

INM

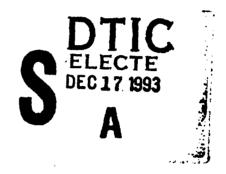
DOT/FAA/EE/93-03 DOT-VNTSC-FAA-93-19

Office of Environment and Energy Washington, DC 20591 Integrated Noise Model Version 4.11

### **User's Guide - Supplement**

Gregg G. Fleming John R. D'Aprile

John A. Volpe National Transportation Systems Center Acoustics Facility Cambridge, MA 02142-1093



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#### PREFACE

This document was prepared by the John A. Volpe National Transportation Systems Center (Volpe Center), in support of the Federal Aviation Administration, Office of Environment and Energy. It is a User's Guide for the Integrated Noise Model (INM) Version 4.11 computer software used to predict noise impact around airports. This User's Guide is a supplement to INM, Version 3, User's Guide - Revision 1, which was released in June, 1992, along with the INM Version 3.10 computer software. The Version 4.11 supplement, prepared by the Volpe Center's Acoustics Facility, presents computer system requirements as well as installation procedures and INM Version 4.11 enhancements.

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#### 1. INTRODUCTION

During June, 1992, through December, 1993, the John A. Volpe National Transportation Systems Center (Volpe Center), in support of the Federal Aviation Administration, Office of Environment and Energy, developed Version 4.11 of the Integrated Noise Model (INM). The User's Guide for the Version 4.11 computer software, prepared by the Volpe Center's Acoustics Facility, is a supplement to the Integrated Noise Model (INM), Version 3, User's Guide - Revision 1<sup>1</sup> for the Version 3.10 computer software released in June, 1992. Section 1.0 of the supplementary document presents computer system requirements and installation procedures for INM Version 4.11. Section 2.0 describes the user's implementation of several new capabilities, including descriptive examples. Appendix A describes the technical revisions made to several internal algorithms primarily revisions which are transparent to INM users. Appendices B and C, respectively, present a technical discussion of two new capabilities, the takeoff profile generator and the capability to account for airplane runup operations. Appendix D presents a copy of the INM Input Testcase, revised to reflect INM Version 4.11 enhancements. Appendix E contains a copy of the User's Manual for the WINM computer software, an INM Version 4.11 plotting program for use with Microsoft Windows.

#### 1.1 Computer System Requirements

INM Version 4.11 operates on an IBM Personal Computer (PC)-Compatible platform with the following minimum configuration:

- IBM PC-AT or compatible, Series 286 microprocessor;
- 3 MB of available hard disk space;
- 590 KB of Random Access Memory (RAM) or 3 MB of RAM, if operating the INM from a RAM disk, as discussed in Section 1.2.1 below;
- Math co-processor, Series 80287; and
- Microsoft-compatible Disk Operating System (MSDOS) Version 3.3.

In addition, the CONFIG.SYS file on the PC slated for INM Version 4.11 installation must contain the following lines: BUFFERS=30; and FILES=30.

#### 1.2 Installation

The files on the INM Version 4.11 system diskette have been stored in a compressed format using the PKZIP Version 1.1 utility software [Copyright (c) 1990 PKWare, Inc.]. With the source drive prompt displayed on the screen, execute the UNPACK batch file to install INM Version 4.11 on your PC:

#### • UNPACK <SOURCE DRIVE> <TARGET DRIVE>

For example, the command UNPACK A C will install, from the A drive, INM Version 4.11 on the C drive in a subdirectory called INM411. Note: The UNPACK batch file will, without prompting, overwrite the contents of subdirectory INM411, if one exists on the user-specified target drive.

#### 1.2.1 RAM Disk Installation

Operation of INM Version 4.11 on a RAM disk will improve computation time by an estimated 5 to 15 percent, as compared to operating it from a hard-disk drive. RAMDRIVE.SYS, an installable device driver supplied with Microsoft-compatible DOS, allows a user to configure part of the PC's RAM as if it were a hard disk (i.e., a RAM disk, sometimes referred to as a virtual disk). The following is an example installation of INM Version 4.11 onto a RAM disk. The user is referred to the DOS manual and/or the manual supplied with any memory management software being used if difficulties should occur.

To install RAMDRIVE.SYS for use with INM Version 4.11, the following command line should be included in the CONFIG.SYS file:

#### DEVICE=C:\DOS\RAMDRIVE.SYS 3000/E

Upon including the above command line in the CONFIG.SYS file, the PC must be rebooted. After rebooting, the PC will have a 3 MB RAM drive located in extended memory. The RAM drive's logical, alphabetical drive designation will be one letter higher than the highest current physical drive on the PC (e.g., if a PC has a 5% inch Adrive, a 3% inch B-drive, and a hard-disk C-drive, upon rebooting, the RAM drive will be designated the D-drive). The user may now install the INM software on the RAM drive by designating it as the target drive for installation. For example:

#### • A:\<u>UNPACK A D</u>

The above command will automatically install the INM from the A-drive onto a subdirectory (INM411) on the RAM drive (i.e., in this example the D-drive). The RAM drive must now be logically connected to the hard drive using DOS's JOIN command. To accomplish this, an empty subdirectory, e.g., C:\RAM, must be created on the hard drive. From within that subdirectory execute the following command:

• C:\RAM\<u>JOIN D: C:</u>

This will assign the RAM drive, i.e., the D-drive, to operate within the subdirectory C:\RAM on the hard drive. Note: It is extremely important to remember that each time the PC is reset or its power is turned off, the information stored on the RAM drive will be lost. As a result, i. the INM is run from the RAM drive, all files must be copied to a physical drive, e.g., a floppy drive, prior to powering-off the PC.

