	15497	68.78	72.62	1.135
330000	164.2	180.0	0.0	1.600	954.4	46445	9446	12718	51.99	65.69	1.105
330000	174.2	190.8	10.0	1.696	1011.5	47856	9883	13305	63.70	67.44	1.111
330000	184.2	201.5	20.0	1.791	1068.5	49752	10489	14121	65.75	69.54	1.120
330000	194.2	212.3	30.0	1.887	1125.5	52157	11243	15136	67.98	71.81	1.131
330000	204.2	223.0	40.0	1.982	1182.4	54934	12129	16329	70.21	74.08	1.144
340000	169.7	182.7	0.0	1.600	968.5	47848	9723	13090	62.84	66.59	1.116
340000	179.7	193.4	10.0	1.694	1025.6	49274	10163	13682	64.53	68.31	1.125
340000	189.7	204.2	20.0	1.788	1092.6	51113	10772	14502	66.54	70.35	1.136
340000	199.7	214.9	30.0	1.883	1139.6	53607	11530	15523	68.71	72.56	1.149
340000	209.7	225.7	40.0	1.977	1196.5	56404	12421	16722	70.87	74.75	1.161

SPECIAL PRINT OUT OF INPUT DATA

MODEL DC-10-40

X

HEADER 1

X

X

HEADER 2

X

INITIAL WT = 270000 LB DELTA WT = 20000 LB FINAL WT = 290000

INITIAL DELTA TEMP = -20.00 DEG C DELTA (DELTA TEMP) = 20.00 DEG C FINAL DELTA TEMP = -20.00 DEG C

INITIAL ALT. = 5000 FT DELTA ALT. = 3000 FT FINAL ALT. = 3000 FT

BLEED FLAG = 0 NO. OF AIRCONDITIONING UNITS = 0

APPROACH GRADIENT = 0.0 DEG. (DOWN IS A POSITIVE INPUT)

INITIAL V_{F/VE} STALL = 1.600 DELTA CAS = 10.0 KN

FLAP DEFLECTION = 50 DEG

LANDING GEAR FLAG = 1

DOUGLAS AIRCRAFT COMPANY

MODEL DC-10-40
 FLAPS = 50 DEG.
 APPROACH NOISE LEVEL DEFINITION
 3 ENGINES OPERATING
 ENGINE TYPE

THRUST DATA -20ICRCHOIC5

HEADER 1
 X
 X

HEADER 2
 X
 X

WT LB	CAS KN	TAS KN	DELTA CAS KN	HP = 5000 FT.	VE/VFS	R/S FPM	DRAG LB	FN LB	FN/DELTA LB	N1	N1/ROOT Θ	EPR
270000	148.3	153.7	0.0		1.600	0.0	37861	12620	15168	65.59	68.87	1.138
270000	158.3	164.0	10.0		1.708	0.0	39058	13019	15647	66.94	70.23	1.144
270000	168.3	174.4	20.0		1.815	0.0	40784	13595	16339	68.58	71.90	1.152
270000	178.3	184.7	30.0		1.923	0.0	42966	14322	17213	70.36	73.89	1.163
270000	198.3	195.0	40.0		2.030	0.0	45552	15184	18249	72.16	75.50	1.175
290000	154.7	160.4	0.0		1.600	0.0	40769	13590	16333	67.86	71.22	1.153
290000	164.7	170.7	10.0		1.703	0.0	42061	14020	16850	69.15	72.51	1.159
290000	174.7	181.0	20.0		1.806	0.0	43874	14625	17577	70.70	74.07	1.168
290000	184.7	191.4	30.0		1.909	0.0	46142	15381	18485	72.32	75.69	1.179
290000	194.7	201.7	40.0		2.012	0.0	48313	16271	19555	74.15	77.53	1.192

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APPROACH MISSE LEVEL DEFINITION PROGRAM
ENGINE TYPE

MODEL DC-10-40

FLAPS = 50 DEG.

3 ENGINES OPERATING

THRUST DATA -20IC8CHOIC5

X

HEADER 1

X

HEADER 2

WT LR	CAS KN	TAS KN	DELTA CAS KN	VE/VES	R/S FPM	DRAG LB	FN LB	FN/DELTA LB	NI	NI/ROTT θ	EPR
270000	143.4	160.8	0.0	1.600	0.0	37861	12620	16991	68.19	72.38	1.161
270000	158.4	171.6	10.0	1.707	0.0	39054	13018	17526	69.48	73.69	1.167
270000	168.4	182.3	20.0	1.814	0.0	40773	13591	18297	71.05	75.28	1.177
270000	178.4	193.1	30.0	1.922	0.0	42943	14314	19271	72.67	76.91	1.189
270000	188.4	203.8	40.0	2.029	0.0	45514	15171	20425	74.53	78.80	1.204
290000	154.9	167.5	0.0	1.600	0.0	40769	13590	18296	70.34	74.63	1.177
290000	164.9	178.5	10.0	1.703	0.0	42055	14018	18873	71.62	75.92	1.185
290000	174.9	189.3	20.0	1.805	0.0	43860	14620	19683	73.02	77.32	1.195
290000	184.9	200.1	30.0	1.908	0.0	46116	15372	20695	74.69	79.00	1.209
290000	194.9	210.8	40.0	2.010	0.0	48770	16257	21896	76.49	80.82	1.225

SPECIAL PRINT OUT OF INPUT DATA

MODEL DC-10-4J

X

HEADER 1

X

X

HEADER 2

X

INITIAL WT = 270000 LB DELTA WT = 20000 LB FINAL WT = 340000
INITIAL DELTA TEMP = -20.00 DEG C DELTA (DELTA TEMP) = 20.00 DEG C FINAL DELTA TEMP = 20.00 DEG C
INITIAL ALT. = 5000 FT DELTA ALT. = 3000 FT FINAL ALT. = 10000 FT

BLEED FLAG = 0 NO. OF AIRCONDITIONING UNITS = 3

APPROACH GRADIENT = 3.000 DEG. (DOWN IS A POSITIVE INPUT)

18 INITIAL VE/VE STALL = 1.000 DELTA CAS = 10.0 KN

FLAP DEFLECTION = 35 DEG

LANDING GEAR FLAG = 1

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MODEL DC-10-40 APPROACH NOISE LEVEL DEFINITION PROGRAM
 FLAPS = 35 DEG. 3 ENGINES OPERATING ENGINE TYPE

THRUST DATA -20ICRCHOIC5

WT LB	CAS KMH	TAS KN	DELTA CAS	VF/VES	R/S EPM	DRAG LB	FN LR	FM/DELTA LR	AMB. TEMP. = -14.9 DEG.C	NI	NI/ROOT Θ	FDR	HEADER 1		
													Y	X	
GRAUENT = 3.00 DEG.													HEADER 2		
5000 FT. DELTA TEMP. = -20.0 DEG.C													Y	X	
270000	153.1	158.7	0.0	1.600	341.4	31645	5665	6808	48.20	48.20	50.59	1.042			
270000	163.1	169.1	10.0	1.704	396.4	32181	5820	6995	48.33	49.33	51.73	1.042			
270000	173.1	179.4	20.0	1.808	451.2	33152	6119	7355	50.86	50.86	53.29	1.043			
270000	183.1	189.7	30.0	1.912	505.9	34496	6542	7852	52.59	52.59	55.16	1.047			
270000	193.1	200.0	40.0	2.016	550.6	36166	7071	8498	54.83	54.83	57.34	1.052			
290000	159.8	165.6	0.0	1.600	375.1	34024	5080	7307	49.39	49.39	52.33	1.046			
290000	169.8	175.9	10.0	1.700	432.9	34622	6253	7515	51.03	51.03	53.69	1.046			
290000	179.8	186.3	20.0	1.800	487.7	35649	6568	7849	52.56	52.56	55.04	1.048			
290000	189.8	196.6	30.0	1.899	542.4	37047	7005	8419	54.44	54.44	56.95	1.051			
290000	199.8	206.9	40.0	1.999	597.1	38772	7550	9074	56.57	56.57	59.12	1.057			
310000	165.9	171.9	0.0	1.600	911.6	30397	6491	7801	51.47	51.47	53.97	1.050			
310000	175.9	182.2	10.0	1.696	966.4	37038	6676	8024	52.61	52.61	55.11	1.052			
310000	185.9	192.6	20.0	1.792	1021.1	38106	7002	8415	54.05	54.05	56.60	1.052			
310000	195.9	202.9	30.0	1.836	1075.3	39545	7450	8953	56.05	56.05	58.60	1.056			
310000	205.9	213.2	40.0	1.984	1130.4	41310	8005	9620	58.16	58.16	60.74	1.061			
330000	171.4	177.6	0.0	1.600	941.9	38755	6877	8232	52.95	52.95	55.49	1.055			
330000	181.4	188.0	10.0	1.653	996.6	39421	7087	8513	54.12	54.12	56.66	1.055			
330000	191.4	198.3	20.0	1.726	1051.3	40514	7419	8916	55.68	55.68	58.24	1.061			
330000	201.4	208.6	30.0	1.879	1106.7	41978	7872	9450	57.53	57.53	60.11	1.061			
330000	211.4	219.9	40.0	1.972	1160.7	43772	8433	10135	59.61	59.61	62.22	1.066			
340000	174.0	180.3	0.0	1.600	955.8	39928	7097	8530	53.67	53.67	56.23	1.057			
340000	184.0	190.6	10.0	1.592	1010.3	40593	7297	8758	54.84	54.84	57.40	1.057			
340000	194.0	200.9	20.0	1.783	1065.3	41696	7613	9157	56.38	56.38	58.96	1.059			
340000	204.0	211.2	30.0	1.875	1119.9	43167	8079	9703	58.22	58.22	60.81	1.063			
340000	214.0	221.5	40.0	1.966	1174.6	44971	8636	10379	60.28	60.28	62.90	1.069			

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DOUGLAS AIRCRAFT COMPANY

APPROACH NOTISE LEVEL DEFINITION PROGRAM
3 ENGINES OPERATING ENGINE TYPE

MODEL DC-10-40
FLAPS = 35 DEG.

THRUST DATA -20ICBCH01C5

GRADIENT = 3.00 DEG. HP = 8000 FT. DELTA TEMP. = -20.0 DEG.C DELTA TEMP. = -20.9 DEG.C
Y X
X X

HEADER 1
HEADER 2

WT LR	CAS KN	TAS KN	DELTA CAS KN	VF/VES	S/S FPM	DEAC LR	FN LR	FN/DELTA LR	NI	NI/PROT Θ	EPR
270000	153.3	166.0	0.0	1.600	890.5	31645	5644	7598	50.19	53.26	1.049
270000	163.3	176.6	10.0	1.704	937.6	32179	5796	7803	51.33	54.42	1.049
270000	173.3	187.6	20.0	1.808	994.7	33145	6091	8200	52.91	56.04	1.051
270000	183.3	198.4	30.0	1.911	1051.8	34481	6507	8781	54.36	58.04	1.054
270000	193.3	209.1	40.0	2.015	1108.8	36141	7030	9465	57.08	60.32	1.060
290000	150.0	173.2	0.0	1.600	918.8	34074	6350	8153	51.91	55.05	1.053
290000	170.0	184.0	10.0	1.699	975.3	34610	6225	8331	53.09	56.24	1.054
290000	180.0	194.8	20.0	1.799	1032.3	35640	6535	8798	54.72	57.81	1.056
290000	190.0	205.5	30.0	1.898	1099.8	37030	6966	9378	55.63	59.01	1.060
290000	200.0	216.3	40.0	1.997	1146.3	38742	7503	10101	58.97	62.17	1.066
310000	166.1	179.8	0.0	1.600	953.8	35397	6463	8701	53.57	56.77	1.059
310000	176.1	190.6	10.0	1.696	1010.8	37035	6644	8945	54.79	58.01	1.058
310000	186.1	201.4	20.0	1.791	1067.8	38098	6965	9376	56.42	59.67	1.061
310000	196.1	212.1	30.0	1.887	1124.7	39526	7405	9970	58.35	61.64	1.065
310000	206.1	222.9	40.0	1.983	1181.7	41260	7952	10705	60.52	63.95	1.072
330000	171.7	185.3	0.0	1.600	935.3	35755	6365	9243	55.16	58.42	1.063
330000	181.7	196.6	10.0	1.693	1042.4	37418	7051	9493	56.38	59.65	1.063
330000	191.7	207.3	20.0	1.785	1099.4	40504	7374	9930	57.93	61.28	1.066
330000	201.7	218.1	30.0	1.878	1156.4	41959	7822	10531	59.38	63.21	1.071
330000	211.7	228.8	40.0	1.970	1213.3	43730	8375	11275	62.00	65.38	1.077
340000	174.2	188.6	0.0	1.600	999.9	39928	7064	9510	55.92	59.21	1.065
340000	194.2	199.3	10.0	1.691	1057.0	40595	7249	9739	57.12	60.43	1.066
340000	204.2	210.1	20.0	1.782	1114.0	41686	7574	10197	58.71	62.03	1.069
340000	214.2	220.8	30.0	1.873	1170.9	43147	8021	10793	60.58	63.94	1.073
340000	224.2	231.6	40.0	1.964	1227.8	44937	8575	11544	62.69	66.08	1.080

APPROACH NOISE LEVEL DEFINITION PROGRAM

DIMENSION TIME(2)
COMMON Y(300), DAY(2), ENGTYP(2), AMODEL(2), FDATE(3),
HEAD(20), HEAD2(20), A(9), P(4), C(4), F, ICFE, ICAS, I0
COMMON / ENCODAT / ZIN(25), OUT(50)
COMMON / TRAC / ZIN5, ZIN19, PIN20, PIN21
COMMON / WPIN / Z(18), Y(18)

EQUIVALENCE
1 (X(3), ATE) ; (X(11), WTI) ; (X(2), DW) ;
2 (X(6), HPE) ; (X(4), HPI) ; (X(5), DDT) ;
3 (X(9), ENSN) ; (X(7), ENGAD) ; (X(8), DHP) ;
4 (X(12), VSZDAT) ; (X(10), GRAD) ; (X(11), STDWT) ;
5 (X(23), FLAPS) ; (X(13), ENGRP) ; (X(21), CFN) ;
6 (X(26), CI) ; (X(24), OCAS) ; (X(25), SW) ;
7 (X(32), TSERIZ) ; (X(27), CGGEAF) ; (X(28), CC) ;
8 (X(31), TCFAD) ; (X(30), C2) ; (X(31), C3) ;
9 (Y(2), TCFAD) ; (Y(18), TCFAD) ; (Y(11), AMODEL) ;

DATA IFAA/2, LAPSE/0, SOUND/1.0, RAIN/0.0, NUMBER/3/

10 FOR 4AT (1H 28X 30HD 0 U G L A S A I R C P A F T
1 15HC 0 W B A W Y // 14 244, 89X 4HPAGE I3 //
2 14 12X 19H2 P S O A C H D E V E L D E F I N I T I O N
3 14HP 0 I S P : V // 10H MODEL 0C-12, 1H-12, 24X I2,
4 14H ENGINES OPERATING 26X 12HENGINE TYPE 2A4 // 21X
5 14H FLAPS = 13, 54 DEG. 24X 10H 7X 3H
6 12H THRUST DATA 344 // 14 12X 20A4 // 14 12X 20A4 // 6X
7 11H GRABIENT = F6.2, 5H DEG. 6X 4HP = 16, 4H FT. 6X
8 13H DELTA TEMP. = F6.1, 6H DEG. C 6X 12HAMB. DELTA VE/VES
9 53HR/S .DEAC WT F1 GR/Delta KV NI KV CAS KN 15X EPE I
20 FUR 4AT (1H+ 90X 1H- / 31H LR LR /)
30 FUR 4AT (1H 16,2X F6.1, 2X F6.1, 2X F6.1, 2X F7.3, 2X F7.2X
40 FUR 4AT (21Z, 31Z, 3E6.2, 31Z, 2F5.3, =4.1, 12, 11, 12)
50 FUR 4AT (20,4)
60 FUR 4AT (140)

SET UP PDELTINARY DATA
TP
CALL DATEV (DAY, TIME)
NDAYS I = 1, 300
Y(1) = 0.
HEAD (5,50) HEAD1
HEAD (5,50) HEAD2

MAIN0000
A8PR0010
MAIN0030
A8PR0060
A8PR0090
MAIN0100
MAIN0110
A8PR0120
MAIN0125
MAIN0130
MAIN0200
MAIN0210
MAIN0220
MAIN0230
MAIN0240
MAIN0250
MAIN0260
A8PR0280
A8PR0290
MAIN0300
MAIN0350
MAIN0400
MAIN0410
MAIN0480
MAIN0490
MAIN0500
MAIN0510
MAIN0520
MAIN0530
A8PR0540
MAIN0550
MAIN0560
MAIN0570
MAIN0580
MAIN0590
MAIN0600
MAIN0610
MAIN0620
MAIN0630
A8PR0640
MAIN0650
MAIN0660
MAIN0700
MAIN0710
MAIN0720
MAIN0730
A8PR0740
MAIN0790
A8PR0800
A8PR0810
A8PR0815
MAIN0820
MAIN0830

APR80835
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    70      CALL OC DATA
    71      CALL ZDATA
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    200     CALL INIT
  
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C
HP LOOP
DO 900 IV = 1, NHP
  HP = HP1 + SMOX(IV-1)
  VE ( IV, EQ, NHP ) HP = HPF
  KWP = HP + 0.51
  VE ( LASTHP, EQ, NHP ) GO TO 900
LASTHP = KWP
CALL ATW4 ( HP, DELTA, TEMPC, P, Q40, SOSKN, SIGMA, REPEATV )
DELTA = 0.2116, 215
EK ( HP, GT, 36000.0 ) EK = 0.7
VT LOOP
DO 850 IW = 1, NIV
  W = W1 + CW*(IW-1)
  VE ( IW, EQ, NIV ) W = WF
  KW = W + 0.51
  VE ( LASTW, EQ, KW ) GO TO 850
LASTW = KW
SET UP FOR GAS LOOP
R(4) = W*(LVSEW+1) *GT, 100 ) GO TO 300
CALL TABLE2 ( LVSEW )
GO TO 350
CALL TABLE1 ( LVSEW )
VSEKN = P * SORT(N/STWMT)
VSTAS = VSEKN / SORT(SIGMA )
VVAS = VSTAS + VSEATW
AV = VAS/SOSKN
RW = ( 1.0 + 0.2*AV*AV )**3.5 - 1.0
CW = ( DELTA * RW + 1.0 )**0.2857142 - 1.0
VCFS = SORT( 651.470*661.470*CM/9.2 )

300
350
GAS LOOP
DO 800 IV = 1, NV
  DCAS*(IV-1)
  DV = VCAS + DV
  GAS = 5.0 * ( ( 11.0 + 0.2*(CFS/661.48)**2 )**3.5 - 1.0 ) /
  S * DELTA + 1.0 )**0.2857142
  AV = SORT( AVS )
  TAS = AV + SOSKN
  PV = TAS/VSTAS
  RS = GAMMA*VAS+101.2685
  O = 0.7*PV*AV*AV
  CL = W*CO*(GAMMA)/(O*CM)
  CN = CO + CL*CL + C2*CL*CL + C3*CL**3 + C4*CL**4
  IF ( 17GEAR *GT, 0 ) CN = CO + CNGEAR
  DPAG = O*SM*CO
  INPAG = DPAG + 0.51
  YREQ = (-GAMMA**2*(1.0 + EK*AVS ) + DPAG )/ENGP*CFN
  IFNDEL = TREQ + 0.51
  IFNDEL = TREQ/DELTA + 0.51
CALL THRUSH ( HP, TEMPC, AV, LAPSE, Q1, Q2, Q3, IFATF, FPRN1, ENGRP,

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1  *PROMEO, IALLEN, PCT, TREQ, FA, FPR, TT2, ONL, PCTNL, FE, FOATC, IOI, I32,
2  IJ3, IJ4, IQ5, IQ6, ZK, TEAA, PCTEA, ISEPI, GORING, RAIN, JN2, PCTM2 }
3  IF ( MODEL, NE, 10 ) OUT(10) = ( 0.2*AM*AM )+273.15 +
4  *M1POT = PCT*V1/SQR(V1)OUT(10) + 273.15)/288.15 )
5  IF ( IL, LT, 30 ) GO TO 500
6  IL = 0
7  IP = IO + 1
8  *WRITE (6,10) O.V, IP, MODEL, ISERT, VEMP, ENGTYP, IFLAP,
9  *FOATE, HEADL, HEAD2, GRAD, KHD, DELTC, TCMPC
10 *WRITE (6,20)
11 *IL = IL + 1
12 *WRITE (6,30) K2, CAS, TAS, DV, AV, FS, IDEAG, IFN, IFNDEL,
13 *PCTNL, DM1ROT, FOR
14 *CONTINUE
15 *WRITE (6,60)
16 *CONTINUE = 100
17 GO TO 100
18 END

```

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MAIN2110
MAIN2120
MAIN2124
MAIN2125
MAIN2130
MAIN2300
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245B2340
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DCDA0010
 DCDA0015
 DCDA0016
 DCDA0020
 DCDA0030
 DCDA0040
 DCDA0050
 DCDA0060
 DCDA0070
 DCDA0100
 DCDA0110
 DCDA0120
 DCDA0130
 DCDA0140
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 DCDA0170
 DCDA0175
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 DCDA0200
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 DCDA0240
 DCDA0250
 DCDA0260
 DCDA0270
 DCDA0280
 DCDA0290
 DCDA0295
 DCDA0296
 DCDA0298
 DCDA0300
 DCDA0302
 DCDA0304
 DCDA0306
 DCDA0310
 DCDA0320
 DCDA0325
 DCDA0326
 DCDA0330
 DCDA0340
 DCDA0350
 DCDA0360
 DCDA0370
 DCDA0380
 DCDA0390
 DCDA0400
 DCDA0410
 DCDA0420
 DCDA0430
 DCDA0440
 DCDA0450

```

SUBROUTINE DCDATA
  LOGICAL*1 FIRST / .TRUE. /
  COMMON X(300)
  COMMON /RXY/ DC(1810)
  COMMON /NPN/ Z(18), Y(18)
  EQUIVALENCE ( Y(1), MODEL ), ( Y(2), ISEFIZ ), ( Z(17), IZFLAP )
  NDC = MODEL*100 + ISEFIZ
  LDC = 0
  IF ( NDC .EQ. 861 ) LDC = 1
  IF ( NDC .EQ. 863 ) LDC = 301
  IF ( NDC .EQ. 930 ) LDC = 601
  IF ( NDC .EQ. 1013 ) LDC = 901
  IF ( NDC .EQ. 1040 ) LDC = 1201
  IF ( NDC .GT. 849 .AND. NDC.LT.856 ) LDC =1501
  IF ( LDC .EQ. 0 ) GO TO 10
  LDC = LDC - 1
  DO 10 I = 1, LDC
    X(I) = DC(L+I)
  DO 20 I = 1, LDC
    X(I+1) = DC(LDC+I)
  X(21) = 40.0
  X(25) = DC(LDC+8)
  ENTRY DCFLAP
  LDC = 0
  IF ( IZFLAP .EQ. 1 ) GO TO 50
  CONTINUE
  IF ( LDC .EQ. 0 ) GO TO 60
  DO 30 I = 1, LDC
    Y(I+1) = DC(L+I)
  IF ( .NOT. FIRST ) RETURN
  FIRST = .FALSE.
  LDC = LDC + 14
  NDC = DC(L+1) + 0.1
  NE = DC(L+2) + 0.1
  Y5 = ( NE .LT. 100 ) GO TO 50
  SINGLE INTERPOLATION TABLE
  NP = 1 + 2*NP
  DO 40 I = 1, NP
    X(39+I) = DC(L+I)
  RETURN
  DOUBLE INTERPOLATION TABLE
  
```

50 NO = 2 + NY + NE + NEM
60 Y(39+1) = 1, 40
60 Y(39+1) = DC(L+1)
RETURN

C

FROM MESSAGE

70 ABITE (6,90) MODEL, ISSRIZ
80 #00001 (18M1 * # # # 90DEL DC-12, 14-12, 21H DATA NET AVAILABLE
STOP 13

C

90 BELLE (6,100) IZFLD, WDEL, ISSRIZ
100 #00001 (23H1 * # # # FLD SETTINGS = 13, 20H REC. NET AVAILABLE
STOP 14
END

DCDA0460
DCDA0470
DCDA0480
DCDA0490
DCDA0500
DCDA0510
DCDA0520
DCDA0530
DCDA0540
DCDA0550
DCDA0560
DCDA0570
DCDA0580
DCDA0590
DCDA0600
DCDA0610

```

C
SUBROUTINE ZDATA
LOGICAL *I FIRST /, TOME /
COMMON / (300) / CA(2), ET(2), ANGL(2), EDA(3), HAP1(20), HAP2(20)
C
C
C
DIMENSION BUE(2), JE(16), IZ1(3), IZ2(3)
EQUIVALENCE
A (( Y(2) ), IYWI ), (( Y(4) ), MODEL ), (( Y(2) ), ISEPI )
B (( Y(6) ), IYDT ), (( Y(7) ), IYDW ), (( Y(5) ), IYWF )
C (( Y(8) ), IYHPT ), (( Y(10) ), IYDHP ), (( Y(8) ), IYDTE )
D (( Y(12) ), IYV ), (( Y(13) ), IYVNS ), (( Y(11) ), IYHDF )
E (( Y(15) ), IZWT ), (( Y(16) ), IZVNS ), (( Y(14) ), IYCAM )
F (( Z(3) ), IZDT ), (( Z(4) ), IZDHP ), (( Y(17) ), IYFLAP )
G (( Z(6) ), IZDPT ), (( Z(10) ), IZDHP ), (( Z(5) ), IZWF )
H (( Z(9) ), IZVNS ), (( Z(13) ), IZVNS ), (( Z(8) ), IZDTE )
I (( Z(12) ), IZGEAR ), (( Z(15) ), IZVNS ), (( Z(11) ), IZHDF )
J (( Z(18) ), IZ1(1) ), (( Z(18) ), IZGEAR ), (( Z(14) ), IZCAM )
K (( Z(3) ), IZ2(1) ), (( Z(9) ), IZ2(1) ), (( Z(17) ), IZFLAP )
L (( Z(3) ), IZ2(1) ), (( Z(9) ), IZ2(1) ), (( Z(3) ), IZ1(1) )
C
DATA BLANK4 /4H /, BLANK2 /2H /, BLANK1 /1H /
C
C
10 FORMAT ( 4X310, A2,A4, A2, A4, A2, A4 )
20 FORMAT ( A2, A4, A2, A4 )
21 FORMAT ( F6.2 )
22 FORMAT ( F6.3 )
30 FORMAT ( A1, A4 )
31 FORMAT ( A1 )
34 FORMAT ( A1 )
40 FORMAT ( A4 )
50 FORMAT ( F4.1 )
60 FORMAT ( A2 )
61 FORMAT ( Y2 )
C
C
IF ( FIRST ) GO TO 310
READ ( 5,10,END=400)
A IZWI, IZDW, IZVNS, IZWF, ADT11, ADT12, ZDPT, ADTE1, ADTE2,
1 AHP1, AHP2, IZDHP, AHP1, AHP2, AB, ANC, AGA, AGAM2,
2 AVVNS1, AVVNS2, ADCAS, AELAP, AGEAR
C
C
IF ( IZWI .EQ. 0 ) IZWI = IYWI
IF ( IZDW .EQ. 0 ) IZDW = IYDW
IF ( IZWF .EQ. 0 ) IZWF = IYWF
IF ( ZDPT .EQ. 0.0 ) ZDPT = YDPT
IF ( IZDHP .EQ. 0 ) IZDHP = IYDHP
IF ( ADT11.EQ.BLANK2 .AND. ADT12.EQ.BLANK4 ) GO TO 100

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CALL CORE ( RUF, 6 )
WRITE (99,20) ADT11;
CALL CORE ( RUF, 6 )
READ (99,21) ZDT1
GO TO 110
ZDT1 = YDT1
C 100
C 110 IF ( ADT11.EQ.BLANK2 .AND. ADT2.EQ.BLANK4 ) GO TO 120
CALL CORE ( RUF, 6 )
WRITE (99,20) ADT11;
CALL CORE ( RUF, 6 )
READ (99,21) ZDT1
GO TO 130
ZDT1 = YDT1
C 120
C 130 IF ( ADT11.EQ.BLANK1 .AND. ADT2.EQ.BLANK4 ) GO TO 140
CALL CORE ( RUF, 5 )
WRITE (99,30) ADT11;
CALL CORE ( RUF, 5 )
READ (99,31) IZHP1
GO TO 150
IZHP1 = IYHP1
C 140
C 150 IF ( ADT11.EQ.BLANK1 .AND. ADT2.EQ.BLANK4 ) GO TO 160
CALL CORE ( RUF, 5 )
WRITE (99,30) ADT11;
CALL CORE ( RUF, 5 )
READ (99,31) IZHP1
GO TO 170
IZHP1 = IYHP1
C 160
C 170 IF ( ADT11.EQ.BLANK1 ) GO TO 180
CALL CORE ( RUF, 1 )
WRITE (99,40) ADT11;
CALL CORE ( RUF, 1 )
READ (99,41) IZHP1
GO TO 190
IZHP1 = IYHP1
C 180
C 190 IF ( ADT11.EQ.BLANK1 ) GO TO 200
CALL CORE ( RUF, 1 )
WRITE (99,40) ADT11;
CALL CORE ( RUF, 1 )
READ (99,41) IZHP1
GO TO 210
IZHP1 = IYHP1
C 200
C 210 IF ( ADT11.EQ.BLANK2 .AND. ADT2.EQ.BLANK4 ) GO TO 220
CALL CORE ( RUF, 6 )
WRITE (99,20) ADT11;
CALL CORE ( RUF, 6 )
READ (99,21) ZDT1
GO TO 230
ZDT1 = YDT1
C 220

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ZDAT0540
ZDAT0550
ZDAT0560
ZDAT0570
ZDAT0580
ZDAT0590
ZDAT0600
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ZDAT0980
ZDAT0990
ZDAT1000
ZDAT1010
ZDAT1020
ZDAT1030
ZDAT1040
ZDAT1050
ZDAT1060

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230 IF ( AVVCS1.EQ.BLANK2 .AND. AVVCS2.EQ.BLANK4 ) GO TO 240
CALL CORR ( RUF, 6 )
WRITE ( 30, 20 ) AVVCS1, AVVCS2
CALL CORR ( RUF, 6 )
READ ( 99, 21 ) ZVPCS
DO TO 250
240 ZVPCS = VVPCS
C
250 IF ( ANCAS.EQ.BLANK4 ) GO TO 260
CALL CORR ( RUF, 4 )
WRITE ( 99, 50 ) ANCAS
CALL CORR ( RUF, 4 )
READ ( 99, 51 ) ZPCAS
DO TO 270
260 ZPCAS = VPCAS
C
270 IF ( IVELAP.EQ.BLANK2 ) GO TO 280
CALL CORR ( RUF, 2 )
WRITE ( 99, 60 ) IVELAP
CALL CORR ( RUF, 2 )
READ ( 99, 61 ) IVELAP
CALL CORRELAP
GO TO 280
280 IVELAP = IVELAP
C
290 IF ( ABEAS.EQ.BLANK1 ) GO TO 300
CALL CORR ( RUF, 1 )
WRITE ( 99, 40 ) ABEAS
CALL CORR ( RUF, 1 )
READ ( 99, 41 ) IZBEAS
GO TO 310
300 IZBEAS = IVBEAS
C
310 IZBEAS = IVBEAS
315 I = .FALSE.
DO 320 I = 1, 3
320 X(I) = ELSTAT( IZ1(I) )
DO 325 I = 1, 6
325 X(I) = ELSTAT( IZ1(I) )
DO 330 I = 1, 6
330 X(I) = ELSTAT( IZ1(I) )
DO 335 I = 1, 6
335 X(I) = ELSTAT( IZ1(I) )
DO 340 I = 1, 6
340 X(I) = ELSTAT( IZ1(I) )
DO 345 I = 1, 6
345 X(I) = ELSTAT( IZ1(I) )
DO 350 I = 1, 6
350 X(I) = ELSTAT( IZ1(I) )
DO 355 I = 1, 6
355 X(I) = ELSTAT( IZ1(I) )
DO 360 I = 1, 6
360 X(I) = ELSTAT( IZ1(I) )
DO 365 I = 1, 6
365 X(I) = ELSTAT( IZ1(I) )
DO 370 I = 1, 6
370 X(I) = ELSTAT( IZ1(I) )
DO 375 I = 1, 6
375 X(I) = ELSTAT( IZ1(I) )
DO 380 I = 1, 6
380 X(I) = ELSTAT( IZ1(I) )
DO 385 I = 1, 6
385 X(I) = ELSTAT( IZ1(I) )
DO 390 I = 1, 6
390 X(I) = ELSTAT( IZ1(I) )
DO 395 I = 1, 6
395 X(I) = ELSTAT( IZ1(I) )
DO 400 I = 1, 6
400 X(I) = ELSTAT( IZ1(I) )
DO 405 I = 1, 6
405 X(I) = ELSTAT( IZ1(I) )
DO 410 I = 1, 6
410 X(I) = ELSTAT( IZ1(I) )
DO 415 I = 1, 6
415 X(I) = ELSTAT( IZ1(I) )
DO 420 I = 1, 6
420 X(I) = ELSTAT( IZ1(I) )
DO 425 I = 1, 6
425 X(I) = ELSTAT( IZ1(I) )
DO 430 I = 1, 6
430 X(I) = ELSTAT( IZ1(I) )
DO 435 I = 1, 6
435 X(I) = ELSTAT( IZ1(I) )
DO 440 I = 1, 6
440 X(I) = ELSTAT( IZ1(I) )
DO 445 I = 1, 6
445 X(I) = ELSTAT( IZ1(I) )
DO 450 I = 1, 6
450 X(I) = ELSTAT( IZ1(I) )
DO 455 I = 1, 6
455 X(I) = ELSTAT( IZ1(I) )
DO 460 I = 1, 6
460 X(I) = ELSTAT( IZ1(I) )
DO 465 I = 1, 6
465 X(I) = ELSTAT( IZ1(I) )
DO 470 I = 1, 6
470 X(I) = ELSTAT( IZ1(I) )
DO 475 I = 1, 6
475 X(I) = ELSTAT( IZ1(I) )
DO 480 I = 1, 6
480 X(I) = ELSTAT( IZ1(I) )
DO 485 I = 1, 6
485 X(I) = ELSTAT( IZ1(I) )
DO 490 I = 1, 6
490 X(I) = ELSTAT( IZ1(I) )
DO 495 I = 1, 6
495 X(I) = ELSTAT( IZ1(I) )
DO 500 I = 1, 6
500 X(I) = ELSTAT( IZ1(I) )
DO 505 I = 1, 6
505 X(I) = ELSTAT( IZ1(I) )
DO 510 I = 1, 6
510 X(I) = ELSTAT( IZ1(I) )
DO 515 I = 1, 6
515 X(I) = ELSTAT( IZ1(I) )
DO 520 I = 1, 6
520 X(I) = ELSTAT( IZ1(I) )
DO 525 I = 1, 6
525 X(I) = ELSTAT( IZ1(I) )
DO 530 I = 1, 6
530 X(I) = ELSTAT( IZ1(I) )
DO 535 I = 1, 6
535 X(I) = ELSTAT( IZ1(I) )
DO 540 I = 1, 6
540 X(I) = ELSTAT( IZ1(I) )
DO 545 I = 1, 6
545 X(I) = ELSTAT( IZ1(I) )
DO 550 I = 1, 6
550 X(I) = ELSTAT( IZ1(I) )
DO 555 I = 1, 6
555 X(I) = ELSTAT( IZ1(I) )
DO 560 I = 1, 6
560 X(I) = ELSTAT( IZ1(I) )
DO 565 I = 1, 6
565 X(I) = ELSTAT( IZ1(I) )
DO 570 I = 1, 6
570 X(I) = ELSTAT( IZ1(I) )
DO 575 I = 1, 6
575 X(I) = ELSTAT( IZ1(I) )
DO 580 I = 1, 6
580 X(I) = ELSTAT( IZ1(I) )
DO 585 I = 1, 6
585 X(I) = ELSTAT( IZ1(I) )
DO 590 I = 1, 6
590 X(I) = ELSTAT( IZ1(I) )
DO 595 I = 1, 6
595 X(I) = ELSTAT( IZ1(I) )
DO 600 I = 1, 6
600 X(I) = ELSTAT( IZ1(I) )
DO 605 I = 1, 6
605 X(I) = ELSTAT( IZ1(I) )
DO 610 I = 1, 6
610 X(I) = ELSTAT( IZ1(I) )
DO 615 I = 1, 6
615 X(I) = ELSTAT( IZ1(I) )
DO 620 I = 1, 6
620 X(I) = ELSTAT( IZ1(I) )
DO 625 I = 1, 6
625 X(I) = ELSTAT( IZ1(I) )
DO 630 I = 1, 6
630 X(I) = ELSTAT( IZ1(I) )
DO 635 I = 1, 6
635 X(I) = ELSTAT( IZ1(I) )
DO 640 I = 1, 6
640 X(I) = ELSTAT( IZ1(I) )
DO 645 I = 1, 6
645 X(I) = ELSTAT( IZ1(I) )
DO 650 I = 1, 6
650 X(I) = ELSTAT( IZ1(I) )
DO 655 I = 1, 6
655 X(I) = ELSTAT( IZ1(I) )
DO 660 I = 1, 6
660 X(I) = ELSTAT( IZ1(I) )
DO 665 I = 1, 6
665 X(I) = ELSTAT( IZ1(I) )
DO 670 I = 1, 6
670 X(I) = ELSTAT( IZ1(I) )
DO 675 I = 1, 6
675 X(I) = ELSTAT( IZ1(I) )
DO 680 I = 1, 6
680 X(I) = ELSTAT( IZ1(I) )
DO 685 I = 1, 6
685 X(I) = ELSTAT( IZ1(I) )
DO 690 I = 1, 6
690 X(I) = ELSTAT( IZ1(I) )
DO 695 I = 1, 6
695 X(I) = ELSTAT( IZ1(I) )
DO 700 I = 1, 6
700 X(I) = ELSTAT( IZ1(I) )
DO 705 I = 1, 6
705 X(I) = ELSTAT( IZ1(I) )
DO 710 I = 1, 6
710 X(I) = ELSTAT( IZ1(I) )
DO 715 I = 1, 6
715 X(I) = ELSTAT( IZ1(I) )
DO 720 I = 1, 6
720 X(I) = ELSTAT( IZ1(I) )
DO 725 I = 1, 6
725 X(I) = ELSTAT( IZ1(I) )
DO 730 I = 1, 6
730 X(I) = ELSTAT( IZ1(I) )
DO 735 I = 1, 6
735 X(I) = ELSTAT( IZ1(I) )
DO 740 I = 1, 6
740 X(I) = ELSTAT( IZ1(I) )
DO 745 I = 1, 6
745 X(I) = ELSTAT( IZ1(I) )
DO 750 I = 1, 6
750 X(I) = ELSTAT( IZ1(I) )
DO 755 I = 1, 6
755 X(I) = ELSTAT( IZ1(I) )
DO 760 I = 1, 6
760 X(I) = ELSTAT( IZ1(I) )
DO 765 I = 1, 6
765 X(I) = ELSTAT( IZ1(I) )
DO 770 I = 1, 6
770 X(I) = ELSTAT( IZ1(I) )
DO 775 I = 1, 6
775 X(I) = ELSTAT( IZ1(I) )
DO 780 I = 1, 6
780 X(I) = ELSTAT( IZ1(I) )
DO 785 I = 1, 6
785 X(I) = ELSTAT( IZ1(I) )
DO 790 I = 1, 6
790 X(I) = ELSTAT( IZ1(I) )
DO 795 I = 1, 6
795 X(I) = ELSTAT( IZ1(I) )
DO 800 I = 1, 6
800 X(I) = ELSTAT( IZ1(I) )
DO 805 I = 1, 6
805 X(I) = ELSTAT( IZ1(I) )
DO 810 I = 1, 6
810 X(I) = ELSTAT( IZ1(I) )
DO 815 I = 1, 6
815 X(I) = ELSTAT( IZ1(I) )
DO 820 I = 1, 6
820 X(I) = ELSTAT( IZ1(I) )
DO 825 I = 1, 6
825 X(I) = ELSTAT( IZ1(I) )
DO 830 I = 1, 6
830 X(I) = ELSTAT( IZ1(I) )
DO 835 I = 1, 6
835 X(I) = ELSTAT( IZ1(I) )
DO 840 I = 1, 6
840 X(I) = ELSTAT( IZ1(I) )
DO 845 I = 1, 6
845 X(I) = ELSTAT( IZ1(I) )
DO 850 I = 1, 6
850 X(I) = ELSTAT( IZ1(I) )
DO 855 I = 1, 6
855 X(I) = ELSTAT( IZ1(I) )
DO 860 I = 1, 6
860 X(I) = ELSTAT( IZ1(I) )
DO 865 I = 1, 6
865 X(I) = ELSTAT( IZ1(I) )
DO 870 I = 1, 6
870 X(I) = ELSTAT( IZ1(I) )
DO 875 I = 1, 6
875 X(I) = ELSTAT( IZ1(I) )
DO 880 I = 1, 6
880 X(I) = ELSTAT( IZ1(I) )
DO 885 I = 1, 6
885 X(I) = ELSTAT( IZ1(I) )
DO 890 I = 1, 6
890 X(I) = ELSTAT( IZ1(I) )
DO 895 I = 1, 6
895 X(I) = ELSTAT( IZ1(I) )
DO 900 I = 1, 6
900 X(I) = ELSTAT( IZ1(I) )
DO 905 I = 1, 6
905 X(I) = ELSTAT( IZ1(I) )
DO 910 I = 1, 6
910 X(I) = ELSTAT( IZ1(I) )
DO 915 I = 1, 6
915 X(I) = ELSTAT( IZ1(I) )
DO 920 I = 1, 6
920 X(I) = ELSTAT( IZ1(I) )
DO 925 I = 1, 6
925 X(I) = ELSTAT( IZ1(I) )
DO 930 I = 1, 6
930 X(I) = ELSTAT( IZ1(I) )
DO 935 I = 1, 6
935 X(I) = ELSTAT( IZ1(I) )
DO 940 I = 1, 6
940 X(I) = ELSTAT( IZ1(I) )
DO 945 I = 1, 6
945 X(I) = ELSTAT( IZ1(I) )
DO 950 I = 1, 6
950 X(I) = ELSTAT( IZ1(I) )
DO 955 I = 1, 6
955 X(I) = ELSTAT( IZ1(I) )
DO 960 I = 1, 6
960 X(I) = ELSTAT( IZ1(I) )
DO 965 I = 1, 6
965 X(I) = ELSTAT( IZ1(I) )
DO 970 I = 1, 6
970 X(I) = ELSTAT( IZ1(I) )
DO 975 I = 1, 6
975 X(I) = ELSTAT( IZ1(I) )
DO 980 I = 1, 6
980 X(I) = ELSTAT( IZ1(I) )
DO 985 I = 1, 6
985 X(I) = ELSTAT( IZ1(I) )
DO 990 I = 1, 6
990 X(I) = ELSTAT( IZ1(I) )
DO 995 I = 1, 6
995 X(I) = ELSTAT( IZ1(I) )

```