#### 2. IMPLEMENTATION OF INM VERSION 4.11 ENHANCEMENTS

This Section of the document describes the methodology for implementing INM Version 4.11 enhancements. It includes a background discussion of the enhancements, a brief discussion of the need for the enhancements, and example implementation of the enhancements. The following enhancements are discussed: (1) the takeoff profile generator; (2) the ability to account for terrain elevation around a specified airport; (3) the ability to compute the CNEL, WECPNL, LEQDAY, and LEQNIGHT noise metrics; (4) the ability to account for airplane runup operations; (5) the ability to account for runway thresholds during approach operations; (6) an enhancement to the noise contour computations; (7) an increase in the number of takeoff profile segments; and (8) enhancements to the echo file.

#### 2.1 Takeoff Profile Generator

This enhancement allows for the computation of airplane takeoff profiles based on the user-supplied airport elevation and temperature entry in the SETUP section of the INM input file. The takeoff profiles are utilized by the INM in the computation of all noise metrics. Previous versions of the INM utilize takeoff profiles which were based on standard-day conditions, i.e., temperature of 59°F and airport elevation of zero ft Above Mean Sea Level (MSL). Previously, the usersupplied airport elevation (altitude) and temperature were only used to compute an atmospheric acoustic impedance correction.

The takeoff profile generator is made possible by the inclusion of standardized airplane operating procedures and performance coefficients in Data Base Number 11. These procedures and coefficients are presented in References 2, 3, and 4, and accessible from the Data Base using the ACDB11.EXE computer program, supplied with the Version 4.11 release. With the exception of INM airplane numbers 1, 6, 7, 8, 10, 24, 56, 100, 101, and four of the new airplanes (INM airplane numbers 104 to 107) discussed further in Appendix A, the operating procedures and performance coefficients required for takeoff profile computation are included in Data Base Number For the airplanes without standard procedures and 11. coefficients the takeoff profile for standard conditions is assumed regardless of the airport elevation and temperature. Note: The incorporation of the takeoff profile generator will not affect the standard approach profiles. The approach profiles are the same as employed in INM Version 3.10.

Operation of the profile generator is time-efficient and entirely transparent to the user. If other than standard-day conditions are specified by the user in the SETUP portion of the input file, the profile generator automatically computes the takeoff profiles using the airplane performance coefficients in Data Base Number 11 and the equations in the Society of Automotive Engineers Aerospace Information Report 1845<sup>5</sup> (SAE/AIR 1845). When an airport elevation and temperature is not specified, the INM assumes standard conditions and utilizes the standard profiles included with Data Base Number 11, i.e., the internal profile generator will not be exercised.

To insure the takeoff profiles and resultant noise metrics computed by INM Version 4.11 are reasonable for the userdefined input case, a runway length check has been instituted. When the computed ground roll segment of the takeoff profile exceeds the user-specified runway length, the user is notified of the discrepancy. A message similar to the following is included in the echo file.

#### • WARNING: COMPUTED GROUND ROLL ERROR FOR INM AIRPLANE 747200, STAGE WEIGHT 7, -- EXCEEDS USER-DEFINED RUNWAY LENGTH BY X PERCENT FOR THE TAKEOFF ON TRACK TR1, RUNWAY 09L.

In Fight, cases this warning will indicate to the user that there is an error in the input file, possibly in the userdefined average yearly temperature, airport elevation, airport runway length, or airplane stage weight. In cases where the computed ground roll segment exceeds the runway length by more than 10 percent, the above message will be included in the echo file as a fatal error rather than a warning and the user will not be permitted to continue processing of the input case.

There may be instances where the user has correctly defined the input case and the computed ground roll segment exceeds the runway length by more than 10 percent. This apparent anomaly may be the result of using the average yearly temperature at the airport as an input. For example, a particular airport may be capable of operating a high stageweight B747 airplane in the early evening or during winter months only, when the temperature is significantly lower than the average yearly temperature. In such cases it is suggested that a user-defined profile be included in the input file.

In addition, there may be instances (e.g., high stage weights, high temperatures, and high airport elevations combined) where a negative rate-of-climb is computed. Consequently, a fatal error will occur and a profile will not be generated. In such instances, the user will be notified with a message similar to that below; it is suggested that a user-defined profile be included in the input file.

## • FATAL: PROFILE FOR INM AIRPLANE 747200, STAGE WEIGHT 7 CANNOT BE COMPUTED.

A technical discussion of the takeoff profile generator is presented in Appendix B. In addition, Appendix B presents tables which summarize the runway requirements and operational boundaries of the profile generator. These tables are presented for various combinations of airport elevation and temperature intended to cover the range of average yearly conditions at airports across the United States.