```

330 PRINT OUT, IZ1, IZ2, IZ3, IZ4, IZ5, IZ6, IZ7, IZ8, IZ9, IZ10, IZ11, IZ12, IZ13, IZ14, IZ15, IZ16, IZ17, IZ18, IZ19, IZ20, IZ21, IZ22, IZ23, IZ24, IZ25, IZ26, IZ27, IZ28, IZ29, IZ30, IZ31, IZ32, IZ33, IZ34, IZ35, IZ36, IZ37, IZ38, IZ39, IZ40, IZ41, IZ42, IZ43, IZ44, IZ45, IZ46, IZ47, IZ48, IZ49, IZ50, IZ51, IZ52, IZ53, IZ54, IZ55, IZ56, IZ57, IZ58, IZ59, IZ60, IZ61, IZ62, IZ63, IZ64, IZ65, IZ66, IZ67, IZ68, IZ69, IZ70, IZ71, IZ72, IZ73, IZ74, IZ75, IZ76, IZ77, IZ78, IZ79, IZ80, IZ81, IZ82, IZ83, IZ84, IZ85, IZ86, IZ87, IZ88, IZ89, IZ90, IZ91, IZ92, IZ93, IZ94, IZ95, IZ96, IZ97, IZ98, IZ99, IZ100

```

```

D 54 USE C 4X INITIAL DELTA TEMP = F0.2, 6H DEG C //
E 15H INITIAL DELTA TEMP = F0.2, 6H DEG C //
F 15H INITIAL DELTA TEMP = F0.2, 6H DEG C //
G 15H INITIAL DELTA TEMP = F0.2, 6H DEG C //
H 15H INITIAL DELTA TEMP = F0.2, 6H DEG C //
I 15H INITIAL DELTA TEMP = F0.2, 6H DEG C //
J 15H INITIAL DELTA TEMP = F0.2, 6H DEG C //
K 15H INITIAL DELTA TEMP = F0.2, 6H DEG C //
L 15H INITIAL DELTA TEMP = F0.2, 6H DEG C //
M 15H INITIAL DELTA TEMP = F0.2, 6H DEG C //
N 15H INITIAL DELTA TEMP = F0.2, 6H DEG C //
O 15H INITIAL DELTA TEMP = F0.2, 6H DEG C //
P 15H INITIAL DELTA TEMP = F0.2, 6H DEG C //
Q 15H INITIAL DELTA TEMP = F0.2, 6H DEG C //
R 15H INITIAL DELTA TEMP = F0.2, 6H DEG C //
S 15H INITIAL DELTA TEMP = F0.2, 6H DEG C //
T 15H INITIAL DELTA TEMP = F0.2, 6H DEG C //
U 15H INITIAL DELTA TEMP = F0.2, 6H DEG C //
V 15H INITIAL DELTA TEMP = F0.2, 6H DEG C //
W 15H INITIAL DELTA TEMP = F0.2, 6H DEG C //
X 15H INITIAL DELTA TEMP = F0.2, 6H DEG C //
Y 15H INITIAL DELTA TEMP = F0.2, 6H DEG C //
Z 15H INITIAL DELTA TEMP = F0.2, 6H DEG C //

```

```

ZDAT11570
ZDAT11580
ZDAT11590
ZDAT11600
ZDAT11610
ZDAT11620
ZDAT11630
ZDAT11640
ZDAT11650
ZDAT11660
ZDAT11670
ZDAT11675
ZDAT11680

```

```

WRITE (6,33)M,DEL, I,CE,IZ, H,MI, H,MD, WR

```

```

RETURN
STOP I
END

```

```

400

```

TABL0010
 TABL0020
 TABL0030
 TABL0040
 TABL0050
 TABL0060
 TABL0070
 TABL0080
 TABL0090
 TABL0100
 TABL0110
 TABL0120
 TABL0130
 TABL0140
 TABL0150
 TABL0160
 TABL0170
 TABL0180
 TABL0190
 TABL0200
 TABL0210
 TABL0220
 TABL0230
 TABL0240
 TABL0250
 TABL0260
 TABL0270
 TABL0280
 TABL0290
 TABL0300
 TABL0310
 TABL0320
 TABL0330
 TABL0340
 TABL0350
 TABL0360
 TABL0370
 TABL0380
 TABL0390
 TABL0400
 TABL0410
 TABL0420
 TABL0430
 TABL0440
 TABL0450
 TABL0460
 TABL0470
 TABL0480
 TABL0490
 TABL0500
 TABL0510
 TABL0520
 TABL0530
 TABL0540

```

SUBROUTINE TABLE(L)
  DIMENSION X(30), HEAD(20), ENSTYP(2), AMODEL(2), FORTG(3),
  & HEFT(20), HEAD2(20), X(9), R(4), C(4), C(4), S1
  EQUIVALENCE ( R(4), R(4) ), ( C(4), C(4) )
  DIM(V1,Y2,YD,X1,X2,X3,X,EX) = V1 + (X - X1) + (X - X2) /
  BEGIN IN X ARRAY, THIS SECTIF OF THE ROUTINE PICKS 0, A
  VALUES, 3 B VALUES, AND 3 C VALUES, ACCORDING TO THE A
  AND C VALUES, SEEKS TO MINIM FOR DOUBLE VARIABLE
  TABLE ENERGY
  C
  C DETERMINE TABLE SIZE
  NB = X(L) + 0.01
  IF (NB.LE.2) GO TO 30
  NC = X(L+1) + 0.01
  C
  C SEARCH FROM 2ND B VALUE TO NEXT TO LAST B VALUE, NO
  THE SAME FOR C VALUES
  J = L + 3
  DO 10 I = J, K
  M = I + NB
  IF (X(I) .GE. R4) GO TO 2)
  10 CONTINUE
  C
  C PICK OUT 3 B VALUES
  B1 = X(M-1)
  B2 = X(M)
  B3 = X(M+1)
  C KEEP TRACK OF NO. OF STARTING B VALUE
  M = M + I - J
  C
  C SEARCH FOR C VALUES
  J = K + 3
  DO 30 I = J, K
  N = I + NC
  IF (X(I) .GE. C4) GO TO 40
  30 CONTINUE
  C
  C PICK OUT 3 C VALUES
  C1 = X(N-1)
  C2 = X(N)
  C3 = X(N+1)
  C
  C KEEP TRACK OF NO. OF STARTING C VALUE
  N = N + I - J
  C
  C LOCATION OF FIRST A VALUE
  K = L + 1 + NC + M + NB
  C
  C PICK OUT 9 A VALUES
  A1 = X(K)
  A2 = X(K + 1)
  A3 = X(K + 2)

```

```

K = K + NR
AW = ( B4 - B1 ) / ( B2 - B1 )
AX = ( B4 - B2 ) / ( B3 - B1 )
AY = ( B4 - B1 ) / ( B3 - B2 )
A1 = A1 + AW * ( A2 - A1 ) + AX * ( A3 - A2 ) + AY * ( A1 - A2 )
A2 = A2 + X(K + 1)
A3 = X(K + 2)
K = K + NR
A1 = A1 + AW * ( A2 - A1 ) + AX * ( A3 - A2 ) + AY * ( A1 - A2 )
A2 = X(K)
A3 = X(K + 1)
A4 = X(K + 2)
A5 = A1 + AW * ( A2 - A1 ) + AX * ( A3 - A2 ) + AY * ( A1 - A2 )
A6 = ( A2 - A1 ) / ( A3 - A1 )
PI = ONI ( E1, E2, E3, C1, C2, C3, C4, EX )

```

C MOVE OUT
RETURN

FROM AN X ARRAY, THIS SECTION OF THE ROUTINE PICKS 3
AND 3 P VALUES, ROUNDING A SPECIFIED P VALUE, REFER TO
MANUAL FOR SINGLE VARIABLE TABULAR FORMAT

ENTRY TABLE (L)

```

C DETERMINE TABLE SIZE
NR = X(L) + 1
IF (NR.LF.1) GO TO 30

```

```

C SEARCH FROM 2ND P VALUE TO NEXT TO LAST P VALUE
J = L + 3
K = L + 2 * NR - 3
DO 50 I = J, K, 2
M = I
IF (X(I) .GE. 64) GO TO 60
50 CONTINUE

```

C PICK OUT THE 6 REQUIRED VALUES

```

60 A1 = X(M-2)
A2 = X(M-1)
A3 = X(M)
A4 = X(M+1)
A5 = X(M+2)
A6 = X(M+3)
IF (ABS(A1-A2).LT. 1.E-10 .OR. ABS(A2-A3).LT. 1.E-10 .OR.
ABS(A1-A3).LT. 1.E-10) GO TO 30
A1 = ( A2 - A1 ) / ( A3 - A1 )
A2 = ONI ( A1, A2, A3, A1, A2, A3, A4, EX )
RETURN
70 A1 = A1 + (A4-A1)*(A2-A1) / (A2-A1)
RETURN
80 WRITE (5, 90) A1, A2, A3, A4, A5, A6, A7, A8, A9, A10
90

```

TABL0550
TABL0560
TABL0570
TABL0580
TABL0590
TABL0600
TABL0610
TABL0620
TABL0630
TABL0640
TABL0650
TABL0660
TABL0670
TABL0680
TABL0690
TABL0700
TABL0710
TABL0720
TABL0730
TABL0740
TABL0750
TABL0760
TABL0770
TABL0780
TABL0790
TABL0800
TABL0810
TABL0820
TABL0830
TABL0840
TABL0850
TABL0860
TABL0870
TABL0880
TABL0890
TABL0900
TABL0910
TABL0920
TABL0930
TABL0940
TABL0950
TABL0960
TABL0970
TABL0980
TABL0990
TABL1000
TABL1010
TABL1020
TABL1030
TABL1040
TABL1050
TABL1060
TABL1070
TABL1080

TABL1090
TABL1100
TABL1110
TABL1120
TABL1130
TABL1140
TABL1150
TABL1160

PL = 21 (COMPUTATION PROBLEMS) (1) SET TO ALL) /
CALL ERRPR
THATS ALL
SETUP
END

ATM 0010
 ATM 0020
 ATM 0030
 ATM 0035
 ATM 0040
 ATM 0070
 ATM 0080
 ATM 0090
 ATM 0100
 ATM 0110
 ATM 0120
 ATM 0130
 ATM 0140
 ATM 0150
 ATM 0170
 ATM 0170
 ATM 0190
 ATM 0190
 ATM 0200
 ATM 0210
 ATM 0220
 ATM 0230
 ATM 0240
 ATM 0250
 ATM 0260
 ATM 0270
 ATM 0280
 ATM 0290
 ATM 0300
 ATM 0310
 ATM 0320
 ATM 0330
 ATM 0340
 ATM 0350
 ATM 0360
 ATM 0370
 ATM 0380
 ATM 0390
 ATM 0400
 ATM 0410
 ATM 0420
 ATM 0430
 ATM 0440
 ATM 0460
 ATM 0470
 ATM 0480
 ATM 0490
 ATM 0500
 ATM 0510

SUBJECTIVE NOTES

10 0010 = 10.0
 0020 = 10.0
 0030 = 10.0
 CALL ATMS (0, 10, 0, 10)
 TC = 0.0
 P = 0.0
 DMS = 0.0
 CSMS = 0.0
 CSK = 0.0
 TE (0, 10, 0) = 0.0
 EQUAT (10, 0, 10, 0) = 0.0
 174573 CALL ATMS (2, 1)
 RETURN
 END

10 0010 = 10.0
 0020 = 10.0
 0030 = 10.0
 CALL ATMS (0, 10, 0, 10)
 TC = 0.0
 P = 0.0
 DMS = 0.0
 CSMS = 0.0
 CSK = 0.0
 TE (0, 10, 0) = 0.0
 EQUAT (10, 0, 10, 0) = 0.0
 174573 CALL ATMS (2, 1)
 RETURN
 END

CALCULATE AT CONSTANT CARRY LONGER

APPENDIX F
SUPPLEMENTAL CURVES

- EXAMPLE:
- H - HEIGHT OF AIRCRAFT ABOVE GROUND LEVEL, 3000 FT
 - D - PERPENDICULAR DISTANCE TO PROJECTION OF FLIGHT PATH ON TO GROUND PLANE, 4500 FT
 - S - SWING PARALLEL ARC FROM POINT P, THE JUNCTION OF H AND D, TO LOWER SCALE, READ SLANT RANGE OF 5400 FEET.

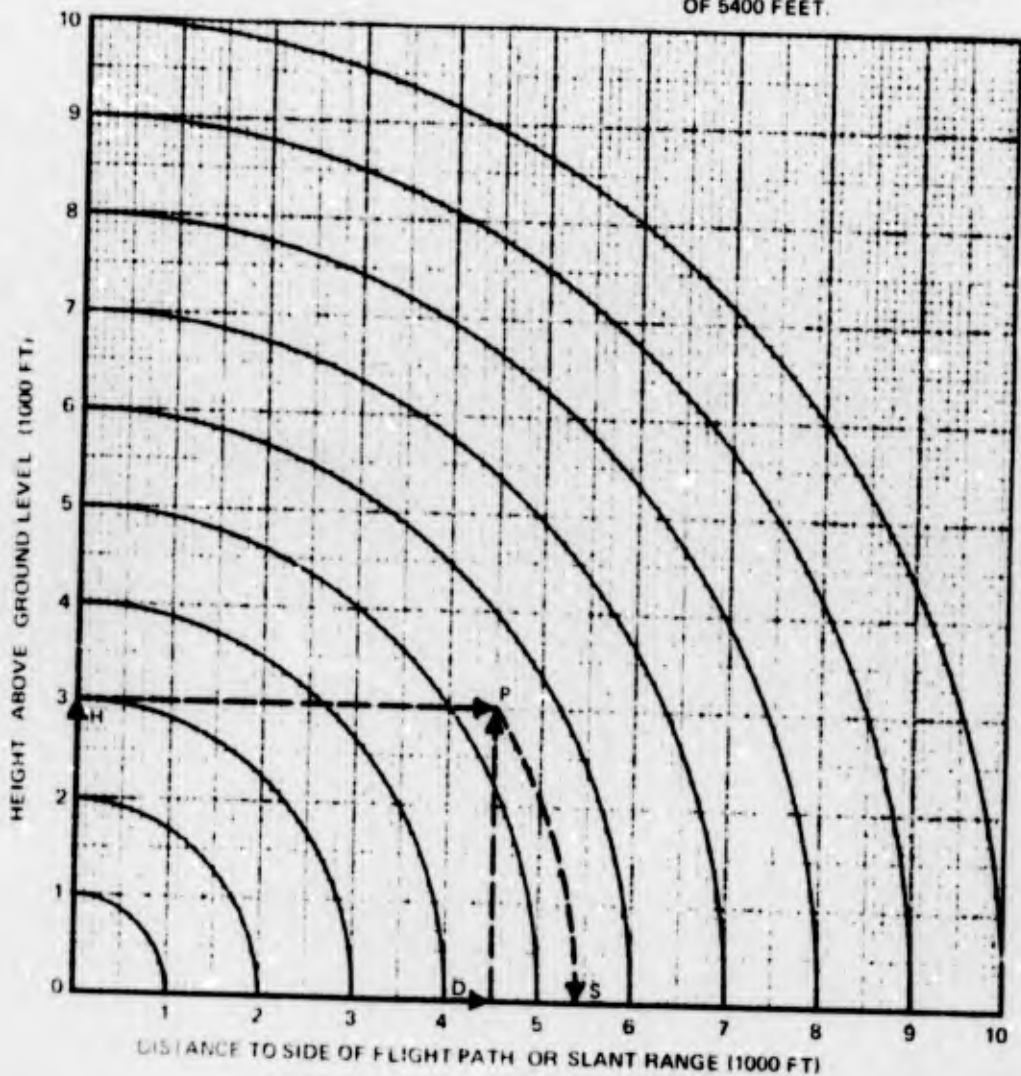


FIGURE F-1. SLANT RANGE DETERMINATION WHEN AIRCRAFT IS TO THE SIDE OF FLIGHT PATH

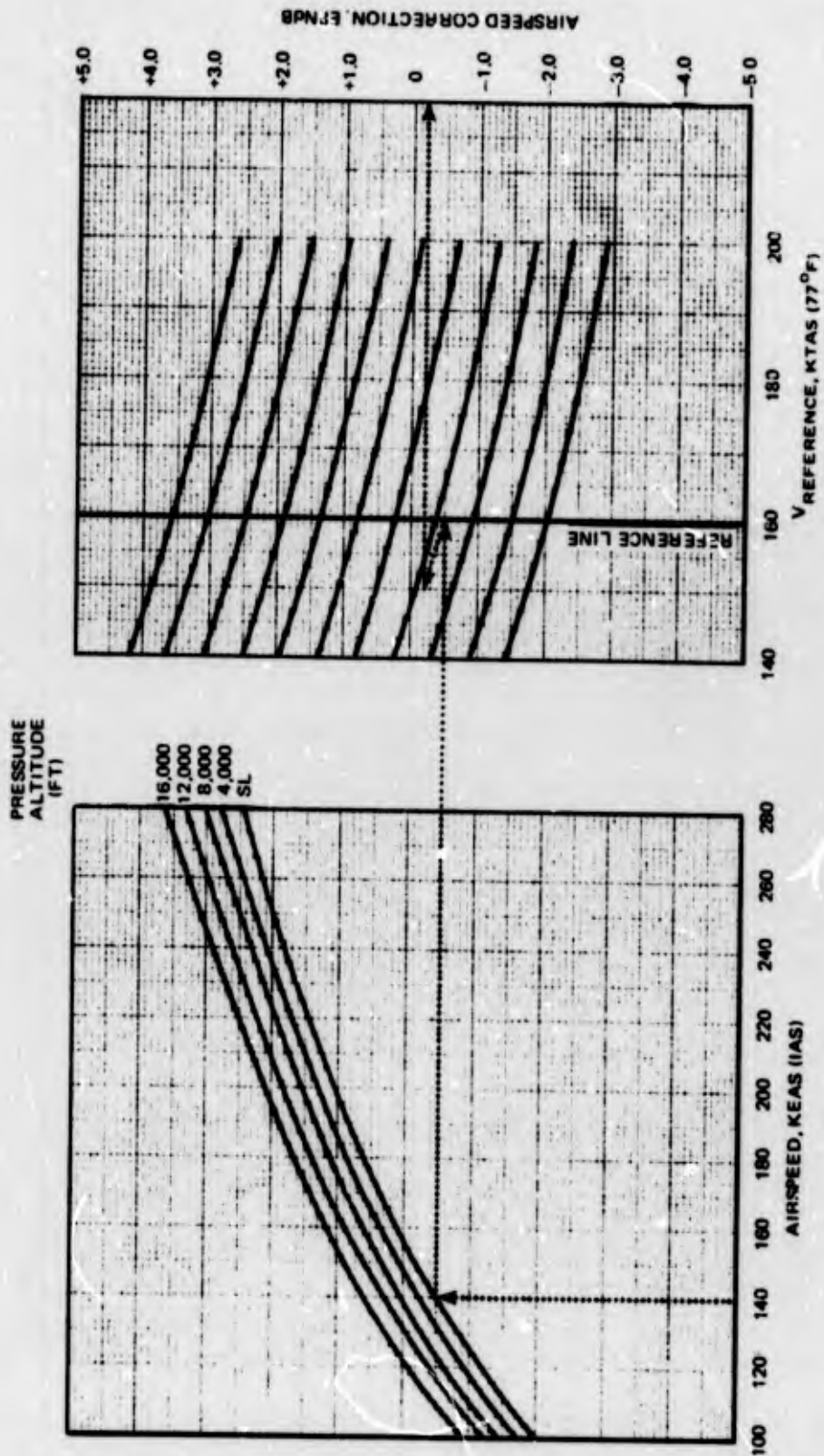


FIGURE F 2. AIRSPEED CORRECTION, Δ EPNL

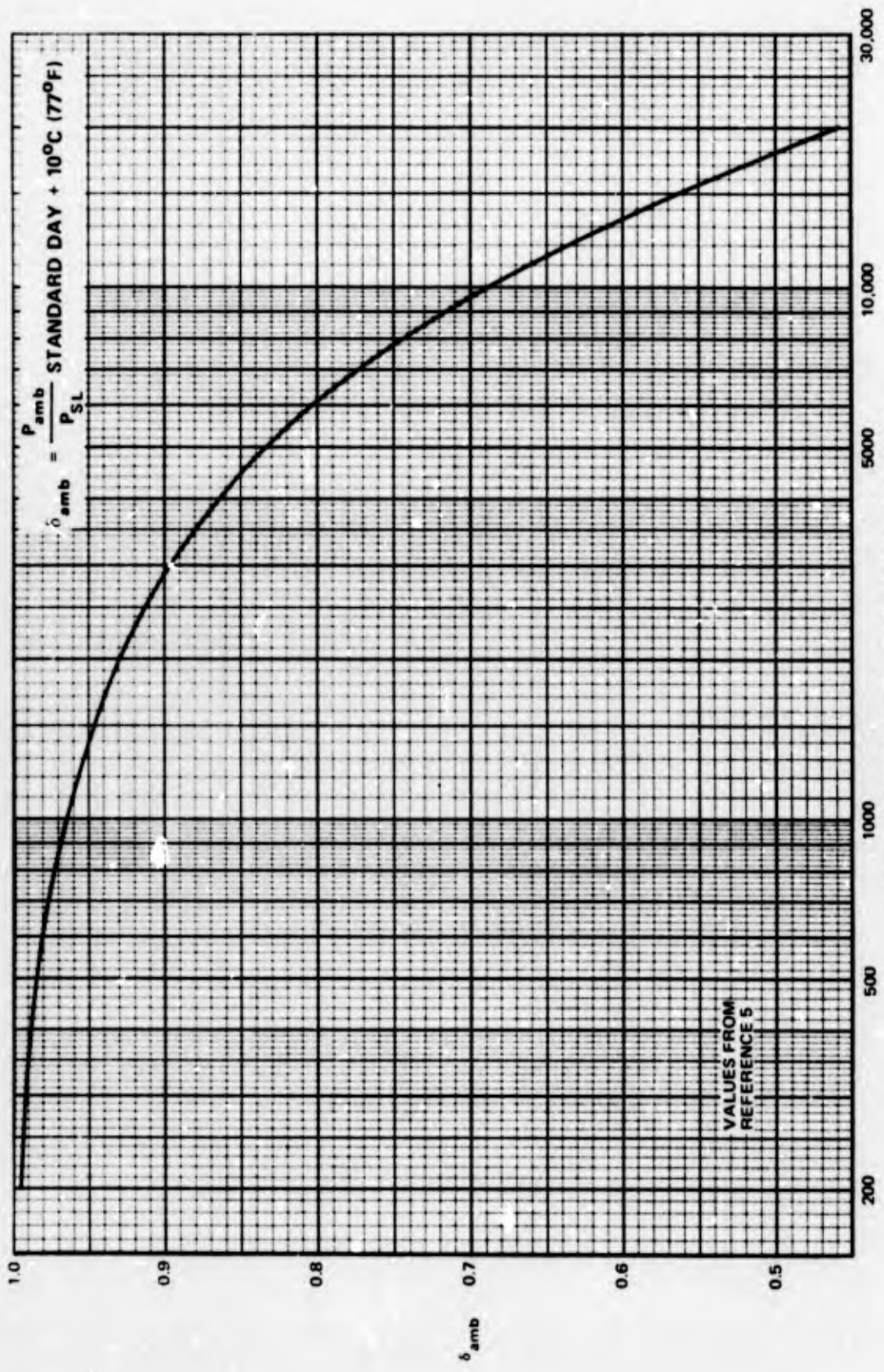


FIGURE F-3. δ_{amb} VERSUS PRESSURE ALTITUDE

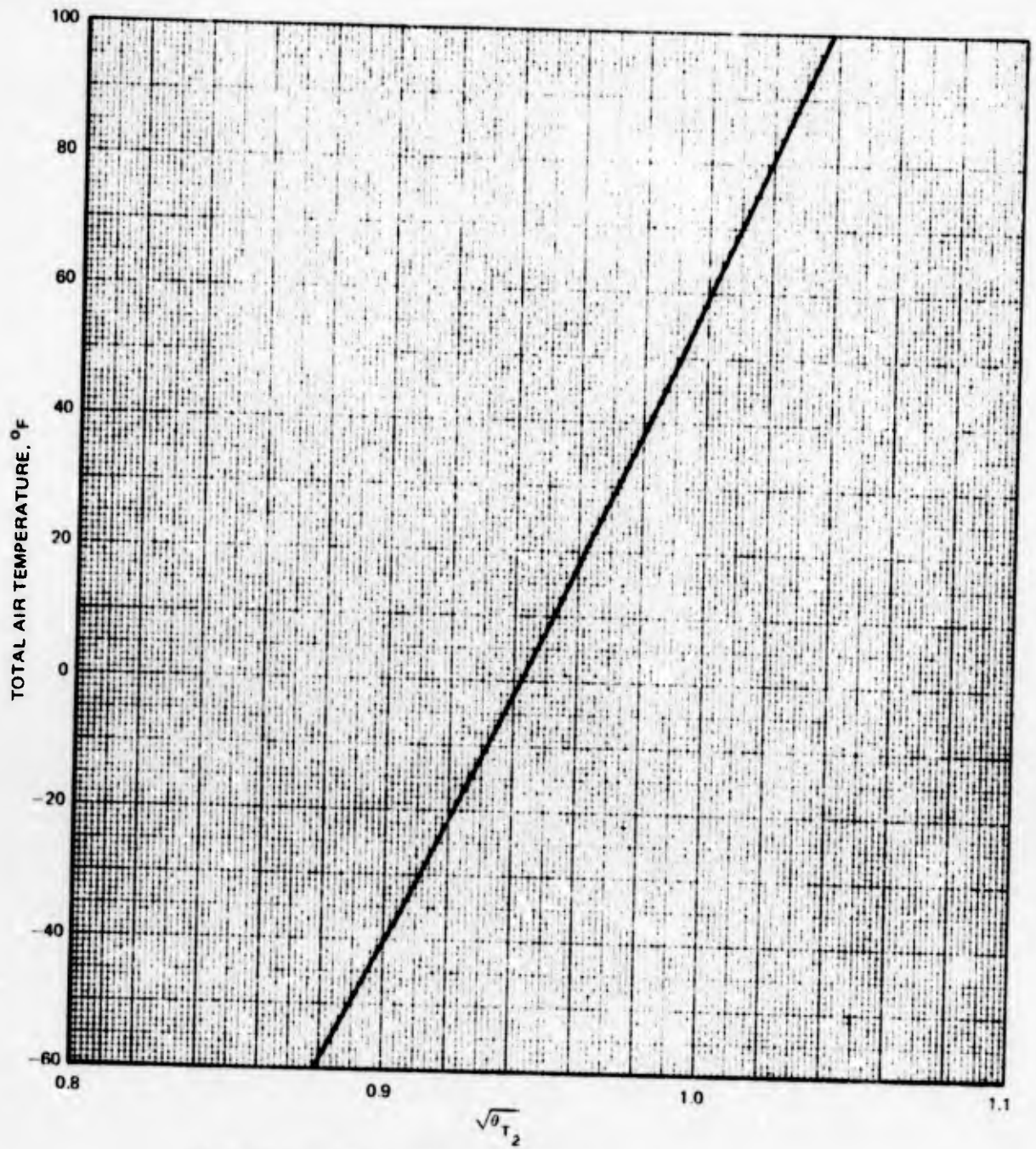


FIGURE F-4. TOTAL AIR TEMPERATURE VERSUS $N_1/\sqrt{\theta T_2}$

BASED ON U.S. STANDARD ATMOSPHERE, 1962

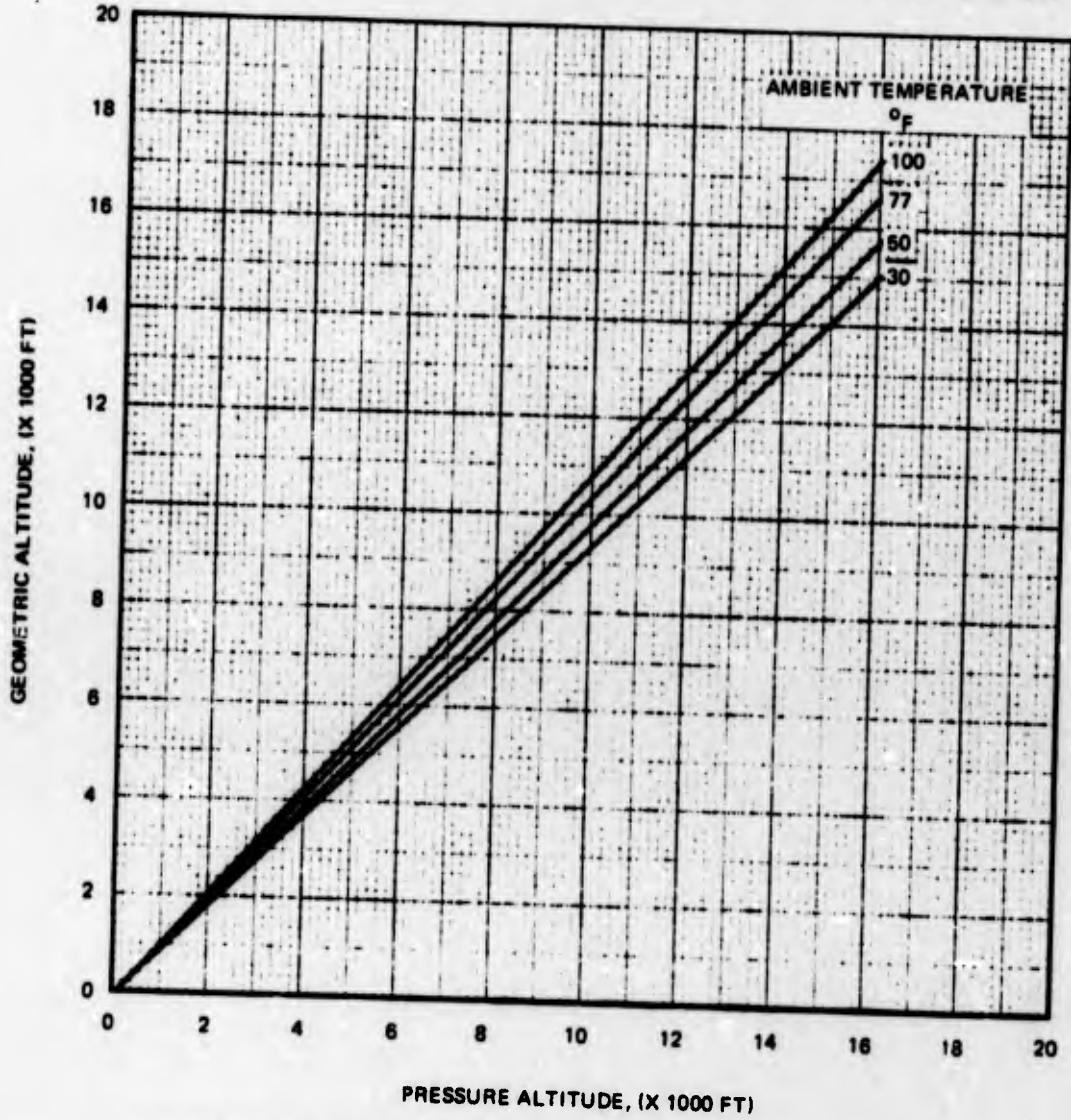


FIGURE F-5. GEOMETRIC ALTITUDE VERSUS PRESSURE ALTITUDE

APPENDIX G
PROCESSING OF DC-9/JT8D-1 AND DC-8-63
FLYOVER NOISE DATA

The raw analog noise data were digitized using the Douglas Controlled Integrating Spectrum Analyzer (CISA). This system consists primarily of a General Radio 1921 Real-Time Audio Spectrum Analyzer controlled by a small digital computer. After being digitized within the analyzer, the data are written incrementally onto digital magnetic tape for further data processing by a large-scale digital computer (Xerox Data Systems Sigma 7). The General Radio-1921 is a hybrid spectrum analyzer with twenty-four analog one-third octave filters, and a digital detector section employing true integration techniques. This analysis system meets the requirements specified in paragraph A36. 2(d) of FAR Part 36. The sound pressure level reference calibration signals and the ambient noise signals were also digitized.

Frequency response calibrations were obtained from recorded sine waves and input via punch cards into the computer.

The digital magnetic tape (generated by CISA) was processed with Sigma 7 computer program L3SK. This program converts the digitized data into measured sound pressure levels (SPLs) by scaling the data relative to the reference sound pressure level and record/playback gains. The SPLs are then corrected for system frequency response, microphone and windscreen frequency response and station barometric pressure.

The reference-weather procedure corrects the entire measured SPL spectrum time history for differences in atmospheric absorption coefficients between measured and reference weather conditions and the effect of acoustical propagation time.

The flight path for space positioning was constructed from photograph minimum distances (used as heights assuming zero lateral deviation).

Figure G-1 is a block diagram showing the data flow-through (CISA).

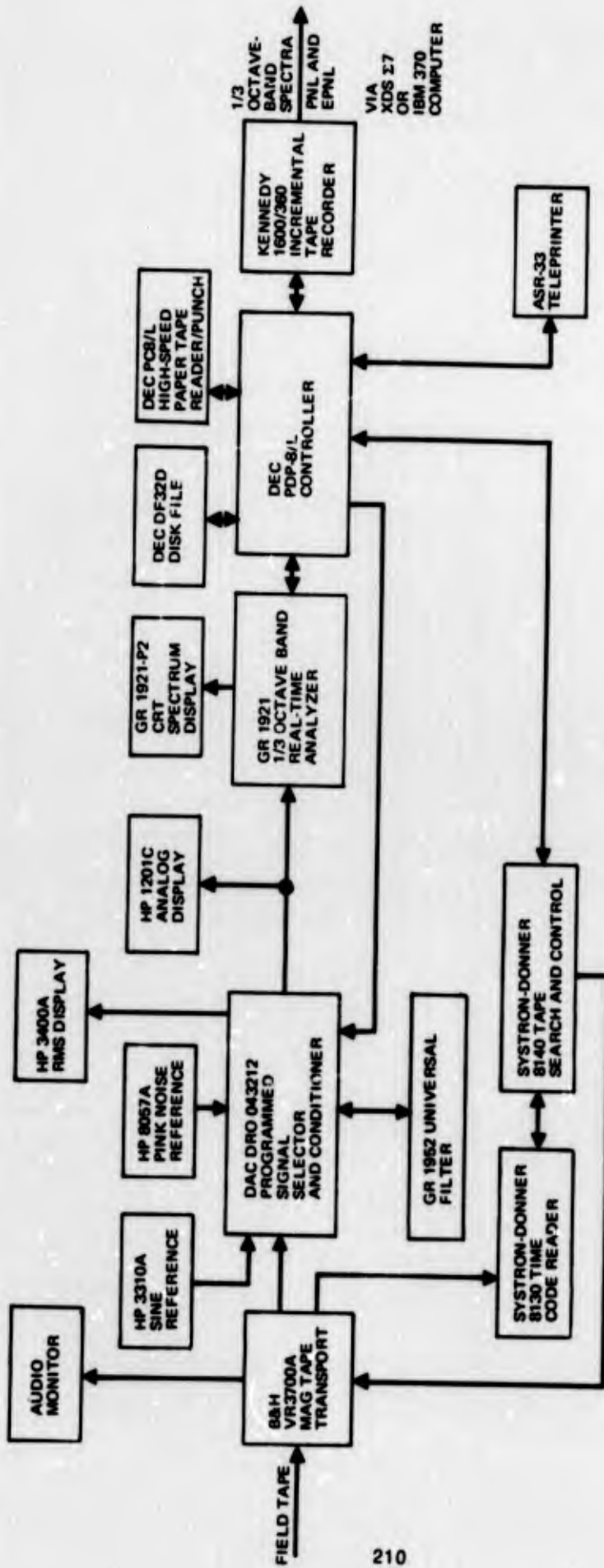



FIGURE G-1. CONTROLLED INTEGRATING SPECTRUM ANALYZER (CISA)

APPENDIX H
F2SA COMPUTER PROGRAM
LISTING

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```

C 130 FORMAT ( 1H 19HINTERPOLATION ERROR 2X 7MT-0/W = E8.6 , 3X 3HSSG/
C 110 = E8.2 , 3X 3HDEL H00 = E8.2 , 3X 9HVG0/V35 = E8.4 , 3X 316 )
C 120
C 130
C 140
C 150
C 160
C 170
C 180
C 190
C 200
C 210
C 220
C 230
C 240
C 250
C 260
C 270
C 280
C 290
C 300
C 310
C 320
C 330
C 340
C 350
C 360
C 370
C 380
C 390
C 400
C 410
C 420
C 430
C 440
C 450
C 460
C 470
C 480
C 490
C 500
C 510
C 520
C 530
C 540
C 550
C 560
C 570
C 580
C 590
C 600
C 610
C 620
C 630
C 640
C 650
C 660
C 670
C 680
C 690
C 700
C 710
C 720
C 730
C 740
C 750
C 760
C 770
C 780
C 790
C 800
C 810
C 820
C 830
C 840
C 850
C 860
C 870
C 880
C 890
C 900
C 910
C 920
C 930
C 940
C 950
C 960
C 970
C 980
C 990

```

```

MAIN0960
MAIN0970
MAIN0980
MAIN0990
MAIN1000
MAIN1010
MAIN1020
MAIN1030
MAIN1040
MAIN1050
MAIN1060
MAIN1070
MAIN1080
MAIN1090
MAIN1100
MAIN1110
MAIN1120
MAIN1130
MAIN1140
MAIN1150
MAIN1160
MAIN1170
MAIN1180
MAIN1190
MAIN1200
MAIN1210
MAIN1220
MAIN1230
MAIN1240
MAIN1250
MAIN1290
MAIN1291

```

```

= PRESSURE ALT - FT.
= MACH NUMBER
= INITIAL ALTITUDE - FT
= NO OF ENGINES OPERATING
= AIRCRAFT DRAG - POUNDS
= FUEL FLOW / ENGINE
= DRAG COEFFICIENT
= CALCULATED VELOCITY - KM
= KINETIC ENERGY CORR.
= SCALE OF ATTACK
= PAGE NUMBER
= COMPRESSIBILITY DRAG NUMBER
= TAKE-OFF VELOCITY - KM
= ACCELERATION - KN / SEC
= VELOCITY INCREMENT - LP/FT
= DYNAMIC PRESSURE - LB/FT
= WING AREA - SQUARE FEET

```

```

SYMBOL NOMENCLATURE
HP
MACH
ALTIM
DR
FUELE
CVIAS
ENERGY
ALPHA
PAGE
CROSS
VELTD
ACCEL
DELTAV
AREAW

```

```

= GEOMETRIC ALT. - FT
= TEMPERATURE - DEGR CENT
= THRUST DECK Lapse FLAG
= THRUST DECK RATE FLAG
= THRUST DECK POWER FLAG
= THRUST DECK ENGINE - LPS
= SQUARE ROOT OF DENSITY
= SQUARE VELOCITY - KN
= SPEED OF SOUND
= CLIMB GRADIENT
= DEVIATION FROM STD DAY
= TOTAL DRAG DECK NO.
= LIFT-OFF VELOCITY - KN
= ALTITUDE INCREMENT - FT
= TIME INCREMENT - HOURS
= RATE OF CLIMB FT / MIN
= LIFT COEFFICIENT

```

```

GFORMET(DC,HP) = HP-DC/1.9812E-3 * ALOG((918.67-3.566184E-3*HP) /
1518.67 )

```

```

READ INPUT DATA INTO PROGRAM
PAGE = 0
CALL DATFV ( DATE , HRS )
OBTAIN BASIC DATA INDEPENDENT OF FLAP ANGLE - IST 0 DATA CASES
CALL DATA IN ( DATE )
NCHICK = 0

```

```

CALCULATION OF INITIAL CONSTANTS
ENGRMP = NGRMG - NGRPRA
DELTA0 = 0.0
G = FLOAT ( PACKS )
LAPSE = 1
MACH1 = 0.0
NWT2 = 1
NWT3 = 1
IF ( ENGRMP .GT. 0.5 ) NWT3 = 2
IF ( ENGRMP .GT. 0.5 ) NWT3 = 12
POWER = 1

```

```

TEST TO SEE IF ITEMS WAS CORRECTLY INPUT AND CALCULATE WEIGHTS
WTSMD = (WTEIN - WTI) / (DELTAV - .001) + 1.