#### 2.2 Terrain Elevation

This user-selectable enhancement included with INM Version 4.11 allows for the computation of source-to-receiver slant range, i.e., propagation distance, based upon actual terrain elevation at receiver locations around a specified airport. The implementation of this enhancement can result in a vast improvement in the accuracy of the noise computations at hilly airports located near terrain, however its implementation will result in an increase in computation time by an estimated 50 to 100 percent. To utilize this enhancement, INM Version 4.11 users must have the United States Geological Survey (USGS) 3 Arc Second Elevation Data on CD-ROM, available from:

> Rocky Mountain Communications, Inc. (RMC) 2023 Montane Drive East Golden, CO 80401 (303) 526-5454 (303) 526-2662 (FAX)

The USGS data are available for the entire United States or parts thereof.

Prior to implementing the elevation enhancement within INM Version 4.11, the preprocessing program, MAKEFILE.EXE, which is included with the Version 4.11 distribution package, must be run on the RMC Digital Elevation Model (DEM) files. MAKEFILE.EXE constructs a 2.8 MB, one-degree by one-degree, geodetic data file with the user-specified airport located at the geographic center of the file. The file generated by MAKEFILE.EXE, which has a three-letter user-defined prefix and a .3CD extension (e.g., Boston's Logan International Airport might be designated BOS.3CD), will be used by INM Version 4.11 to compute the source-to-receiver slant range. Use of the MAKEFILE.EXE program is described below.

With the drive prompt displayed on the screen, type MAKEFILE to invoke the program.

#### • C:\INM411\ <u>MAREFILE</u>

MAKEFILE.EXE will then prompt the user to enter a three-letter airport identification, e.g., BOS, and the latitude and

longitude of a reference point at the airport (e.g., the beginning of the primary runway). In the following example the latitude and longitude are for the start of Runway 09L at Boston-Logan.

- ENTER 3 LETTER AIRPORT IDENTIFIER (EX. BOS): BOS
- ENTER RUNWAY LAT COORD. DEGS MINS SECS (EX. 42 21 20): 42 21 20
- ENTER RUNNAY LON COORD. DEGS MINS SECS (EX. 71 00 48): 71 00 48

The MAKEFILE.EXE program then computes the coordinates of the southeast corner of a one-degree by one-degree data-block based upon the start of the airport's primary runway being at the geographic center of the block. The computed southeast corner is displayed along with the four RMC DEM files required to construct the one-degree  $L_f$  one-degree data-block around the airport. The user is also given the option to overwrite an existing or create a new BOS.3CD file, where BOS is the three-letter airport identifier.

- THE SE CORNER OF THE REQUIRED (1X1 DEG) DATA BLOCK IS: 41 52 70 31
- THE REQUIRED DEM FILES ARE: NW FN=42071.3CD NE FN=42070.3CD SW FN=41071.3CD SE FN=41070.3CD
- DO YOU WISH TO CREATE A NEW BOS.3CD FILE (Y/N) ? Y

The user should type  $\underline{\mathbf{Y}}$  to overwrite/create a new file. If the four DEM files exist in the current directory, the program will create the BOS.3CD file without further prompting. If MAKEFILE.EXE cannot find the required DEM files, it will request that the user enter the drive where the DEM files are resident. In addition, MAKEFILE.EXE will ask if the data are on the RMC CD-ROM and, if so, copy them into the current directory. If the four DEM files are not on the CD-ROM drive, MAKEFILE.EXE will request the path where the files can be The program will then construct the required onefound. degree by one-degree data-file, with the airport's primary runway at its approximate geographic center. The user will be informed that the file has been constructed, and the minimum and maximum elevation within the constructed one-degree by one-degree block will be provided.

#### • WRITING OF BOS.3CD IS COMPLETE

The example BOS.3CD file is now ready for implementation by the INM. To utilize the elevation data in the BOS.3CD file in the computation of source-to-receiver slant range, the user must specify, in the SETUP portion of the INM input file: (1) the three-letter airport code which identifies the specific user pre-processed .3CD file; (2) the disk-drive location of the .3CD file (Note: It is not necessary to specify the location of the .3CD file if it is in the current directory; also, if the .3CD file resides in a subdirectory, the path to that subdirectory must be created prior to running INM.); and (3) the latitude and longitude of a user-defined reference point at the airport, where the X and Y coordinates of all defined runways must be referenced to this point. To insure that the user has identified the appropriate .3CD file, the INPUT.EXE program will test the user-defined reference point at the airport against the stored reference in the .3CD file.

In the following example the user has: (1) specified Boston's Logan International Airport; (2) identified the C-drive as the location for the BOS.3CD file; and (3) specified the latitude and longitude of a reference point at Boston-Logan.

• SETUP:

#### TITLE <EXAMPLE IMPLEMENTATION OF ELEVATION ENHANCEMENT> AIRPORT <ELEVATION EXAMPLE>

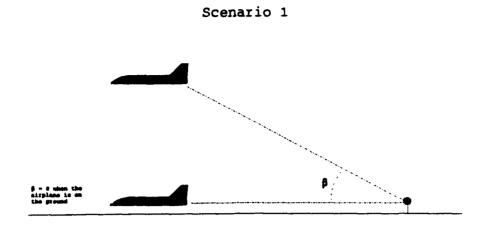
CODE BOS DRIVE C LATITUDE 42 21 20 LONGITUDE 71 00 48

With the elevation enhancement invoked as described above, all noise-level computations are performed based upon the actual source-to-receiver slant range, rather than assuming a flat terrain as was the case in previous versions of the INM.

In addition, the data in the BOS.3CD file are used to compute the slope of a three-by-three arc-second tangential ground plane, with the receiver at its physical center. This ground plane is used in the computation of the source-to-receiver elevation-angle, beta, required by the lateral attenuation algorithm in the INM. The beta angle is defined as the angle subtended by the propagation path from the airplane to the receiver and the three-by-three arc-second ground plane. Figures 2-1 and 2-2, respectively, depict the beta angle for two scenarios: (1) previous versions of the INM (i.e., flat terrain); and (2) INM Version 4.11.

#### 2.3 CNEL, WECPNL, LEQDAY, and LEQNIGHT Noise Metrics

The capability to compute four additional noise metrics has been included in INM Version 4.11. They are the Community Noise Equivalent Level (CNEL), Weighted Equivalent Continuous Perceived Noise Level (WECPNL), Equivalent Sound Level During Daytime Hours (LEQDAY), and Equivalent Sound Level During Nighttime Hours (LEQNIGHT). The addition of these four metrics brings the total number of metrics available for computation by the INM to eight (NEF, LEQ, LDN, TA, CNEL, WECPNL, LEQDAY, and LEQNIGHT). As was the case in previous



# FIGURE 2-1: BETA ANGLE FOR INM VERSION 3.10 AND BEFORE

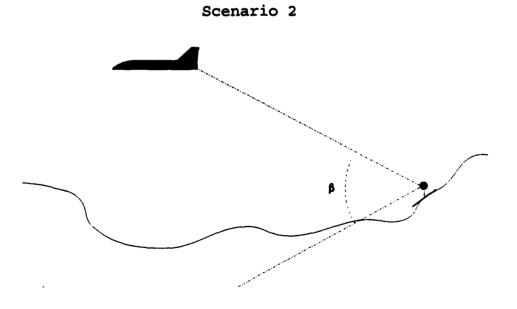


FIGURE 2-2: BETA ANGLE FOR INM VERSION 4.11

versions of the INM, Version 4.11 allows for the computation of all metrics simultaneously in grid mode or a single userdefined metric in contour mode for a given input case. A brief description of the CNEL, WECPNL, LEQDAY, and LEQNIGHT noise metrics follows:

(1) <u>Community Noise Equivalent Level (CNEL)</u>: The CNEL noise metric, which is primarily used in California, is similar to the Day-Night Sound Level (LDN) metric in that it incorporates the energy-averaged A-weighted sound level integrated over a 24-hour period. However, unlike LDN, CNEL incorporates an additional penalty for operations occurring between the evening hours of 1900 and 2200 hours. For CNEL, a 3 dB penalty is applied to operations occurring between 1900 and 2200 hours, and a 10 dB penalty is applied to operations occurring between 2200 and 0700 hours. The equation for computing CNEL within the INM is as follows:

CNEL =	: SEL + 1	010g10	$(N_{day} + 3N_{eve} + 10N_{night}) - 49.4,$
where	SEL	=	Sound Exposure Level in dBA;
	N <sub>day</sub>	×	number of operations between 0700 and 1900 hours local time;
	N <sub>eve</sub>	=	number of operations between 1900 and 2200 hours local time;
	N <sub>night</sub>	=	number of operations between 2200 and 0700 hours local time;
and	49.4	=	<pre>constant which normalizes CNEL to a 24-hour period, (i.e., 10log<sub>10</sub>(1/86,400 sec/day) = -49.4).</pre>

(2) <u>Weighted Equivalent Continuous Perceived Noise Level</u> <u>(WECPNL)</u>: The WECPNL noise metric, which is primarily used by the European Community, is based upon the PNLT noise metric and is computed within the INM as follows:

WECPNL = EPNL +  $10\log_{10}(N_{day} + 3N_{eve} + 10N_{night}) - 39.4$ ,

where all definitions are the same as in CNEL, above, except:

- EPNL = Effective Perceived Noise Level in dB; and
- 39.4 = (49.4 10); where 49.4 is the constant which normalizes WECPNL to a 24-hour period,

(i.e.,  $10\log_{10}(1/86,400 \text{ secs/day}) = -49.4$ ); and -10 is the duration normalizing factor in the definition of EPNL.<sup>6</sup>

(3) Equivalent Sound Level During Daytime Hours (LEODAY): The LEQDAY noise metric is an energy summation of the aggregate environment, as measured in A-weighted decibel units (dBA) normalized to the 15-hour time period from 0700 to 2200. The equation for computing LEQDAY within the INM is as follows:

 $LEQDAY = SEL + 10log_{10}(N_{day} + N_{eve}) - 47.3,$ 

where all definitions are the same as in CNEL, above, except:

- 47.3 = constant which normalizes LEQDAY to the 15-hour period from 0700 to 2200, (i.e.,  $10\log_{10}(1/54,000 \text{ sec}) = -47.3$ ).
- (4) Equivalent Sound Level During Nighttime Hours (LEONIGHT): The LEQNIGHT noise metric is an energy summation of the aggregate environment, as measured in A-weighted decibel units (dBA) normalized to the 9-hour time period from 2200 to 0700. The equation for computing LEQNIGHT within the INM is as follows:

LEQNIGHT = SEL +  $10\log_{10}(N_{night}) - 45.1$ ,

where all definitions are the same as in CNEL, above, except:

45.1 = constant which normalizes LEQNIGHT to the 9-hour period from 2200 to 0700, (i.e.,  $10\log_{10}(1/32,400 \text{ sec}) = -45.1$ ).