```

```

MAIN1320
MAIN1350
MAIN1360
MAIN1370
MAIN1380
MAIN1390
MAIN1400
MAIN1410
MAIN1420
MAIN1430
MAIN1440
MAIN1450
MAIN1460
MAIN1470
MAIN1490
MAIN1500
MAIN1510
MAIN1550

```


MAIN2210
 MAIN2220
 MAIN2230
 MAIN2240
 MAIN2250
 MAIN2260
 MAIN2270
 MAIN2280
 MAIN2290
 MAIN2300
 MAIN2310
 MAIN2320
 MAIN2330
 MAIN2340
 MAIN2350
 MAIN2360
 MAIN2370
 MAIN2380
 MAIN2390
 MAIN2400
 MAIN2410
 MAIN2420
 MAIN2430
 MAIN2440
 MAIN2450
 MAIN2460
 MAIN2470
 MAIN2480
 MAIN2490
 MAIN2500
 MAIN2510
 MAIN2520
 MAIN2530
 MAIN2540
 MAIN2550
 MAIN2560
 MAIN2570
 MAIN2580
 MAIN2590
 MAIN2600
 MAIN2610
 MAIN2620
 MAIN2630
 MAIN2640
 MAIN2650
 MAIN2660
 MAIN2670
 MAIN2680
 MAIN2690
 MAIN2700
 MAIN2710
 MAIN2720
 MAIN2730
 MAIN2740

```

11 = GRK
12 = K1 + 1 TO
13 ( J, 1 ) = A( K, 1 )
14 ( J, 1 ) = A( K, 2 )
15 ( J, 1 ) = 3.141592653589793
16 ( A1 ( K2 ) * E. 01 ) GO TO 100
100 CONTINUE
11 = A2( 1, 1 ) + .1
12 = A2( 1, 2 ) + .1
13 = A2( 1, 3 ) + .1
14 = A2( 1, 4 ) + .1
15 = A2( 1, 5 ) + .1
16 = 2 * AMAX
17 = 1 * W
18 = A2( 1, 1 ) = A( 1, 1 )
19 = A2( 1, 2 ) = A( 1, 2 )
20 = A2( 1, 3 ) = A( 1, 3 )
21 = A2( 1, 4 ) = A( 1, 4 )
22 = A2( 1, 5 ) = A( 1, 5 )
TEMPERATURE DO-LOOP
DO 595 IT = 1, NITEMPS
TEMPC = T( IT )
DELTAC = TEMPC - 15. + .0019412 * ALTIN
TEMPCL = 15. - .0019412 * ALTIN + DELTAC
ENGINE OUT FLIGHT PATH COORDINATE DO-LOOP
DO 590 NWT1 = 1, NWT2
170 = NWT5
18 ( NWT1 * 50. 2 ) 176 = 1
WEIGHT DO-LOOP
DO 590 I2 = 1, I73
WEIGHT = WTI + ( I2 - 1 ) * DELTAW
18 ( I2 * 50. NWT5 ) WEIGHT = NTCW
19 ( NTCW * GT ) CALL INSIC WEIGHT * SS00 * VSEK * I * N7 )
AMAX = A( 72 )
ANGLEW = AMSAVE
ENGINP = FLOAT ( NENGP )
ESLAT = ESCAVE
G = GSAVE
HORE = 0.0
WU = WUS
RATE = 4
18 ( A4( 58 ) * GT * I ) RATE = 7
19 ( NWT1 * 50. 2 ) GO TO 300
WWT = WEIGHT
WMAX = 400.
18 ( ALTIN * 100. * GT. AMAX ) AMAX = ALTIN * 2000.
DO 220 I1 = 1, 5
  
```

```

220 C(I111) = 0.0
C
C
WRITE HEADERS AT TOP OF PAGE
IF ( ENCHOP .LT. .1 ) GO TO 230
L28 = L28 + 1
IF ( L28 .LT. 5 ) GO TO 240
L28 = 0
PAGE = PAGE + 1
WRITE(6, 10) JOB ,PAGE ,DATE ,BLEED ,WFLD ,SERIES ,PACKS ,FEA
1 ,NTEMP ,MELTNG
C
C
CALCULATE TAKEOFF
C
C
240 CALL TAKEOFF
CALL STORF
PASFHC = ALTG - 35.0
REFLAT = 44(7)
ESLAT = 34(5)
IF ( FRGMD .GT. .1 ) C = 0.0
IF ( NOENG .NE. 3 .OR. SERIES .LT. 16 ) GO TO 260
C
C
CALCULATE DC-10-40 GEAR UP POINT
F2 = FUELF
GAMBAR = .8025 * ( FOPCI * FIGNP / WEIGHT - CRAGUT ) + .00075
GAMBAR = GAMBAR / ( 1.0 ) + 0.566 * WACH = MACH )
CALL INSI ( GLOB , TABS35 , S35VLO , 2 , N99 )
ALSO ALTS
VFL = VFL
DELTAH = 100
VCLTMR = VIAS
MSAVE = WIL
WIL = 0
DO 250 IJKL,N3 = 1 , 3
ALTG = ALS + DELTAH
CALL SPD
CALL SPEED2
NS = 0.5 * ( VFL + VL ) * 1.6878 * ( TIMEOP - S35VLO )
DELTAH = NS * GAMBAR
CONTINUE
GO TO 280
250 CONTINUE
260 CONTINUE
C
C
CALCULATION OF GLAD RETRACTION POINT
CALL INSI ( GLOB , TABSGU , SQVULO , 2 , N6 )
CALL INSI ( GLOB , TABWGI , DELTAH , 2 , N7 )
CALL INSI ( GLOB , TABVGI , VELEGI , 2 , N8 )
IF ( N6 + N7 + N8 .EQ. 3 ) GO TO 270
WRITE(6, 10) GLOB , SQVULO , DELTAH , VELEGI , N6 , N7 , N8
F2 = FUELF
VFL = VFLT ) * VELPGU

```

```

MAIN2750
MAIN2760
MAIN2770
MAIN2780
MAIN2790
MAIN2800
MAIN2810
MAIN2820
MAIN2830
MAIN2840
MAIN2850
MAIN2860
MAIN2870
MAIN2880
MAIN2890

```

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MAIN2900
MAIN2910
MAIN2920
MAIN2930
MAIN2940
MAIN2950
MAIN2960
MAIN2970
MAIN2980
MAIN2990
MAIN3000
MAIN3010
MAIN3020
MAIN3030
MAIN3040
MAIN3050
MAIN3060
MAIN3070
MAIN3080
MAIN3090
MAIN3100
MAIN3110
MAIN3120
MAIN3130
MAIN3140
MAIN3150
MAIN3160
MAIN3170
MAIN3180
MAIN3190
MAIN3200
MAIN3210
MAIN3220
MAIN3230
MAIN3240
MAIN3250
MAIN3260

```

```

MAIN3270
MAIN3280
MAIN3290
MAIN3300
MAIN3310
MAIN3320
MAIN3330
MAIN3340
MAIN3350
MAIN3360
MAIN3370
MAIN3380
MAIN3390
MAIN3400
MAIN3410
MAIN3420
MAIN3430
MAIN3440
MAIN3450
MAIN3460

```

```

IF ( VEL .LT. 20.) VFL = VELTO
MSAVE = MIL
MIL = 0
DS = SGUVLN * VELTRN
DELTAH = DELTAH - DELTAG * DS
ALTS = ALTG + DELTAH
CALL SOPER1
CALL MSAVE
CALL THR
EI = FUEL
DELTAH = ( TIMEGR - TIMELO ) / 3600
DELTAH = ( TIMEGR - 00001 ) DELTAH = SGUVLN / 3600.
DELTAH = ( EI + E2 ) / 2.0 * ENGRD * DELTAH
GAMMA = DELTAH / DS
WEIGHT = WEIGHT - EUFI
CALL PITCH
CLIMPA = ATAN ( GAMMA ) * 57.2958
PITCHA = CLIMPA + ALPHA
CALL DRAG
CALL PRINT

```

230

```

CHECK TO SEE THAT WEIGHT IS BELOW DESIRABLE SECOND SEGMENT WEIGHT

```

```

SSGRAD = 0.013 + .003 * ENGRD
GRAD = ( FORCE * ( ENGRD - 1.0 ) - DS ) / ( WEIGHT * ( 1.0 ) + .566
1 * MACH * MACH ) )
I10 = 3
IF ( GRAD .GT. SSGRAD ) GO TO 286
WRITE (6,284)
CALL STPR

```

```

284 FORMAT ( 'LOCAL CALCULATIONS DISCONTINUED. 0.4X * WEIGHT IS POSSIBLY AB

```

```

286 I10F SECOND SEGMENT LIMITING WEIGHT. )
IF ( GRAD - .008 .GT. SSGRAD ) GO TO 590

```

```

VI = VEL
VEL = V2 + VELGR
CALL SPEED1

```

```

IF ( VFL .LT. V1 ) VEL = V1 - .001
IF ( VFL .LT. V1 ) GO TO 290
VMAX = VFL
VMIN = V1
CALL ACCEL

```

```

290 CALL STORE
VMAX = WMAX
HI = ALTG
CALL SPEED

```

```

IF ( WNT2 .EQ. 1 ) GO TO 300

```

```

STORAGE AT GEAR RETRACTION HEIGHT

```

```

I3 = I2 * 2
SGAMMA = ( FORCE * ENGRD - DS ) / WEIGHT / ( 1.0 + MACH**2 * .566 )
SGAMMA = SGAMMA - DELTAG

```

```

MAIN2490
MAIN2490
MAIN2500
MAIN2510
MAIN2520
MAIN2530
MAIN2540
MAIN2550

```

```

MAIN3560
MAIN3570
MAIN3580
MAIN3590
MAIN3600
MAIN3610
MAIN3620
MAIN3630
MAIN3640
MAIN3650
MAIN3660

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```

SHG(I3+1) = ALTS
SWT(I3) = SGAMMA
SWT(I3+1) = WEIGHT
SER(I3) = SGAMMA
SER(I3+1) = FUEL
CHP(I3+1) = HOUR
SHR(I3) = SGAMMA
SV2(I3+1) = V2
SV2(I3) = SGAMMA
SVT(I3+1) = VIAS
SVT(I3) = SGAMMA
S1(I3+1) = CI(1)
S2(I3+1) = SGAMMA
S2(I3) = CI(2)
S3(I3+1) = SGAMMA
S3(I3) = CI(3)
S4(I3+1) = CGAMMA
S4(I3) = CI(4)
S5(I3+1) = SGAMMA
S5(I3) = CI(5)
CU TO 590

```

C INTERPOLATE STORED CONDITIONS TO OBTAIN PERFORMANCE AT GRADIENTS

```

300 ON 580 IGD = 1, NWT3
IF (NWT3.EQ.1) GO TO 320
IF (NWT1.EQ.1) GO TO 580
IGRAD = SQ(IIGD) / 100.
CALL INSL (TABLE, CHG, ALTS, 2, NER)
FORMAT (1, TABLE, 216(1), 10F12.3, 1)
TE (NER, NE, 1) GO TO 580

```

C WRITE HEADER AT TOP OF PAGE

```

PAGE = PAGE + 1
WRITE(6, 10) JOB, PAGE, DATE, IFILED, MODEL, SERIES, NPACKS
10 WRITE(6, 120) NFLAPS
WRITE(6, 120) NGRAD
CALL INSL (NER, NE, 1) NWT3, WEIGHT, 2, NER
CALL INSL (NER, NE, 1) NWT1, FUEL, 2, NER
CALL INSL (NER, NE, 1) NWT2, HOUR, 2, NER
CALL INSL (NER, NE, 1) NWT3, V2, 2, NER
CALL INSL (NER, NE, 1) NWT4, VIAS, 2, NER
CALL INSL (NER, NE, 1) NWT5, CI(1), 2, NER
CALL INSL (NER, NE, 1) NWT6, CI(2), 2, NER
CALL INSL (NER, NE, 1) NWT7, CI(3), 2, NER
CALL INSL (NER, NE, 1) NWT8, CI(4), 2, NER

```

```

MAIN3670
MAIN3680
MAIN3690
MAIN3700
MAIN3710
MAIN3720
MAIN3730
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MAIN3780
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MAIN3800
MAIN3810
MAIN3820
MAIN3830
MAIN3840
MAIN3850
MAIN3860
MAIN3870
MAIN3880
MAIN3890
MAIN3900
MAIN3910
MAIN3920
MAIN3930
MAIN3940
MAIN3950
MAIN3960
MAIN3970
MAIN3980
MAIN3990
MAIN4000
MAIN4010
MAIN4020
MAIN4030
MAIN4040
MAIN4050
MAIN4060
MAIN4070
MAIN4080
MAIN4090
MAIN4100
MAIN4110
MAIN4120
MAIN4130
MAIN4140
MAIN4150
MAIN4160
MAIN4170
MAIN4180
MAIN4190
MAIN4200

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MAIN4210
 MAIN4220
 MAIN4230
 MAIN4240
 MAIN4250
 MAIN4260
 MAIN4270
 MAIN4280
 MAIN4290
 MAIN4300
 MAIN4310
 MAIN4320
 MAIN4330
 MAIN4340
 MAIN4350
 MAIN4360
 MAIN4370
 MAIN4380
 MAIN4390
 MAIN4400
 MAIN4410
 MAIN4420
 MAIN4430
 MAIN4440
 MAIN4450
 MAIN4460
 MAIN4470

MAIN4480
 MAIN4490
 MAIN4500
 MAIN4510
 MAIN4520

MAIN4560
 MAIN4570
 MAIN4580
 MAIN4590
 MAIN4600
 MAIN4610
 MAIN4620
 MAIN4630
 MAIN4640
 MAIN4650

CALL IPR1 (ACCRAD, S5, 01(5), 2, NER, 1)
 IF (NER, 1) WRITE(6, 310) NER, S5
 MILSVE = 0

CALL AIP
 MI = MHSVE
 VCLIMB = VIAS
 CALL CPDEF02
 WTY = WEIGHT + COEF
 CL = 1000
 CALL P-INT1
 MI = ALTC
 V1 = VEL

320 VCLY = ALTC / 100.
 VELS = V2 + VELS
 VENGUP = ANDEVA
 VE (MIL, 50, 1) VALT = HP / 100.
 ALTI = IALT * 100
 DELTAA = ALTI + 100, DELTALTC = ALTI + 100, - HP
 VE (MIL, 50, 1) DELTAA = 100.
 VE (DELTA, ALTY, .1) DELTAA = 100.

CALCULATION OF CLIMB LIMITED BY PITCH ANGLE AND 1.2 VSTALL
 ALTITUDE AND FUEL BURNED DO-LOOPS

DELE = 5.0
 DPS = DELE
 330 DO 450 J = 1, 95
 VE (DELTA, ALTY, .1) GO TO 460
 CALL AIP
 V4 = VEL

LIMIT PITCH ANGLE IF REQUESTED ON LOAD SHEET
 IF (R4(33) .LT. 100, 100) GO TO 305
 IF (MIL, 50, 1) AND: APS (ALTC - HGTEST) .LT. 5.) ANGLEM =
 IPTCHA = R4(34)
 IF (MIL, 50, 1) AND: APS (HP - HGTEST) .LT. 5.) ANGLEM =
 IPTCHA = R4(34)
 WTSAVE = WEIGHT
 305 WEIGHT = WEIGHT - DELE

CLIMB AT CONSTANT EPR OF MI AT REQUESTED DELTA HG ABOVE AIRPORT
 IF (DELTA, 0T, 900, 0R, HP, GT, 9998, 0R, R4(36) .LT. 0.5 .OR.
 1HP - ALTI, .LT. R4(33) .OR. R4(36) .GT. 120.) GO TO 340
 POWER = 4
 IF (R4(36) .GT. 10.) POWER = 2

ITERATION ON FUEL BURNED

```

340 DO 420 K = 1, 20
VSTALL = 1.2 * VSQ
VSTALL = VSTALL / 651.48 / DELTA
CALL SPEED
IF ( ENERGY .LT. 1.0 ) ENERGY = 1.0
IF ( K = J .EQ. 1 ) ENERGY = 1. + .565 * MACH * MACH
DELVI = VFL
CALL THR
CALL DRAG
CALL PITCH
GAMMA = ( FORCE * ENGGP - DR ) / WEIGHT / ENERGY - DELTAG
CLIMBA = ARSTH ( GAMMA ) * 57.2958
PITCHA = ALPHA + CLIMBA
VTEST = ABS ( V4 - VFL )
IF ( PITCHA .LT. ANGLEM .AND. VTEST .LT. .001 ) GO TO 360
IF ( CLIMBA .LT. 0.0 ) CLIMBA = 0.000001
PITCHA = ALPHA + CLIMBA
GAMMA = SIN ( CLIMBA )
C2 = VEL * GAMMA * 101.2683
350 RESTRICT RATE OF CLIMB IF REQUESTED ABOVE DELTA HG ALTITUDE
IF ( DELTAA .GT. 990 .OR. HD .GT. 9999. ) GO TO 370
IF ( R4(36) .LT. 100.0 ) GO TO 370
IF ( HP - ALTIM .LE. R4(33) ) GO TO 370
IF ( C2 .LT. R4(36) ) GO TO 370
C2 = R4(36) / ( VEL * 101.2683 ) - DELTAG
GAMMA = ARCSIN(GAMMA) * 57.2958
CLIMBA = ALPHA + CLIMBA
PITCHA = PITCHA + CLIMBA
FORCE = FUELFL / FORCE
FUELF = (GAMMA * WEIGHT * ENERGY + DR ) / ENGGP
DELTAAT = DELTAA / C2 / 60.
IF ( NOENG .EQ. 3 ) GO TO 380
DRS = DR
DR = FORCE
POWER = 3
CALL THR
DR = DRS
GO TO 380
370 DELTAT = DELTAA / ( C2 - C1 ) * ALDG ( C2 / C1 ) / 60.
380 FACTOR = ( TEMPC + 273.15 ) / ( TEMPC + 273.15 - DELTAC )
IF ( MIL .EQ. 1 ) DELTAT = DELTAT * FACTOR
IF ( J .EQ. 1 ) GO TO 430
IF ( PITCHA .LT. ANGLEM .AND. VTEST .LT. .001 ) GO TO 390
VEL = V1 + 68525.5 * DELTAT / WEIGHT * ENGGP * FORCE - DR
GAMMA = WEIGHT
IF ( VEL .LT. V4 ) VEL = V4 + .002
IF ( VEL .GT. 6 ) VEL = 0.5 * ( VEL + VELVI )
390 CALL SPEED
LIMITED BY PITCH ATTITUDE AND SPEED
IF ( VIAS .LE. VMAX ) GO TO 400

```

```

MAIN4870
MAIN4880
MAIN4890
MAIN4900
MAIN4910
MAIN4920
MAIN4930
MAIN4940
MAIN4950
MAIN4960
MAIN4970
MAIN4980
MAIN4990
MAIN5000
MAIN5010
MAIN5020
MAIN5030
MAIN5040
MAIN5050
MAIN5060
MAIN5070
MAIN5080
MAIN5090
MAIN5100
MAIN5110
MAIN5120
MAIN5130
MAIN5140
MAIN5150
MAIN5160
MAIN5170
MAIN5180

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MAIN5190
 MAIN5200
 MAIN5210
 MAIN5220
 MAIN5230
 MAIN5250
 MAIN5260
 MAIN5270
 MAIN5280
 MAIN5290
 MAIN5300
 MAIN5310
 MAIN5320
 MAIN5330
 MAIN5340
 MAIN5350
 MAIN5360
 MAIN5370

MAIN5380
 MAIN5390
 MAIN5400
 MAIN5410
 MAIN5420
 MAIN5430
 MAIN5440
 MAIN5450
 MAIN5460
 MAIN5470
 MAIN5480
 MAIN5490
 MAIN5500

MAIN5520
 MAIN5530
 MAIN5540
 MAIN5550
 MAIN5560
 MAIN5570
 MAIN5580

MAIN5590

```

VCLT**3 = VVAX
CALL SPECF2
FORC = ( DRX + GAMMA * WEIGHT * ENERGY ) / ENCOB
IF ( FORC > 0 ) FORC = FORC
FUELF = SEC * FORC
IF ( VCLT > VSTALL ) GO TO 410
CALL SPEED
CALL THR
CALL DRAG
CALL PITCH
GAMMA = ( FORCE * ENCOB - DE ) / WEIGHT / ENERGY - DELTAG
CLIMB = APSIN ( GAMMA ) * 57.2958
PITCHA = ALPHA + CLIMB
C2 = VCL * GAMMA * 101.2633
DELTAJ = DELTAA / ( C2 - C1 ) + ALDG ( C2 / C1 ) / 60.
IF ( J > 0 ) GO TO 430
IF ( DELTAA > 0 ) DELTAA = DELTAA * 0.5 * ENCOB
IF ( ABS ( DELV1 - VCL ) > 0.06 * AND.ARS(DEFINES) ) .LT. .01 )
  GO TO 430
DEFS = DELC
WEIGHT = WTSAVE - DELC
420 FUEL = FUELF
430 C4 = C2 / 101.2633
IF ( VCL * VCL - C4 * C4 )
  GO TO 440
IF ( J > 0 ) GO TO 500
DELTAJ = 100.
XX = MIL + ALT * ( 1 - MIL )
IF ( HP + DELTAA * GT * AMAX ) DELTAA = 2 * VAX - XX
DS = DELTAA * ( C1 + C2 ) * 3038.0577
PRINT OUT ANSWERS TO 100 FT CLIMB SEGMENTS
CALL PRINT
TEST FOR CLIMBING WHEN ACCELERATING WHILE RETRACTING FLAPS - SLATS
IF ( MIL > 0 ) AND. ABS(ALTG-CL3ALT) .GT. 5. ) GO TO 440
IF ( MIL > 0 ) AND. ABS( HP -CL3ALT ) .GT. 5. ) GO TO 440
ANGLEM = PITCHA - 44(34)
GO TO 460
440 D1 = C2
D1 = C2
H1 = ALTG
V1 = VCL
IF ( VIAS > 0 ) VCLIMB = VIAS
HP = HP + DELTAA * FLOAT (MIL)
ALTG = ALTG + DELTAA
TO = 5
IF ( HP > 0 ) AND. FFSAVE .GT. 0.1 ) ANGLEM = 50.
IF ( HP - ALTG > 500. ) TO = 10
IF ( HP > 1000. ) TO = 12
CALL STORE
IF ( HP - ALTG > 500. ) GO TO 540
  
```