#### 2.4 Airplane Runup Operations

This enhancement allows INM Version 4.11 to compute noise levels due to airplane engine runup operations. The need for this particular enhancement is recognized primarily around airplane maintenance facilities. To invoke this capability the user must define an airplane runup in the TAKEOFF section of the input file as follows:

> INT.NM. Tareoffs by frequency:

> > TRACK RU1 RWY 09L STRAIGHT 50
> >
> >
> >  OPERATION 747200 RUNUP 1 D=30
> >
> >
> >  OPERATION 747200 STAGE 4 D=80
> >
> >
> >  <0R>
> >
> >
> >  OPERATION 747200 STAGE 4 D=80 RUNUP 1 D=30

In the above example, a 30 second (D=30) runup operation is defined for a B747-200 airplane operation at the thrust setting of Stage Weight 1. The runup, as specified, takes place on a runway designated as 09L and a track designated as RU1. STRAIGHT 50 defines the length of the track in nautical miles. In fact, the track length for runup operations is ignored in the computation of runup noise. For runup noise computations it is assumed that the airplane covers a track with an arbitrarily chosen fixed length of 20 ft. The specific location and heading of the runup operation in the above example must be defined in the RUNWAYS section of the input file as shown in the following:

#### RUNWAYS

#### RW 09L-27R 0 0 TO 9487 -497

In the above example, the runup operation takes place at the start of an active runway, i.e., Runway 09L. If the user wants to define a runup operation at a location at the airport other than on an active runway, e.g., at a maintenance facility, then the maintenance facility must be defined as if it were a runway. Here it is suggested that a maintenance facility, or any other location specified for a runup operation, be defined as a runway which is 20 ft in length. The definition of a maintenance facility as a 20 ft runway is shown in the following example.

• RUNWAYS RW 13-31 0 5000 TO 20 5000

The above runup definitions assume that the full-power takeoff thrust associated with the user-defined stage weight is maintained for the duration of the runup. However, runup operations can occur at other than full-power thrust. To model such instances, a user-defined runup should be included in the input file as follows:

• AIRCRAFT: Types AC 747200 STAGE 1<u>=RU</u>

PROFILES	s takeoff				
PF RU	SEGMENTS=	<u>3 WEIG</u>	HT=525	000	ENGINES=4
DIST	NCES	<u>0</u>	10	20	
ALTIT	TUDES	<u>0</u>	Ō	<u>0</u>	
SPEEL	08	<u>160</u>	160	160	<u>)</u>
THRUS	STS	<u>35022</u>	35022		_

INT.NM. TAKEOFFS BY FREQUENCY:

TRACK RU1 RWY 09L STRAIGHT 50 OPERATION 747200 RUNUP 1 D=30 In addition, the specific location, e.g., the start of a runway or at a maintenance facility, and heading of the runup operation in the above user-defined example must be specified in the RUNWAYS section of the input file as discussed earlier in this section. A technical discussion of the airplane engine runup capability is presented in Appendix C.

#### 2.5 Approach Runway Thresholds

The capability to account for displaced runway thresholds for approach operations has been added to INM Version 4.11. In previous versions of the INM, the runway touch-down point was assumed to be a fixed 954 ft from the edge of the runway for airplanes with a three degree approach glide slope, and 572 ft for the four airplanes with a five degree approach glide slope (INM airplane numbers 74 to 77). With INM Version 4.11, a user-defined displaced threshold (DT), either positive or negative, is added to the fixed runway touch-down point. To insure realistic DT's are defined by the user, they are If discrepancies checked versus the runway coordinates. exist, the user is notified in the echo file, as appropriate. In the following example, a 1454 ft runway touch-down point has been defined in the SETUP section of the input file for Runway 09L (i.e., 500 ft for the user-defined DT plus 954 ft for the fixed touch-down point); and a runway touch-down point or 954 ft has been defined for Runway 27R:

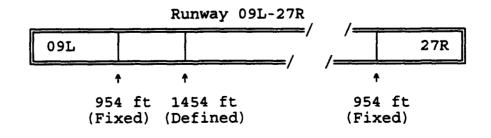
SETUP:

TITLE <EXAMPLE IMPLEMENTATION OF APPROACH RUNWAY THRESHOLD> AIRPORT <RUNWAY THRESHOLD EXAMPLE>

ALTITUDE 23 TEMPERATURE 12.66 C

RUNWAYS RW 09L-27R 0 0 <u>DT 500</u> TO 9487 -497 <u>DT 0</u> <OR> RW 09L-27R 0 0 <u>DT 500</u> TO 9487 -497

The above runway definition is depicted graphically below:



#### FIGURE 2-3: RUNWAY DEFINITION

The inclusion of the 500 ft user-defined DT results in a runway touchdown point 1454 ft from the start of Runway 09L (i.e., 500 ft for the user-defined DT plus 954 ft for the fixed touch-down point).

#### 2.6 Noise Contour Computations

INM Version 4.11 provides, in the echo file, a warning to users when there are insufficient grid points to accurately compute a specific noise contour. In previous versions, the INM would automatically make the determination that there were insufficient grid points, and return a run-time error to the computer display without further explanation. The INM's noise computation window must be redefined to encompass additional grid points in the area of interest.

If the user-defined computational window is too coarse to allow computation of a requested contour or the requested contour is not encompassed by the window, INM Version 4.11 will include a message in the echo file which is similar to the following:

•	Contour Level	CONTOUR AREA (SQ. MILES)

#### CN 3 \*WARNING: LDN 30.0 CONTOUR DOES NOT EXIST

In the above example, the defined window was either too coarse to reliably compute the user-requested 30 dB LDN contour or the contour was not encompassed by the window.

#### 2.7 Takeoff Profile Segments

INM Version 4.11 provides for user-defined takeoff profiles with up to 18 segments. Previous versions of the INM limited the number of segments to 14. This enhancement allows for more precise user-defined takeoff profiles. It will also more easily facilitate the incorporation of a flight-procedure generator planned for a future version of the INM, since certain procedures may require higher resolution profiles, and thus more segments.

#### 2.8 Echo File

All output reports generated by INM Version 4.11 have been modified to account for the enhanced capabilities discussed in Section 2.0, above.

#### 3. **REFERENCES**

- <sup>1</sup> Flythe, M.C., <u>Integrated Noise Model Version 3. User's Guide -</u> <u>Revision 1</u>, Report No. DOT/FAA/EE-92/02, Arlington, VA: CACI, Inc. - Federal, June 1992.
- <sup>2</sup> Bishop, D.E., Mills, J.F., <u>Update of Aircraft Profile Data for</u> <u>the Integrated Noise Model Computer Program, Volume 1</u>, Report No. FAA-EE-91-02, Canoga Park, CA: Acoustical Analysis Associates, Inc., March 1992.
- <sup>3</sup> Bishop, D.E., Mills, J.F., <u>Update of Aircraft Profile Data for</u> <u>the Integrated Noise Model Computer Program, Volume 2</u>, Report No. FAA-EE-91-02, Canoga Park, CA: Acoustical Analysis Associates, Inc., March 1992.
- Bishop, D.E., Mills, J.F., <u>Update of Aircraft Profile Data for</u> <u>the Integrated Noise Model Computer Program, Volume 3</u>, Report No. FAA-EE-91-02, Canoga Park, CA: Acoustical Analysis Associates, Inc., March 1992.
- <sup>5</sup> <u>Procedure for the Calculation of Airplane Noise in the</u> <u>Vicinity of Airports</u>, SAE/AIR 1845, Warrendale, PA: Society of Automotive Engineers Committee A-21, Aircraft Noise, 1986.
- <sup>6</sup> <u>Federal Aviation Regulations, Part 36, Noise Standards:</u> <u>Aircraft Type and Airworthiness Certification</u>, Washington, D.C.: Federal Aviation Administration, December 1988.

#### APPENDIX A

#### **REVISIONS TO INM ALGORITHMS**

This Appendix discusses, in general terms, revisions to several algorithms and subroutines included in INM Version 4.11. It also discusses the rationale for these revisions and presents their effects on the noise contours, where applicable. The associated computer source code is not included. All revisions discussed below are transparent to the user in that they do not affect useroperation of the INM. However, these revisions will result in more accurate INM noise predictions and an increase in INM computational efficiency. They include: (1)revisions to the flight significance testing within the INM; (2) implementation of a directivity smoothing equation; (3) revisions to the dipole directivity pattern within the INM; and (4) revisions to the INM Data Base.

#### A.1 Flight Significance Testing

The methodology employed for determining flight noise significance during grid computations has been streamlined in INM Version 4.11. Rather than looping through each of the first four refinement levels individually and constructing the noise grid on a level-bylevel basis, INM Version 4.11 begins by constructing the 17-by-17 point regular grid previously associated with the fourth refinement level, and setting all parameters associated with the 289 total points, including the noise significance flags for each point.

In restructuring the flight significance methodology, it was discovered that INM Version 3.10 was performing unnecessary (i.e., insignificant) noise computations due to improper setting of the flight significance flags. This impropriety had no effect on the computed noise levels but it did increase run-time unnecessarily. Revising the methodology for grid development, including the proper setting of flight significance flags, improved computation time by an estimated 40 percent over INM Version 3.10, for comparable input cases.

#### A.2 Directivity Smoothing Equation

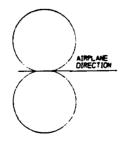
The directivity algorithm of SAE/AIR 1845 implemented for receivers behind start-of-takeoff roll, which is based on field-measured data published in 1980, has been maintained within INM Version 4.11. However, a directivity smoothing equation, operating as a function of distance, has been implemented. In previous versions of the INM, the directivity algorithm is applied to noise levels behind start-of-takeoff-roll regardless of lateral distance. In the 1980 study, measurements were made at distances from start-of-takeoffroll of only 970 to 1280 ft. Recent studies<sup>6,7</sup> have indicated that INM Version 3.10 tends to underpredict noise levels behind startof-takeoff-roll at distances of 3000 to 5000 ft, well beyond those represented in the 1980 study. This underprediction was especially evident for measurements made directly behind the airplane where the reduction in noise level due to the directivity algorithm is most pronounced.