```

IF ( TIMEFP + FSLAT .LT. .0001 ) GO TO 540
IF ( FLAP .LT. .001 ) GO TO 540
CLIMRA = 0.0
CALL SPEED
IF ( 34(36) .GT. .1 .AND. 34(36) .LT. 100. ) GO TO 465
POWER = 1
IF ( 34(36) .GT. 100. ) RATE = 2
IF ( RATE .EQ. 2 ) G = GSAVE
IF ( ENGINP .GT. .2 ) G = 0.0
ACCELERATE TO FLAP RETRACTION SPEED ( IF NECESSARY )
C
C
465 VMIN = VEL
IF ( TIMEFP .LT. .0001 ) GO TO 470
VCLIMR = VEL
CALL SPEED2
VMAX = VEL
IF ( VMAX .LT. VMIN ) GO TO 470
CALL ACCEL
IF ( ALTG .GT. 4100. ) GO TO 552
ACCELERATE DURING FLAP AND/OR SLAT RETRACTION
C
C
470 VMIN = VEL
VCLIMR = VELSO
CALL SPEED2
VMAX = VEL
VMAXX = VMAX
TSAVE = HOUR
ACCTIM = TIMEFP
IF ( FLAP .LT. .001 ) ACCTIM = TIMESL
IF ( VMIN .GT. VMAX .AND. TIMEFR .GT. TIMESL ) ACCTIM = TIMESL
IF ( ACCTIM .LT. .0001 ) GO TO 480
HGS = ALTG
HPS = HB
CALL ACCEL2
C
C
OBTAIN NEW VMAX AT NEW ALTITUDE
VX = VEL
VCLIMR = VELSO
CALL SPEED2
VMAX = VEL
VEL = VX
CALL SPEED
TEST1 = GFS ( ACCTIM - TIMEFP )
IF ( TEST1 .LT. .0001 .AND. VMIN .GT. VMAX ) WRITE(6, 70 ) TEST1, TS
IF ( TEST1 .LT. .0001 .AND. VMIN .LE. VMAX ) WRITE(6, 60 ) TFR
IF ( TEST1 .GT. .0001 ) WRITE(6, 90 ) TSD

```

MAIN5600
 MAIN5610
 MAIN5620
 MAIN5630

MAIN5640
 MAIN5650
 MAIN5660

MAIN5670
 MAIN5680
 MAIN5690
 MAIN5700
 MAIN5710
 MAIN5720
 MAIN5730
 MAIN5740
 MAIN5750
 MAIN5760
 MAIN5770

MAIN5780
 MAIN5790
 MAIN5800
 MAIN5810
 MAIN5820
 MAIN5830
 MAIN5840

MAIN5850
 MAIN5860
 MAIN5870
 MAIN5880

MAIN5890

MAIN5900
 MAIN5910
 MAIN5920
 MAIN5930
 MAIN5940

MAIN5950
MAIN5960
MAIN5970
MAIN5980

```
IF ( VEL .GT. VMAX .AND. VMIN .LT. VMAX ) GO TO 485  
CALL POINT  
VFL = VFL  
IF ( VMIN .GT. VMAX ) GO TO 500  
480 GO TO 490  
485 ALTG = HRS  
490 HRS = HRS  
VMAX = VMAXY  
CALL AIR
```

MAIN5990
MAIN6000
MAIN6010
MAIN6020
MAIN6030
MAIN6040

```
ACCELERATE TO SLAT RETRACTION SPEED  
IF ( HOUR - TSAVE .GT. .00001 ) FFLAP = 0.0  
IF ( FFLAP .EQ. 0 ) FFLAP = 0  
CALL ACCEL  
IF ( FFLAP .GT. 0 .AND. ALTG .GT. 41000. ) FFLAP = 84(7)  
IF ( FFLAP .GT. 0 .AND. ALTG .GT. 41000. ) FFLAP = FESAVE  
VMIN = VEL  
ALTG = 41000. ) GO TO 552
```

MAIN6050
MAIN6060
MAIN6070
MAIN6080
MAIN6090
MAIN6100
MAIN6110
MAIN6120
MAIN6130
MAIN6140
MAIN6150

```
ACCTIM = TIMESR  
T2 = TIMESR - TSAVE + TSAVE  
IF ( HOUR - TSAVE .LT. TIMESR .AND. T2 .LT. ACCTIM ) ACCTIM = T2  
IF ( ACCTIM .GE. .00001 .AND. ACCTIM .LE. T2 ) WRITE(6, 90 ) TSR  
90 GO TO 510  
ACCTIM = ABS ( TIMESR - TIMESR )  
IF ( TIMESR .GT. TIMESR ) FFLAP = 0.0  
IF ( TIMESR .LT. TIMESR ) FFLAP = 0.0  
IF ( FFLAP .EQ. 0 ) FFLAP = 0  
IF ( FFLAP .EQ. 0 ) FFLAP = 0  
T2 = TIMESR
```

MAIN6160
MAIN6170
MAIN6180
MAIN6190
MAIN6200
MAIN6210

```
ACCELERATE DURING SLAT RETRACTION ( FLAP RET ONLY IN ONE CASE )  
IF ( ACCTIM .LT. .00001 ) GO TO 520  
CALL ACCEL2  
IF ( ABS(ACCTIM - TIMESR) .LT. .00001 ) WRITE(6, 90 ) TSR  
CALL POINT  
VMIN = VFL  
IF ( FFLAP .LT. TSAVE .OR. FFLAP .LT. HOUR ) GO TO 530  
IF ( TEST1 = ABS ( HOUR - TSAVE - TIMESR ) ) FFLAP = 0.0  
IF ( TEST1 .LT. .00001 ) FFLAP = 0.0  
IF ( TEST1 .GT. .00001 ) FFLAP = 0.0  
IF ( FFLAP .EQ. 0 ) FFLAP = 0  
IF ( FFLAP .EQ. 0 ) FFLAP = 0  
ACCTIM = TIMESR - HOUR + TSAVE  
IF ( ACCTIM .LT. .00001 ) ACCTIM = TIMESR - T2  
CALL ACCEL2  
IF ( ACCTIM .GT. .00001 ) CALL POINT  
IF ( ACCTIM .GT. .00001 ) VMIN = VFL
```

MAIN6220
MAIN6230
MAIN6240
MAIN6250
MAIN6260
MAIN6270
MAIN6280
MAIN6290
MAIN6300
MAIN6310
MAIN6320
MAIN6330
MAIN6340
MAIN6350
MAIN6360
MAIN6370
MAIN6380

```
ACCELERATE TO FINAL CLIMB SPEED WITH FLAPS AND SLATS RETRACTED  
FLAP = 0.0
```

```

EFLAP = 0
WRITE(6, 100 )
ESLAT = 0.0
ISLAT = 0
CALL STORE
VCLIMR = 250.
IF ( HP - 10005. .GT. 5. ) GO TO 590
IF ( HTEST .LT. 10000. )
IF ( HTEST .LT. 2 ) WRITE(6, 550 )
FORMAT ( 'ACCEL RATE AT 10000 FEET TO OPERATIONAL CLIMB SPEED' / )
IF ( HTEST .LT. 2 ) VCLIMR = 300.
IF ( R4(59) .GT. 100. .AND. HTEST .LT. 2.0 ) VCLIMR = 94(59)
IF ( RATE .EQ. 2 ) G = GSAVE
IF ( ENGINP .GT. 2 ) G = 0.0
IF ( R4(36) .GT. 100. ) RATE = 2
VMIN = VEL
CALL AIR
CALL SPEED2
VMAX = VEL
CLIMRA = 0.0
IF ( VCLIMR .GT. 251. ) I7 = 11
IF ( VMAX .GT. VMIN ) CALL ACCELL
IF ( ALTG .LT. 41000. ) CALL STORE
IF ( ALTG .LT. 41000. ) GO TO 555
ALTG = ALTG - 4200.
HP = HP - 42000.
DELTA = 100.
VCLIMR = VIAR
IF ( HP + 2. .LT. AMAX .AND. MIL .EQ. 1 ) GO TO 330
IF ( ALTG + 2. .LT. AMAX .AND. MIL .EQ. 0 ) GO TO 320
IF ( HTEST .GT. 2.0 .AND. FINALA .LT. ALTG + 2.0 ) GO TO 580
CALCULATE CLIMB TO 10000 FEET ALTITUDE
IF ( HTEST .GT. 2. ) WRITE(6, 560 )
FORMAT ( 'VCLIMB TO 10000 FEET ALTITUDE AT CONSTANT GAS SPEED' / )
IF ( HTEST .LT. 2. ) WRITE(6, 570 )
FORMAT ( 'CLIMB TO 10000 FEET GEOMETRIC ALTITUDE' / )
G = GSAVE
IF ( ENGINP .GT. 2 ) G = 0.0
RATE = 2
DELTA = 1000.
AMAX = 10000.
IF ( MIL .EQ. 0 ) AMAX = GEOMET ( DELTAC , 10000. )
VCLIMR = VIAR
IF ( HTEST .LT. 2 ) MIL = 0
IF ( HTEST .LT. 2 ) AMAX = FINALA
IF ( HTEST .LT. 3 ) .AND. ALTG + DELTAA .GT. AMAX ) DELTAA = AMAX - ALTG
VMAX = WMAX
IF ( ALTG .LT. AMAX - 1. ) GO TO 330
580 CONTINUE

```

MAIN6390
 MAIN6400
 MAIN6410
 MAIN6420

MAIN6430
 MAIN6440
 MAIN6450
 MAIN6460
 MAIN6470
 MAIN6480
 MAIN6490
 MAIN6500

MAIN6510
 MAIN6520
 MAIN6530
 MAIN6540
 MAIN6550
 MAIN6560

MAIN6570

MAIN6590
 MAIN6600
 MAIN6610
 MAIN6620
 MAIN6630
 MAIN6640

MAIN6660
 MAIN6670
 MAIN6680
 MAIN6690
 MAIN6700

MAIN6740
 MAIN6750
 MAIN6760
 MAIN6780
 MAIN6800

590 CONTINUE
CALL CHARGE
595 CONTINUE
596 TO 160
596

MATN6810

MATN6820
MATN6890

```

SURROUQVINE ACCFL
REAL MACH DATE
INTEGRAL ENCE
1(A(93),H
EQUIVALENCE ( (A(80),NWENC ) , (R4(22),ACC1
EQUIVALENCE ( (R4(8),FWJ ) , ( ACC3 ,B4(24)
1(A(73),MILI) , ( R4(5),FFLAP) , ( ( B4(9),AV )
C(04404) /TCV) , VELTR ) , ( TIMELO ,VELTR ) ,
1(3,2) ,MACHL ,ACCF(2),V2 ,HP ,ENGNOP ,CJ ,POWER ,DR ,MACH(3) ,
2(FRCE ,EMELF ,DELTA ,WRIGHT ,ALPHA ,DELTA ,VCLIMR ,VMAX ,SFC ,
4SSOUND) ,ENERGY ,MILV1 ,CAMVA ,ALPHA ,DELTA ,VCLIMR ,VMAX ,SFC ,
5A(51) ,PITCHA ,FUELMR ,VFINAL ,ID ,GRAD ,TARS35(17) ,
6ACCT14 ,PITCHA ,CLIMRA ,VFINAL ,ID ,GRAD ,TARS35(17) ,
COMMON / TAM / A(97) , R4(36) / TIM / FINAL ,EQUITAL
1EFLAP ,FSLAT ,PTCHMAJ(9) ,CLBLAT ,ACCELERATION IN LEVEL FLIGHT
CALCULATION OF AIRCRAFT ACCELERATION IN LEVEL FLIGHT
VMIN INITIAL VELOCITY (KTAS) VMAX FINAL VELOCITY (KTAS)
ALTO GEOMETRIC ALTITUDE (FT) HP PRESSURE ALTITUDE (FT)
VEL TRUE AIR VELOCITY(KTAS)
CLIMRA = 0.0
TF ( VMAX .LE. VMIN + 0.001 ) RETURN
CALCULATION OF VELOCITY INCREMENTS
NVEL = 2
DELTA V = VMAX - VMIN
GD TO 10
ENTRY ACCEL TO CAS
CONVERT VMIN TO CAS
IE ( VMAX .LE. VMIN + 0.001 ) RETURN
VEL SPEED
CALL SDEF
ICAS = VIAC * 0.10 + 0.1
VCAS = 10.0 * ICAS + 10.
CONVERT VCAS TO V TRUE
VCLIMP = VCAS
CALL SPEED2
DELTA V = VEL - VMIN
NVEL = 100
V
FS = EFLAP
ES = EFLAP
DELTA C = 0.0
VEL = C.0
CAMVA = VEL
VMAX = 0
IC ( R+(53) .GT. .1 ) VMAX = R4(60) * 8.33 / ( ENGR * 34(58) *
13600.

```

10

```

ACC E0010
ACC E0020
ACC E0030
ACC E0040
ACC E0050
ACC E0060
ACC E0070
ACC E0080
ACC E0090
ACC E0100
ACC E0110
ACC E0120
ACC E0130
ACC E0140
ACC E0150
ACC E0160
ACC E0170
ACC E0180
ACC E0190
ACC E0200
ACC E0210
ACC E0220
ACC E0230
ACC E0240
ACC E0250
ACC E0260
ACC E0270
ACC E0280
ACC E0290
ACC E0300
ACC E0310
ACC E0320
ACC E0330
ACC E0340
ACC E0350
ACC E0360
ACC E0370
ACC E0380
ACC E0390
ACC E0400
ACC E0410
ACC E0420
ACC E0430
ACC E0440
ACC E0450
ACC E0460
ACC E0470
ACC E0480
ACC E0490
ACC E0500
ACC E0510
ACC E0520
ACC E0530

```

```

C
VELOCITY LOOP
MSAVE = MTL
MIL = 0
20 I = I + 1
IF ( CURALT .GT. 2. ) GAMMA = 0.05
IF ( ANGLEM .LT. 1. ) OP ANGLEM .GT. 30. ) GAMMA = 0.0
IF ( CURALT .LT. 2. ) GAMMA = 0.0
IF ( ARSCHP - 1000. ) .LT. 5.0 ) GAMMA = 0.0
ALTI = ALTG
WACH = VFL / SROUND
CALL VTRUF
VCLIMB = VIAS
CALL THR
ITERATION FOR AIRCRAFT WEIGHT
WTSAVE = WEIGHT
WEIGHT = WEIGHT
IF ( GAMMA .EQ. 0.0 ) GO TO 30
CALL DITCH
GAMMA = ( ANGLEM - ALPHA ) / 57.2958
IF ( GAMMA .LT. 0. ) GAMMA = 0.0
C
C
C
ITERATE FOR TIME AND FUEL BURNED AT A PARTICULAR CLIMB ANGLE
30 DO 50 J = 1 , 8
CALL DRAG
ACC = 19.06 * ( FORCE * ENGOP - DR - WEIGHT * SIN(GAMMA)) / WEIGHT
IF ( ACC .LT. 0.09 ) ACC = 0.09
IF ( I .EQ. 1 ) GO TO 30
DELTA = DELTAV / (( ACC - ALTI + 3500. ) * ALG ( ACC / ALI )
IF ( TIMEP .LT. 0.001 .AND. DELTAT .GT. 0.05 ) DELTAT = 0.06
IF ( TIMEP .LT. 1. ) DELTAT = DELTAT * ES
EFLAP = ( TIMEP - DELTAT ) / TIMEP * ES
IF ( EFLAP .LT. 0.0 ) EFLAP = 0.0
IF ( EFLAP .LT. 0.0 ) EFLAP = 0.0
DEL = ( FUEL + DEL ) * 0.5 = DELTAT * ENGOP
DEFIN = DEL
WEIGHT = WTSAVE - DELF
CALL PITCH
PITCHA = ALPH
C
C
C
CALCULATE NEW HP AND HG BASED ON A POSITIVE GAMMA
DS = ( VFL - DELTAV * 0.5 ) * DELTAT * 6076.1154
DMG = DS * 0.5 = ( GAMMA + GI )
ALTG = ALTI + DMG
C
C
C
OBTAIN NEW TOJE SPEED WHEN CLIMBING MAINTAINING SAME IAS SPEED
CALL AIR
CALL SPEED2
VELTAV = VEL - SAVE
CALL THR

```

```

ACCE0550
ACCE0560
ACCE0570
ACCE0580
ACCE0590
ACCE0600
ACCE0610
ACCE0620
ACCE0630
ACCE0640
ACCE0650
ACCE0660
ACCE0670
ACCE0680
ACCE0690
ACCE0700
ACCE0710
ACCE0720
ACCE0730
ACCE0740
ACCE0750
ACCE0760
ACCE0770
ACCE0780
ACCE0790
ACCE0800
ACCE0810
ACCE0820
ACCE0830
ACCE0840
ACCE0850
ACCE0860
ACCE0870
ACCE0880
ACCE0890
ACCE0900
ACCE0910
ACCE0920
ACCE0930
ACCE0940
ACCE0950
ACCE0960
ACCE0970
ACCE0980
ACCE0990
ACCE1000
ACCE1010
ACCE1020
ACCE1030
ACCE1040
ACCE1050
ACCE1060
ACCE1070

```

C
C

```

SOLVE FOR CLIMB ANGLE
CALL DITCH
CLIMBA = GAMMA * 57.2958
PITCHA = CLIMBA + ALPHA
IF ( CLRALY .LT. 2.0 ) GO TO 50
IF ( ABS(HP - 10000. ) .LT. 5.0 ) GO TO 50
IF ( ANGLEM .LT. 1.00 ) ANGLEM = .GT. 30. ) GO TO 50
CLIMBA = ANGLEM / ALPHA
GAMMA = CLIMBA / 57.2958
IF ( GAMMA .LT. 0.0 ) CLIMBA = 0.0
IF ( GAMMA .LT. 0.0 ) GAMMA = 0.0
CONTINUE
DELTA = DELTAV * 0.5 ) * DELTAT * 6076.1154 * COS(GAMMA)
IF ( ACC .GE. 0.1 ) GO TO 90
FORMAT ('0BCCEL DISCONTINUED. : 4X BALL ENGINE ACCELERATION WAS
FLOW 0.1 KM / SEC AT : : EG.2. : : PITCH ANGLE. )
WRITE(6, 70) ANGLEM
WEIGHT = WTSAVE
ALTS = ALTI
VEL = SAVE
CALL SPEED
VCLIMR = VIAS + 42000.
ALTS = HP + 42000.
EFLAP = ES
EFLAP = ES
GO TO 100
EI = FUELF
IF ( ACC .LT. 0. ) GO TO 190
ALTS = CLIMBA + ALPHA
IF ( I .GT. 1 ) CALL ODINT
SAVE ( RATE .GT. 6 .AND. HUMP .GT. HMAX ) RATE = 3
IF ( I .NE. NVFL ) VEL = VEL + DELTAV
IF ( I .EQ. 1 ) GO TO 20
IF ( NVEL .EQ. 100 ) GO TO 90
IF ( I .LT. NVFL ) GO TO 20
MIL = MSAVE
RETURN
DELTA = TRUF, EQUIVALENT TO 10 KTS CAS
VCLIMR = 10.001 + VIAS
CALL SPEED2
DELTA = VEL - SAVE
IF ( VEL .LE. VMAX + 9.9 ) GO TO 20
VIAS = VIAS - 10.001
MIL = MSAVE
RETURN

```

229

C

C
C

```

ACCFE1090
ACCFE1100
ACCFE1110
ACCFE1120
ACCFE1130
ACCFE1140
ACCFE1150
ACCFE1160
ACCFE1170
ACCFE1180
ACCFE1190
ACCFE1200
ACCFE1210
ACCFE1220
ACCFE1230
ACCFE1240
ACCFE1250
ACCFE1260
ACCFE1270
ACCFE1280
ACCFE1290
ACCFE1300
ACCFE1310
ACCFE1320
ACCFE1330
ACCFE1340
ACCFE1350
ACCFE1360
ACCFE1370
ACCFE1380
ACCFE1390
ACCFE1400
ACCFE1410
ACCFE1420
ACCFE1430
ACCFE1440
ACCFE1450
ACCFE1460
ACCFE1470
ACCFE1480
ACCFE1490
ACCFE1500
ACCFE1510
ACCFE1520
ACCFE1530
ACCFE1540
ACCFE1550
ACCFE1560
ACCFE1570
ACCFE1580
ACCFE1590
ACCFE1600

```


ACCFE2150
 ACCFE2160
 ACCFE2170
 ACCFE2180
 ACCFE2190
 ACCFE2200
 ACCFE2210
 ACCFE2220
 ACCFE2230
 ACCFE2240
 ACCFE2250
 ACCFE2260
 ACCFE2270
 ACCFE2280
 ACCFE2290
 ACCFE2300
 ACCFE2310
 ACCFE2320
 ACCFE2330
 ACCFE2340
 ACCFE2350
 ACCFE2360
 ACCFE2370
 ACCFE2380
 ACCFE2390
 ACCFE2400
 ACCFE2410
 ACCFE2420
 ACCFE2430
 ACCFE2440
 ACCFE2450
 ACCFE2460
 ACCFE2470
 ACCFE2480
 ACCFE2490
 ACCFE2500
 ACCFE2510
 ACCFE2520
 ACCFE2530
 ACCFE2540
 ACCFE2550
 ACCFE2560
 ACCFE2570
 ACCFE2580
 ACCFE2590
 ACCFE2600
 ACCFE2610