As a result, an equation has been incorporated into INM Version 4.11 which smooths out the directivity effect as a function of distance behind the airplane, beginning at a distance of 2500 ft. The smoothing algorithm reduces the directivity effect in decibels by a factor of 50 percent per doubling of distance behind the airplane, beginning at a distance of 2500 ft. For example, a noise level attenuation of 10 dB computed by the directivity algorithm at a distance of 2500 ft will be reduced to 5 dB at 5000 ft due to the smoothing equation.

The smoothing equation built into INM Version 4.11 was empirically and conservatively derived from the data of Reference 6, the more detailed study of the two cited above. However, it is strongly recommended that additional measurments behind start-of-takeoffroll be performed at a variety of offset distances and azimuth angles at several sites across the country to fine-tune the smoothing equation.

#### A.3 Dipole Directivity Pattern

The 90° dipole directivity pattern was originally instituted within the INM as a means of approximating the directivity characteristics Although the exact directivity of an airplane in flight. characteristics are a function of parameters such as airplane type, power setting, speed, and distance, the dipole model has served as a reasonable approximation. In INM Version 4.11, the 90° dipole directivity pattern has been modified. Figures A-1 and A-2 depict the dipole directivity pattern of INM Version 3.10 and earlier modified pattern of INM Version 4.11, and the versions, For INM Version 4.11, the original dipole respectively. directivity directly in front of and behind the airplane has been In addition, the directivity algorithm of SAE/AIR suppressed. 1845, with the addition of the smoothing equation discussed in Section A.2 above, is applied behind the airplane for <u>all</u> modes of operation. See Appendix C for a discussion of the appropriateness of the modified directivity pattern for runup operations.





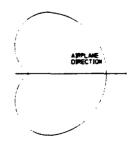
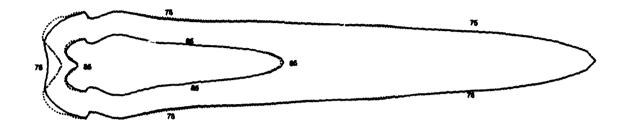


FIGURE A-2: MODIFIED DIRECTIVITY PATTERN, INM VERSION 4.11

The effect of the modified directivity pattern on the noise contours is depicted in Figures A-3 and A-4, below. Figure A-3 shows the effect on the SEL footprint for a single takeoff operation of the B737-200 airplane (INM number 47). Figure A-4 shows the effect on the LDN contour for the INM Input Testcase provided with INM Version 3.10.



----- INM VERSION 3.10 AND BEFORE INM VERSION 4.11

FIGURE A-3: SEL TAKEOFF FOOTPRINT COMPARISON FOR B737-200 AIRPLANE

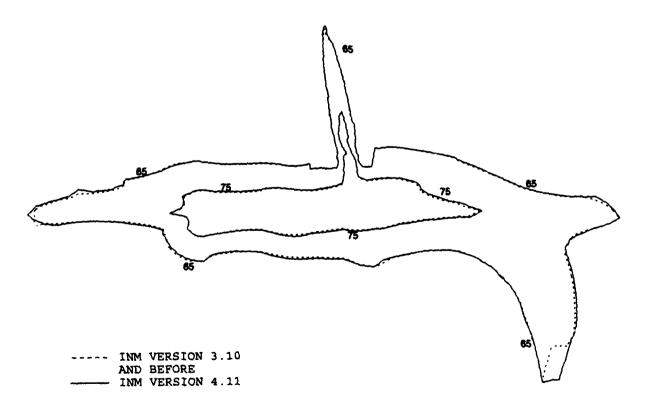


FIGURE A-4: LDN CONTOUR COMPARISON FOR INM INPUT TESTCASE

#### A.4 Data Base Number 11

Data Base Number 11 has been created through modifications, consisting primarily of the removal of artifacts from previous versions of the Data Base, and the addition of six new airplanes. As discussed in Section 2.1, Data Base Number 11 was expanded to include airplane performance coefficients and standard flight procedures required for use with the takeoff profile generator. With the exception of INM airplane numbers 1, 6, 7, 8, 10, 24, 56, 100, 101, and four of the new airplanes discussed below, procedures and coefficients required for profile generation are included in the Data Base. For those airplanes without standard flight procedures and coefficients, the takeoff profile for standard conditions is utilized regardless of airport elevation and temperature.

In addition, six new airplanes have been added to Data Base Number 11 (See Table A-1). They include the MD11 with the CF6-80C2D1F and PW4460 engines (INM numbers 102 and 103, respectively), the F-16A with the F100-PW-200 engine (INM number 104), and the F-16C/D with the F110-GE-100, F100-PW-220, and F100-PW-229 engines (INM numbers 105, 106 and 107, respectively). The Noise-Power-Distance (NPD) data, standard-day profiles, performance coefficients and standard flight procedures included in the Data Base for the MD11 airplanes were obtained from the McDonnell Douglas Corporation.