```

ESLAT = 0.0
GO TO 150

RETRACT FLAPS IF THIS IS FLAP RETRACTION DELTAT

140 FFLAP = 0.0
150 FFLAP = 0.0
VELF = VMIN + DELTAT * ( ACC + A1 ) * 1800.
DEL = DELTAT * ( FUEL + FI ) * 0.5 * ENGGP
DS = ( VEL + VMIN ) * DELTAT * 6076.1154 * 0.5
IF ( GAMMA .LT. .00001 ) GO TO 160
DHG = DS * 0.5 * ( GAMMA + G1 )
ALTS = ALTI + DHG
CALL SPEED
WEIGHT = WTSAVE - DELE
DS = DS * COS(GAMMA)
MIL = WSAVE
FFLAP = ES
FFLAP = ES
ESLAT = ESS
RETURN

CALCULATION OF ACCELERATION FROM INPUT CURVES

ENTRY ACCEL ( VE )
CALL QUAD ( T1 , T2 , T3 , VE , FMS )
VESQ = VE * VE
C = 0.0033855 * VESQ
ASAE = 1. / ( ACC1 + ACC2 * VESQ + ACC3 * VESQ * VESQ )
ASEE = ASAE - FMS * 32.174 / WTSTD - Q * ( FWJ + AV * VESQ ) / Q
1 + FWJ ) * 2 ) / WTSTD * 32.174
CONST = 1. - WTSTD / WEIGHT )
ON 180 17 = 1 , 2 , T(2,17) , T(3,17) , VE , FM )
CALL QUAD ( T(1,17) , T(2,17) , T(3,17) , FMS )
CI = 32.174 / WEIGHT * ( FM - FMS )
ACCE(17) = ASEF * WTSTD / WEIGHT + CI * ( ENGGP - 2 + 17 ) - CONST
ASEF = ASAE
180 RETURN

RETURN BECAUSE OF NEGATIVE ACCELERATION

190 WRITE(6, 200 )
200 FORMAT ( ' DRAG EXCEEDED THRUST WHILE TRYING TO ACCELEPATE' )
MIL = WSAVE
RETURN
END
  
```

C

```

CALCULATION OF ATMOSPHERIC DATA
SIGNIFICANCE AIR
EQUVALENCE (
COMMON / ATM/
11 (3.2) / MACHL
21 ARSE / MACHL
31 RICE / MACHL
41 SOND / MACHL
51 (5) / MACHL
61 ACTI / MACHL
COMMON / 12M / A(97) * 84(36) /
CHANGE (P.G.C) = C + C / 1.9312E-3 * ALOG ((518.67 *
17 218.67)
CHANGE (DC,HP) = HP - DC / 1.9812E-3 * ALOG ((518.67 - 3.566134E-3 * HP) / 518.67)
IF (MIL,LT: 1) GO TO 10
ALTC = SECMET ( DELTAC * 40 )
GO TO 20
10 HP = CHANGE (ALTC, ALTC, DELTAC)
HP = CHANGE (HP, ALTC, DELTAC)
HP = CHANGE (HP, ALTC, DELTAC)
HP = CHANGE (HP, ALTC, DELTAC)
HP = CHANGE (HP, ALTC, DELTAC)
20 IE ( HP * GT 36032 ) GO TO 30
DELTA = (1.0 - (0.375535E-6 * HP)) ** 2.62805
TEMPC = 13. - 0.019412 * HP + DELTAC
GO TO 40
30 HP = 36032 + (ALTC - 36032) - DELTAC * 143.95219 / (1. + DELTAC /
1519.67)
TEMPC = DELTAC * 50.5
DELTA = 10. * (1.051155 - 1.043633E-5 * HP )
SSOUNG = 29.0449 * SQRT (TEMPC * 1.8 + 491.67)
END

```

```

AIR 0010
AIR 0020
AIR 0030
AIR 0040
AIR 0050
AIR 0060
AIR 0070
AIR 0080
AIR 0090
AIR 0100
AIR 0110
AIR 0120
AIR 0130
AIR 0140
AIR 0150
AIR 0160
AIR 0170
AIR 0180
AIR 0190
AIR 0200
AIR 0210
AIR 0220
AIR 0230
AIR 0240
AIR 0250
AIR 0260
AIR 0270
AIR 0280
AIR 0290
AIR 0300
AIR 0310
AIR 0320
AIR 0380
AIR 0390

```



```

CALL THRUSH ( HP
10ATE , FPRIN , ENGRP , TEMPCL , MACH , LAPSE , ALTI , MACHL , TEMPCL ,
20ATE , A3 , DCTN , FUELE , POWER , IBL ECH , A1 , D9 , FORCE , FPR ,
30TEA , A4 , SECTES , I. , A6 , N2 , N3 , N4 , N5 , N6 , N7 , G ,
LEP = FDB
IF ( R4(53) .GT. .3 ) FORCE = FORCE * R4(53)
IF ( R4(54) .GT. .2 ) FUELE = FUELE * R4(53)
IF ( RATE .LT. .8 ) FUELE = FUELE * R4(54)
SFCE = FUELE / ( FORCE * .0001 )
FSAVE = FORCE
FUSAVE = FUELE
XALTY = HP
XMT = MACH
FRC2 = FORCE
DS = POWER
RETURN
END

```

```

00AG0520
00AG0530
00AG0540
00AG0550
00AG0560
00AG0570
00AG0590
00AG0600
00AG0610
00AG0620
00AG0630
00AG0640
00AG0650
00AG0660
00AG0670

```

SHIPPING CRIME
ENTRY CRIME
ENTRY CRIME
RETURN
END

SUM UP CALCULATED VALUES

```

ENTRY PRINT
I77 = 1
HOUR = HOUR + DELTAT
FUEL = FUEL + DELF
FACTOR = -20.
DO 20 I7 = 1, 5
  FACTOR = FACTOR + 10.
  D(I7) = D(I7) + DS - FACTOR * DELTAT * 6076.115
ENTRY PRINT I
WEIGHT = WTN - FUEL
SECOND = HOUR * 3600.

```

DETERMINE EVEN DISTANCES

```

IF (I.GT.31) I=1
STEP = 1000.
IF ( NI(2) .GT. 23999. ) STEP = 2000.
30 IW7=1
  IZ = DI(2) / STEP + 1.4999
  ZALT = IZ * STEP

```

STORE CALCULATIONS FOR INTERPOLATIONS AT EVEN DISTANCES

```

40 TABLE(2*I) = NI(2)
  STORY(I) = ALTG
  STORY(I+3) = 4P
  STORY(I+6) = WEIGHT
  STORY(I+9) = NI(1)
  STORY(I+12) = NI(3)
  STORY(I+15) = NI(4)
  STORY(I+18) = NI(5)
  STORY(I+21) = VEL
  STORY(I+24) = FUDGE
  STORY(I+27) = FUELE
  TEST = ALTG + J.5
  IF (DI(2).LT.7) ALTGO TO 120
  IF ( MIL .LT. ALTG + 40. ) GO TO 120
  IF ( MIL .EQ. 0 .AND. ALTG - A(71) .GE. A(72) ) GO TO 120
50 CONTINUE
  IF ( ITEST .EQ. IMS(I) ) GO TO 120
  DO 80 J = 1,10
    KP = 3 * J - 2
    DO 60 K = 3,7,2
      TABLE(K) = STORY(KP)
    60 KP = KP + 1

```

INTERPOLATE STORED DATA AT ZALT - EVEN HORIZONTAL DISTANCES

```

DO 70 JZ = 1,7
70 CHANGE(JZ) = TABLE(JZ)

```

PITC0430
PITC0440
PITC0400
PITC0410
PITC0450
PITC0460
PITC0470
PITC0480
PITC0490
PITC0500
PITC0510
PITC0520
PITC0530

PITC0540
PITC0550
PITC0560
PITC0570
PITC0580
PITC0590
PITC0600
PITC0610

PITC0620
PITC0630
PITC0640
PITC0650
PITC0660
PITC0670
PITC0680
PITC0690
PITC0700
PITC0710
PITC0720
PITC0760
PITC0730
PITC0740

PITC0750
PITC0770
PITC0780
PITC0790
PITC0800
PITC0810
PITC0820

PITC0830
PITC0840

IF (ABS(HPS - HP) .LT. 0.001) GO TO 190

HPS = HP
FINOVL(2* NZV) = HP
FINOVL(2* NZV+1) = VFI
FINOVL(2* NZV) = HP
FINOVL(2* NZV+1) = WEIGHT
FINOVL(2* NZV) = HP
FINOVL(2* NZV+1) = ENERGY

NZV = NZV+1
VFI = VFI+1
ALTY = ALTY+1
IF (MIL .EQ. 1) ALTY = HP
IF (FINOVL .GT. 5) GO TO 190
IF (FINOVL .GT. 1) GO TO 190
IF (CLINE .LT. 4) GO TO 190
GO 150 J=1,5

IF (ABS(ALTY - TESTAL(J) - A(71)) .LT. 2.0) GO TO 160

CONTINUE

150 GO TO 190

INTERPOLATE FOR VEL, DRAG, WEIGHT, AND KE AT ALTY

160 CALL SERR0 (FINOVL)
CALL SERR0 (FINOVL)
CALL SERR0 (FINOVL)

ALTY = HP
CALL INSI (ALTY, FINOVL, VELOUT, 2, NERR2)
CALL INSI (ALTY, FINOVL, ENOUT, 2, NERR4)
CALL INSI (ALTY, FINOVL, ENOUT, 2, NERR5)
IF (NERR2 .NE. 1) WRITE(6,699) FINOVL
IF (NERR3 .NE. 1) WRITE(6,599) FINOVL
IF (NERR4 .NE. 1) WRITE(6,599) FINOVL
IF (NERR5 .NE. 1) WRITE(6,599) FINOVL

699 VEL = VELOUT
DRAG = DRAGOUT
WEIGHT = WEIGHTOUT
KE = KEOUT
GO TO 190

CALL SERR0
CALL SERR0
CALL SERR0
IF (HP .GT. 0.5
IF (ALTY .GT. 0.5
DRAG = 0.0
KE = 0.0

SOLVE FOR REQUIRED THRUST AT INPUT RATE OF CLIMB THAT IS J

DR 170 J = 250, 1000, 250
GAMMA = J / (101.2683 * VFI)

CALL SERR0
THRUST = J / 1000 (VELOUT * 101.2683) * WTOUT * ENOUT + DR
IF (ABS(ENOUT - 3.0) .GT. 0.001) CALL THEI(605)
IF (J .EQ. 500) WRITE(6,100) VFI, J, DR, ENOUT, KE, WTOUT
100 J=1,5
J1 = J
J2 = J5
J3 = DR

PITC1290
PITC1300
PITC1330
PITC1340
PITC1350
PITC1360
PITC1370
PITC1380
PITC1390
PITC1400
PITC1410
PITC1420

PITC1440
PITC1450
PITC1460
PITC1470

PITC1480
PITC1500
PITC1510

PITC1520
PITC1540
PITC1550

PITC1560

PITC1570
PITC1580
PITC1590

PITC1600

PITC1610
PITC1620
PITC1630
PITC1640
PITC1650
PITC1660
PITC1670
PITC1680

```

04 = PCTMI
CONTINUE
FORMAT (I, , 15, 17, PCTMI 2(, , F6.2 ) ) THOUST = , F7.0,
1 IF (ALTX.GY.(A(72)-10.))IMZ7=1
POWER = 1
CONTINUE
IF (ALTX.GY. 32.) GO TO 200
N77 = N77 + 1
ZX(N77) = Z(12)
ZY(N77) = ALTX
VC(N77) = 2.23MS
ALTX.GY.(A(72)-10.))M77= N77-1
151 ALTX -(A(72)-1.) 200 * 210 * 210
CONTINUE
210 IF (N77.LE.4) RETURN
CALL ZDATA(ZX,ZY, N77)
N77=0
RETURN
PRINT OUT BRAKE RELEASE INFORMATION
ENTRY BRK-
ES = FFLAG
LTIME = 1
IMZ7 = 0
N77 = 0
DO 220 I= 4, 12
INS(I) = ALTC + 0.5
ALTF1 = ALTC
INS(2) = MD + 0.5
INS(3) = VTY + 0.5
INS(12) = FORCE + 0.5
INS(13) = FORCE / ( DELTA * DELTA ) + 0.5
INS(14) = FORCE / ( DELTA * DELTA ) + 0.5
WRITE (6, 140) RMS
DATE = UTIM
IMZ7(2) = INS(3)
ZERO OUT STORAGE TABLES
IMAX = 12
IMAX = 1
IF ( I 12 .NE. 1 ) RETURN
DO 260 K = 1, 12
DO 260 J = 1, 12
IF ( J.LT.6 ) VST(J,K) = 0.0
151 ST(J,K) = 0
RETURN
260

```

```

PITC1690
PITC1700
PITC1710
PITC1720
PITC1730
PITC1740
PITC1750
PITC1760
PITC1770
PITC1780
PITC1790
PITC1800
PITC1810
PITC1820
PITC1830
PITC1840
PITC1850
PITC1860
PITC1870
PITC1880
PITC1890
PITC1900
PITC1910
PITC1920
PITC1940
PITC1950
PITC1960
PITC1970
PITC1980
PITC1990
PITC2000
PITC2010
PITC2020
PITC2030
PITC2040
PITC2050
PITC2060
PITC2070

```

```

ENTRY SUMMARY
IF ( I MAX .LT. 12 ) RETURN = 12
IF ( I MAX .GT. 12 ) I MAX = 12
DATA / DISTANCE , LIFT , CLIFF , ALTITUDE , WIND , WIND DIR , WIND SPEED , WIND GUST , WIND VELOCITY , WIND DIRECTION , WIND TYPE , WIND CLASSIFICATION , WIND CATEGORY , WIND SOURCE , WIND EFFECT , WIND HAZARD , WIND WARNING , WIND ACTION , WIND NOTES , WIND REFERENCES , WIND COMMENTS , WIND SUMMARY , WIND CALCULATED FLIGHT PATH
100 DISTANCE = 1000 * I MAX
110 DISTANCE = 1000 * I MAX
120 DISTANCE = 1000 * I MAX
130 DISTANCE = 1000 * I MAX
140 DISTANCE = 1000 * I MAX
150 DISTANCE = 1000 * I MAX
160 DISTANCE = 1000 * I MAX
170 DISTANCE = 1000 * I MAX
180 DISTANCE = 1000 * I MAX
190 DISTANCE = 1000 * I MAX
200 DISTANCE = 1000 * I MAX
210 DISTANCE = 1000 * I MAX
220 DISTANCE = 1000 * I MAX
230 DISTANCE = 1000 * I MAX
240 DISTANCE = 1000 * I MAX
250 DISTANCE = 1000 * I MAX
260 DISTANCE = 1000 * I MAX
270 DISTANCE = 1000 * I MAX
280 DISTANCE = 1000 * I MAX
290 DISTANCE = 1000 * I MAX
300 DISTANCE = 1000 * I MAX
310 DISTANCE = 1000 * I MAX
320 DISTANCE = 1000 * I MAX
330 DISTANCE = 1000 * I MAX
340 DISTANCE = 1000 * I MAX
350 DISTANCE = 1000 * I MAX
360 DISTANCE = 1000 * I MAX
370 DISTANCE = 1000 * I MAX
380 DISTANCE = 1000 * I MAX
390 DISTANCE = 1000 * I MAX
400 DISTANCE = 1000 * I MAX
410 DISTANCE = 1000 * I MAX
420 DISTANCE = 1000 * I MAX
430 DISTANCE = 1000 * I MAX
440 DISTANCE = 1000 * I MAX
450 DISTANCE = 1000 * I MAX
460 DISTANCE = 1000 * I MAX
470 DISTANCE = 1000 * I MAX
480 DISTANCE = 1000 * I MAX
490 DISTANCE = 1000 * I MAX
500 DISTANCE = 1000 * I MAX
510 DISTANCE = 1000 * I MAX
520 DISTANCE = 1000 * I MAX
530 DISTANCE = 1000 * I MAX
540 DISTANCE = 1000 * I MAX
550 DISTANCE = 1000 * I MAX
560 DISTANCE = 1000 * I MAX
570 DISTANCE = 1000 * I MAX
580 DISTANCE = 1000 * I MAX
590 DISTANCE = 1000 * I MAX
600 DISTANCE = 1000 * I MAX
610 DISTANCE = 1000 * I MAX
620 DISTANCE = 1000 * I MAX
630 DISTANCE = 1000 * I MAX
640 DISTANCE = 1000 * I MAX
650 DISTANCE = 1000 * I MAX
660 DISTANCE = 1000 * I MAX
670 DISTANCE = 1000 * I MAX
680 DISTANCE = 1000 * I MAX
690 DISTANCE = 1000 * I MAX
700 DISTANCE = 1000 * I MAX
710 DISTANCE = 1000 * I MAX
720 DISTANCE = 1000 * I MAX
730 DISTANCE = 1000 * I MAX
740 DISTANCE = 1000 * I MAX
750 DISTANCE = 1000 * I MAX
760 DISTANCE = 1000 * I MAX
770 DISTANCE = 1000 * I MAX
780 DISTANCE = 1000 * I MAX
790 DISTANCE = 1000 * I MAX
800 DISTANCE = 1000 * I MAX
810 DISTANCE = 1000 * I MAX
820 DISTANCE = 1000 * I MAX
830 DISTANCE = 1000 * I MAX
840 DISTANCE = 1000 * I MAX
850 DISTANCE = 1000 * I MAX
860 DISTANCE = 1000 * I MAX
870 DISTANCE = 1000 * I MAX
880 DISTANCE = 1000 * I MAX
890 DISTANCE = 1000 * I MAX
900 DISTANCE = 1000 * I MAX
910 DISTANCE = 1000 * I MAX
920 DISTANCE = 1000 * I MAX
930 DISTANCE = 1000 * I MAX
940 DISTANCE = 1000 * I MAX
950 DISTANCE = 1000 * I MAX
960 DISTANCE = 1000 * I MAX
970 DISTANCE = 1000 * I MAX
980 DISTANCE = 1000 * I MAX
990 DISTANCE = 1000 * I MAX
1000 DISTANCE = 1000 * I MAX

```

ENN

01TC2090

```

SUBROUTINE QUAD ( T1 , T2 , T3 , V , T )
AU = ( T1 - 2 * T2 + T3 ) / 2500. * V * T
AI = - 150. * 20 + ( T2 - T1 ) / 50.
A2 = T1 - 50. * ( AU + 50. + AI )
RETURN
END

```

```

QUAD0010
QUAD0020
QUAD0030
QUAD0040
QUAD0050
QUAD0060
QUAD0070

```

```

MAIN0030
MAIN0040
MAIN0050
MAIN0060
MAIN0070
MAIN0080
MAIN0090
MAIN0100
MAIN0110
MAIN0120
MAIN0130
MAIN0140

```

THE TABLE OF VALUES USED IN VNS1

```

C THIS SUBROUTINE PROVIDES THE TABLE OF VALUES USED IN VNS1
SUBROUTINE FNS03(
  DIMENSION P(7), X(3), Y(3)
  P(1) = 1.0
  Y(1) = 2.0(2*1)
  Y(2) = 5.0(2*1+1)
  CALL SVP2 ( X, Y )
  X(1) = 1.0
  X(2) = X(1)
  X(3) = X(1) + 1
  Y(1) = Y(1)
  Y(2) = Y(1) + 1
  Y(3) = Y(1)
  END

```

```

C THIS SUBROUTINE CALCULATES INDICATED VELOCITY AND MACH NUMBER
C SUBROUTINE SPEED
COMMON /TGM/ VELTO, VELLO, TIVELD, VELTPH, WFLAP, I2, IA, IT
1T(3,2) V(3) ACCE(2), VZ, HP, ALTG, MACH, O
2LAPSE MACHL, RATE, ENGRD, PRMER, DR, DATET(3)
3FORCE ENLE, WIGHT, ENGNOP, CD, VCLIMB, VIAS, G
4SSOUND HI, VI, GAMMA, ALPHA, DELTAC, VCLIMB, TARLFP(9)
5DI(5) DELTAT, ENEL, HGR, DELE, OS, VMIN, VMAX, SEC
6ACCTIN, PITCHA, CLIMRA, VEINAL, IP, GRAD, WNTIN, GLOR
COMMON / (97) , R4(36) / YTM / TABS35(17) , TARV35(17)
REAL MACH
DOUBLE PRECISION X , XM , D
CALL AIR
C INPUT VELOCITY ( VEL ) IS TRUE AIR SPEED
MACH = VEL / SOUND
XM = MACH
D = DELTA
ENERGY = 1. + 2.848688 * VEL*(VEL - V1)/32.174/(ALTO - H1 - .0001)
GO TO 10
C INPUT VELOCITY ( VEL ) IS EQUIVALENT AIR SPEED
ENTRY SPEED1
CALL AIR
MACH = VEL / 661.4805 / DELTA
ENERGY = 1. + .566 * MACH * MACH
IF ( HP .GT. 35089. ) ENERGY = 1. + .7 * MACH * MACH
VEL = MACH * SOUND
ENTRY VTRUE
XM = MACH
D = DELTA
10 VIAS = 1479.115 *DSQRT ( ( G * C * ((1. + .2 * XM * XM
RETURN
CALCULATION OF TRUE AIR VELOCITY FROM INPUT INDICATED AIR SPEED
ENTRY SPEED2
VIAS = VCLIMB
X = VCLIMB / 661.4805
D = DELTA
MACH = 2.236063 *DSQRT((( 1. + .2*XM*X )**3.5 - 1. ) / ( D
10 VEL = MACH * SOUND
ENERGY = 1. + 2.848688 * VEL*(VEL - V1)/32.174/(ALTO - H1 - .0001)
RETURN
END

```

SPEED0010
SPEED0030
SPEED0040
SPEED0050
SPEED0060
SPEED0070
SPEED0080
SPEED0090
SPEED0100
SPEED0110
SPEED0120
SPEED0130
SPEED0140
SPEED0150
SPEED0160
SPEED0170
SPEED0180
SPEED0190
SPEED0200
SPEED0210
SPEED0220
SPEED0230
SPEED0240
SPEED0250
SPEED0260
SPEED0270
SPEED0280
SPEED0290
SPEED0300
SPEED0310
SPEED0320
SPEED0330
SPEED0340
SPEED0350
SPEED0360
SPEED0370
SPEED0380
SPEED0390
SPEED0400
SPEED0410
SPEED0420
SPEED0430
SPEED0440
SPEED0450
SPEED0460
SPEED0470

```

C
DRAW LINE ALIGNMENT SQUARE
SUBROUTINE ZALIGN
DIMENSION XA7(5), YA7(5), XPA7(10), YPAZ(10), X1(2), Y1(2), X2(2), Y2(2)
COMMON /TAM/ A(97), R4(36)
EQUIVALENCE (A(77), NFLAPS)
DATA XAZ/.1, 2*.24, 2*.1/, YAZ/2*.1, 2*.17, 9*.1/,
1 XPAZ/1, 19.9424, 0, 2.54, 6*0., 2.54, 6*0., 2.54, 6*0., /,
2 X1/2*13., /, Y1/.1, 17.9/, X2/.1, 24.9/, Y2/ 2*9. /
XPAZ(11)= 1.
DO 10 I=1, NFLAPS
CALL GBLINE (XA7, YAZ, 5, XPAZ, YPAZ)
CALL GBLINE (X1, Y1, 2, XPAZ, YPAZ)
CALL GBLINE (X2, Y2, 2, XPAZ, YPAZ)
10 XPAZ(11)= XPAZ(1)+ 15.
CALL GRFILE (0)
RETURN
END
ZALIGN0010
ZALIGN0020
ZALIGN0030
ZALIGN0040
ZALIGN0050
ZALIGN0060
ZALIGN0070
ZALIGN0080
ZALIGN0090
ZALIGN0100
ZALIGN0110
ZALIGN0120
ZALIGN0130
ZALIGN0140
ZALIGN0150
ZALIGN0160
ZALIGN0170

```

MAIN0020
 MAIN0030
 MAIN0040
 MAIN0050
 MAIN0060
 MAIN0070
 MAIN0080
 MAIN0090
 MAIN0100
 MAIN0110
 MAIN0120
 MAIN0130
 MAIN0140
 MAIN0150
 MAIN0160
 MAIN0170
 MAIN0180
 MAIN0190
 MAIN0200
 MAIN0210
 MAIN0220
 MAIN0230
 MAIN0240
 MAIN0250
 MAIN0260
 MAIN0270
 MAIN0280
 MAIN0290
 MAIN0300
 MAIN0310
 MAIN0320
 MAIN0330
 MAIN0340
 MAIN0350
 MAIN0360
 MAIN0370
 MAIN0380
 MAIN0390
 MAIN0400
 MAIN0410
 MAIN0420
 MAIN0430
 MAIN0440
 MAIN0450

```

DRAW AXES AND TICK MARKS
SUBROUTINE ZAYES
DIMENSION X1(2), Y1(2), X2(2), Y2(2), XPAZ(10), YPAZ(10)
COMMON /TAY/ A(47), P4(36)
EQUIVALENCE (A(77), NF(APS))
DATA XPAZ/1., 19.942+0.0, 2.54, 6*0./, YPAZ/1., 8.066, 0., 2.54, 6*0./
DATA X1/1., 8.24./, Y1/2*2./, X2/2*2./, Y2/1.8, 15./
ON 50 J=1, 1
X1(2)=24.
IF (A(86).GT.200000.) X1(2)=19.5
CALL GLLINE (X1, Y1, 2, XPAZ, YPAZ)
Y1(1)=Y1(2)
Y1(2)=1.8
N2=12
IF (A(86).GT.200000.) N2=3
ON 10 I=1, 17
CALL GLLINE (X1, Y1, 2, XPAZ, YPAZ)
X2X=2.
IF (A(85).GT.200000.) X2X=2.5
Y1(1)=X1(1)-X2X
Y1(2)=X1(2)-X2X
CALL GLLINE (X2, Y2, 2, XPAZ, YPAZ)
Y2(1)=Y2(2)
ON 20 I=1, 5
CALL GLLINE (X2, Y2, 2, XPAZ, YPAZ)
Y2(1)=Y2(1)-2.5
Y2(2)=Y2(2)-2.5
ON 30 I=1, 3
Y2(1)=Y2(1)-1.
Y2(2)=Y2(2)-1.
CALL GLLINE (Y2, Y2, 2, XPAZ, YPAZ)
ON 40 I=1, 2
Y2(1)=2.
Y1(1)=2.
X1(1)=1.4
Y2(1)=1.8
Y2(2)=15.
YPAZ(1)=YPAZ(1)+15.
LET JBT
END
  
```

```

C THIS SUBROUTINE PLOTS DISTANCE VERSUS HEIGHT
SUBROUTINE ZDATA(X,Y,M)
COMMON /ZAM/ A(07),B4(30)
COMMON WATE
EQUVALENC 14(77), N(1495), (A(97),WT)
DIMENSION V(100), Y(100), XPAR(10), YPAR(10)
DATA XPAR/1.,10.,2424.,0.,2540.,6*0./, YPAR/1.,8.,066.,1.,9685.,508.,6*0./
1  XPAR(3) = 0
   YPAR(3) = 0
   XPAR(4) = .7874
   XPAR(4) = 2540.
   YPAR(4) = 1.
   YPAR(4) = 5080.
   XPAR(5) = 1.
   YPAR(5) = 1.
   XPAR(6) = 1.
   YPAR(6) = 1.
   XPAR(7) = 1.
   YPAR(7) = 1.
   XPAR(8) = 1.
   YPAR(8) = 1.
   XPAR(9) = 1.
   YPAR(9) = 1.
   XPAR(10) = 1.
   YPAR(10) = 1.
2  CONTINUE
3  IF (X(1).GT.1999.) GO TO 70
   DOYLE = Y(I) - Y(I-1)
   DOYLE = ABS(DOYLE)
   IF (DOYLE.GT. 1.0) GO TO 50
   X(2) = X(M)
   Y(2) = Y(M)
   M1 = M-1
   GO TO 40
4  M1 = M + 1
   X(M1+2) = X(M)
   Y(M1+2) = Y(M)
   IF (M1.EQ.0) GO TO 60
5  CONTINUE
6  CONTINUE
   K = K + 1
7  CALL GBLINE(X,Y,K, XPAR, YPAR)
   CALL ZWATE(WATE,X(K), Y(K))
   IF (ABS(WATE-WT).LT.1.) XPAR(1) = XPAR(1)+15.
   RETURN
END
ZDATA0010
ZDATA0020
ZDATA0030
ZDATA0040
ZDATA0050
ZDATA0060
ZDATA0070
ZDATA0080
ZDATA0090
ZDATA0100
ZDATA0110
ZDATA0120
ZDATA0130
ZDATA0140
ZDATA0150
ZDATA0160
ZDATA0170
ZDATA0180
ZDATA0190
ZDATA0200
ZDATA0210
ZDATA0220
ZDATA0230
ZDATA0240
ZDATA0250
ZDATA0260
ZDATA0270
ZDATA0280
ZDATA0290
ZDATA0300
ZDATA0310
ZDATA0320
ZDATA0330
ZDATA0340
ZDATA0350
ZDATA0360
ZDATA0370
ZDATA0380
ZDATA0390
ZDATA0410
ZDATA0420
ZDATA0430

```


MAIN0570
 MAIN0580
 MAIN0590
 MAIN0600
 MAIN0610
 MAIN0620
 MAIN0630
 MAIN0640
 MAIN0650
 MAIN0660
 MAIN0670
 MAIN0680
 MAIN0690
 MAIN0700
 MAIN0710
 MAIN0720
 MAIN0730
 MAIN0740
 MAIN0750
 MAIN0760
 MAIN0770
 MAIN0780
 MAIN0790
 MAIN0800
 MAIN0810
 MAIN0820
 MAIN0830
 MAIN0840
 MAIN0850
 MAIN0860
 MAIN0870
 MAIN0880
 MAIN0890
 MAIN0900
 MAIN0910
 MAIN0920
 MAIN0930
 MAIN0940
 MAIN0950
 MAIN0960
 MAIN0970
 MAIN0980
 MAIN0990
 MAIN1000
 MAIN1010
 MAIN1020
 MAIN1030
 MAIN1040
 MAIN1050
 MAIN1060
 MAIN1070
 MAIN1080
 MAIN1090
 MAIN1100

```

XPAR(7) = 7 * CNVRT
YPAR(7) = 7.5 * CNVRT
K = 500
DO 80 I=1,4
  CALL CORE ( COREX , 20 )
  WRITE (99, 60) K , I
  CALL CORE ( COREX , 20 )
  READ (99, 70) ILZ
  FORMAT (15, I3)
70 FORMAT (244)
  CALL GTEXT ( L, 5, XPAR, YPAR)
  K = K + 500
80 YPAR(7) = YPAR(7) + 2.5 * CNVRT
  XPAR(7) = 10. * CNVRT
  YPAR(7) = 10. * CNVRT
  CALL GTEXT( DISTANCE FROM START OF TAKEOFF (1000 FT), 40,
  1) XPAR, YPAR)
  YPAR(7) = 18. * CNVRT
  XPAR(7) = 19. * CNVRT
  CALL GTEXT( PITCH ANGLE LIMIT = , 20, XPAR, YPAR)
  XPAR(7) = 22. * CNVRT
  Z77 = 94(20)
  IF (Z77.GT. 30, J877=).
  CALL CORE ( COREX , 20 )
  WRITE (99, 30) J877
  CALL CORE ( COREX , 20 )
  Z877(99, 20) IL
  CALL GTEXT( L, 4, XPAR, YPAR)
  XPAR(7) = 18. * CNVRT
  YPAR(7) = 9.5 * CNVRT
  IF ( IBLEED.GT. 1) CALL GTEXT( ENGINE BLEED OFF, 16, XPAR, YPAR)
  IF ( IRLFED.GT. 1) CALL GTEXT( ENGINE BLEED ON, 15, XPAR, YPAR)
  XPAR(7) = 15.5 * CNVRT
  YPAR(7) = 15.5 * CNVRT
  CALL GTEXT( GROSS WEIGHT (1000 LB), 22, XPAR, YPAR)
  XPAR(7) = 16.00 * CNVRT
  YPAR(7) = 11.3 * CNVRT
  CALL GTEXT( FLAPS , 16, XPAR, YPAR)
  XPAR(7) = 12.
  FORMAT (15.0)
  CALL CORE ( COREX , 20 )
  WRITE (99, 90) JFLAP , 20 )
  CALL CORE ( COREX , 20 )
  Z877(99, 20) IL
  CALL GTEXT( L, 4, XPAR, YPAR)
  XPAR(7) = 11.3 * CNVRT
  YPAR(7) = 12.5 * CNVRT
  IDEL = TEMPC - 15.
  CALL CORE ( COREX , 20 )
  WRITE (99, 10) IDEL , 20 )
  CALL CORE ( COREX , 20 )
  READ (99, 20) IDEL
  IF ( ABS(TEMPC - 15) .LT. 1. * AND. A(96).GT. 200000. )
  CALL GTEXT( STANDARD PAY , 13, XPAR, YPAR)
  
```

```

XPAR(7)= 14.3 * CNVRT
IF( ABS(TFMP) -15.) .GT. 1. .AND. A(E6).GT. 200000.)
1CALL GRTEXT( 'STANDARD PAV #', 14, XPAR, YPAR)
IF( ABS(TFMP) -15.) .GT. 1. .AND. A(86).GT. 200000.)
1CALL GRTEXT( 'DEL. #', 4, XPAR, YPAR)
XPAR(7)= 16.35 * CNVRT
YPAR(7)= 13.0 * CNVRT
CALL GRTEXT( 'ENGINES', 8, XPAR, YPAR)
XPAR(10)= 10.70 * CNVRT
YPAR(10)= 16.70 * CNVRT
CALL GRTEXT( 'ALL ENGINE FLIGHT PATH', 22, XPAR, YPAR)
XPAR(7)= 10.1 * CNVRT
YPAR(7)= 17.2 * CNVRT
CALL GRTEXT( 'MODEL', 6, XPAR, YPAR)
XPAR(7)= 11.5 * CNVRT
YPAR(7)= 13.2 * CNVRT
CALL GRTEXT( 'MODEL', 6, XPAR, YPAR)
XPAR(7)= 13.2 * CNVRT
YPAR(7)= 14.6 * CNVRT
CALL GRTEXT( 'SERIES', 8, XPAR, YPAR)
XPAR(7)= 14.6 * CNVRT
YPAR(7)= 14.6 * CNVRT
HEITE( 99, 100 ) SERIES
100 FORMAT ( 'I3)
CALL COPE ( 'COREX', 20 )
BEAT(99, 110 ) L
110 FORMAT (A4)
CALL GRTEXT( 'L', 4, XPAR, YPAR)
YPAR(10)= 2.078
XPAR(9)= 2.0 * CNVRT
YPAR(7)= 2. * CNVRT
CALL GRTEXT( 'HEADING (KNOTS)', 16, XPAR, YPAR)
XPAR(7)= 5. * CNVRT
YPAR(7)= 5.5 * CNVRT
CALL GRTEXT( 'GEOMETRIC ALTITUDE ABOVE RUNWAY (FT)', 37, XPAR,
1 YPAR)
120 RETURN
END

```

```

MAIN1110
MAIN1120
MAIN1130
MAIN1140
MAIN1150
MAIN1160
MAIN1170
MAIN1180
MAIN1190
MAIN1200
MAIN1210
MAIN1220
MAIN1230
MAIN1240
MAIN1250
MAIN1260
MAIN1270
MAIN1280
MAIN1290
MAIN1300
MAIN1310
MAIN1320
MAIN1330
MAIN1340
MAIN1350
MAIN1360
MAIN1370
MAIN1380
MAIN1390
MAIN1400
MAIN1410
MAIN1420
MAIN1430
MAIN1440
MAIN1450
MAIN1460
MAIN1470
MAIN1480
MAIN1490

```

```

C THIS SUBROUTINE LABELS WEIGHT LINES
SUBROUTINE ZWATE ( WATE, X, Y )
COMMON /TAM/ A(4), RA(36)
DIMENSION A(4), RA(36)
DIMENSION XPAR(10), YPAR(10), XPR(10), YPR(10)
DATA XPR/1.0,1.0,1.0,1.0,1.0,1.0,1.0,1.0,1.0,1.0/
DATA YPR/1.0,1.0,1.0,1.0,1.0,1.0,1.0,1.0,1.0,1.0/
* I = WATE/1000
CALL CORE ( CORE, 20 )
WRITE(09,10) WATE
FORMAT(24,10)
CALL CORE ( CORE, 20 )
FORMAT(24,10) WATE
DO 30 J = 1,10
  XPR(J) = XPAR(J)
  YPR(J) = YPAR(J)
  IF(A(36).GT.200000) AND(X.GT.35000) X=35000
  IF(A(36).LT.200000) AND(X.GT.24000) X=24000
  XPR(J) = ( X/1000. ) * ( 1./2.54 )
  YPR(J) = ( Y/2000. + 2. ) * ( 1./2.54 )
  CALL CORE ( WATE, 4, XPR, YPR )
  CALL CORE ( CORE, 5 )
  CALL CORE ( CORE, 5 )
  WATE = WATE # 1000
  WZ = ABS(WATE-WT)
  IF(ABS(WATE-WT).LT.1.) XPAR(1) = XPAR(1)+15
  IF(ABS(WATE-WT).LT.1.) NNM=NNM+1
  IF(NELAPS.EQ.NNM) YAP(1)=1
  GETJRN
END

```

```

MAIN0020
MAIN0030
MAIN0040
MAIN0050
MAIN0060
MAIN0070
MAIN0080
MAIN0090
MAIN0100
MAIN0110
MAIN0120
MAIN0130
MAIN0140
MAIN0150
MAIN0160
MAIN0170
MAIN0180
MAIN0190
MAIN0200
MAIN0210
MAIN0220
MAIN0230
MAIN0240
MAIN0250
MAIN0260
MAIN0270
MAIN0280
MAIN0290
MAIN0300
MAIN0310
MAIN0320
MAIN0330
MAIN0340
MAIN0350
MAIN0360
MAIN0370
MAIN0390

```

```

C
THIS SUBROUTINE PLOTS HEADING DATA
SUBROUTINE ZWIND(E,ZALT,IE)
COMMON /TAM/ A(97), R(4),R6)
EQUIVALENCE (A(77),NELAPS)
DIMENSION U(200),V(200),XPAR(10),VPAR(10),C(3),Y(10)
DIMENSION ZZ(4),ZW(4),E(4),IE(6)
DATA XPAP/1.,19.94,4.,0.,2540.,6*0./,YPAP/1.,8.066,1.9685,25.4,6*0./
1/2 VNN/O, EQ, 34000.,AND, A(86).GT. 200000.)VPAR(1)=XPAR(1)+ 15.
IF(7ALT.EQ.24000..AND.A(86).LT.200000.)XPAR(1)=XPAR(1)+ 15.
IF(7ALT.GE.34000..AND.A(86).GT.200000.)GO TO 50
NV=1
XPAP(3)=0
IF(A(86).GT.200000.)XPAR(3)=.7474
XPAR(4)=2540
IF(A(86).GT.200000.)XPAR(4)=5080.
DO 10 J=1,4
10 R(J)=(J-1)*(-10)
E(1)=ZALT
E(2)=IE(4)
E(3)=IE(5)
E(4)=IE(6)
CALL LSPI(F, 5, C, Y, 2, 4, YER)
X=7ALT
DO 30 I=1,60
XX=X-100.
R(NV)=C(1)+C(2)*X+C(3)*X*X
U(NV+1)=C(1)+C(2)*XX+C(3)*XX*XX
U(NV)=Y
U(NV+1)=XX
DO 20 J77=1,4
X7=8000.+(J77-1)*2000.
IF(JRS(Y7-ZALT).LT.1..AND.A(86).GT.200000.)Z7(J77)=XX
IF(R(NV).LF.-30.)
1CALL GBLINE(U, R, NV, XPAR, VPAR)
NWX=NV
IF(R(NV).LF.-30.)NV=1
IF(R(NV).LF.-30.)GO TO 40
NV=NV+2
30 X=Y-100
40 IF(7ALT.LY.13999..OR.7ALT.GT.14001.)RETURN
SUBTQC=(Z7(4)-Z7(1))/3.
R(1)=0.
R(2)=-30.
U(1)=6000.
U(2)=Z7(1)-SUBTQC
CALL GBLINE(U,R,2,XPAR,VPAR)
U(1)=4000.
U(2)=U(2)-SUBTQC
CALL GBLINE(U,R,2,XPAR,VPAR)
NWX=NWX+1
RETURN
50 IF(MIN.EQ.NELAPS)XPAR(1)=1.

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ZWIND0010
ZWIND0020
ZWIND0030
ZWIND0040
ZWIND0050
ZWIND0060
ZWIND0070
ZWIND0080
ZWIND0090
ZWIND0100
ZWIND0110
ZWIND0120
ZWIND0130
ZWIND0140
ZWIND0150
ZWIND0160
ZWIND0170
ZWIND0180
ZWIND0190
ZWIND0200
ZWIND0210
ZWIND0220
ZWIND0230
ZWIND0240
ZWIND0250
ZWIND0260
ZWIND0270
ZWIND0280
ZWIND0290
ZWIND0300
ZWIND0310
ZWIND0320
ZWIND0330
ZWIND0340
ZWIND0350
ZWIND0360
ZWIND0370
ZWIND0380
ZWIND0390
ZWIND0400
ZWIND0410
ZWIND0420
ZWIND0430
ZWIND0440
ZWIND0450
ZWIND0460
ZWIND0470
ZWIND0480
ZWIND0490
ZWIND0500
ZWIND0510
ZWIND0520
ZWIND0530
ZWIND0540

```

IF(NNN.EO.NFLAPS) NNN=0
RETIPO
END

ZWI N0550
ZWI N0560
ZWI N0570