The Volpe Center extracted the NPD data for the F-16 airplanes from the United States Air Force's (USAF) data base which is part of their NOISEMAP suite of computer programs. NOISEMAP, the military counterpart of the INM, is used for predicting noise exposure around airports dominated by military operations. The USAF data were normalized to an airspeed of 160 knots and adjusted for the effect of duration consistent with the procedures for developing the INM data base. The standard-day profiles, which are the same for the four F-16 airplanes, were also extracted from the USAF's data base. They are considered typical for transient F-16 airplanes. However, due to significantly varying takeoff procedures for F-16 airplanes throughout the world a user-defined takeoff profile may be more appropriate.

			Category		oise	hannh		Takeo	ff Profi	les by T	rip Leng	th (mm)	
	Name	irplane	Name		Name	Apprh	0- 500	500- 1000	1000-	1500-2500	2500-	3500-	over
	[	Description	4								3500		4500
102	MD11GE	MD-11/CF6-80C2D1F	JCOM	68	2CF68D	102	374	375	376	377	378	379	380
103	MT .1PM	MD-11/PW 4460	JCOM	69	PN4460	103	381	382	383	384	385	386	387
104	<b>P16</b> λ	F-16A/PN-200	JMIL	70	PW200	104	388	0	0	0	0	0	0
105	F16GE	F-16C/D/GE-100	JMIL	71	GE100	105	389	0	0	0	0	0	0
106	F16PW0	F-16C/D/PW-220	JMIL	72	PW220	106	390	0	0	0	0	0	0
107	P16PW9	P-16C/D/PW-229	JMIL	73	PW229	107	391	0	0	0	0	0	0

#### TABLE A-1: INM VERSION 4.11 DATA BASE AIRPLANE DEFINITIONS

#### A.5 References

- <sup>1</sup> Horonjeff, R.D., <u>Analysis of Aircraft Noise Levels in the</u> <u>Vicinity of Start-of-Takeoff Roll at Baltimore-Washington</u> <u>International Airport</u>, Report No. FAA-EE-92-01, Lexington, MA: Harris Miller Miller & Hanson Inc., May 1992.
- Brown-Buntin Associates, "Letter Report, Noise Contour Adjustments - McCarran International Airport, Las Vegas -Unpublished Data", August 1993.

#### APPENDIX B

#### TAKEOFF PROFILE GENERATOR

This Appendix presents a technical discussion of the takeoff profile generator within INM Version 4.11. The discussion, based on the algorithms of SAE/AIR 1845 and the aerodynamic coefficients and standard flight procedures in Data Base Number 11, is presented in two sections. The first section describes the computation of individual takeoff profile segments under standard conditions, i.e., airport temperature of 59°F and airport elevation of zero ft Above Mean Sea Level (MSL). The second section describes the computation of individual takeoff profile segments under nonstandard conditions.

The horizontal distance and altitude increments computed for each acceleration segment at standard conditions are utilized for segment computations at non-standard conditions. In fact, the altitude Above Ground Level (AGL) at the end point of each segment is the same for the non-standard and standard profiles. However, for the non-standard case, the ground roll length of the takeoff segment and the flight angles of the airborne segments are modified in response to the user-defined airport conditions using the equations described below. The non-standard computations are achieved by: (1) an introduction of a specially developed routine for computation of atmospheric coefficients at a given altitude MSL as a function of the airport temperature and elevation; and (2) development of a routine for the automated adjustment of the rateof-climb for acceleration segments due to atmospheric conditions. With the atmospheric coefficients and the rates-of-climb controlled by the user-defined airport elevation and temperature, the SAE equations remain intact.

The takeoff profile generator has been tested for non-standard temperatures from -10 to 100°F and airport elevations up to 6000 ft MSL. Accordingly, the third section of this Appendix presents a set of tables which summarize the runway requirements and operational boundaries of the takeoff profile generator for various combinations of airport elevation and temperature (Tables B-1 through B-9).

#### B.1 Standard Conditions (15°C, Zero ft MSL)

This section describes the computation of a standard-condition takeoff profile on a segment-by-segment basis. The Subscripts 1 and 2 refer to the beginning and end of the segment, respectively. The following definitions, constants, and ratios apply to all computations described herein:

Gravitational Constant:	g	2	32.17
Thermal Gas Constant:	R <sub>c</sub>	=	1716.2
Temperature Lapse Rate:	L	=	0.003566 °F/ft or °R/ft

Standard Temperature, °F:	$T_{fap}$	=	T <sub>f0</sub>	=	59.0
Standard Temperature, °C:	$T_{cap}$	*	T <sub>c0</sub>	=	15.0
Standard Temperature, °R:	T <sub>rap</sub>	*	T <sub>r0</sub>		518.67
Temperature Ratio:	THETA	-		ude M	$[\Gamma_{r0}]$ , where $H_x$ is the USL for segment
Pressure Ratio:	DELTA		THETA	[g/((Rc)(I	911
Density Ratio:	SIGMA	=	THETA	[(g/((Rc))	L)))-1]
Airport Elevation MSL:	H <sub>ap</sub>	*	0.0 f	t	
Brake Release Gross Weight		*	W		
Number of Engines supplying Thrust		=	N		

#### GROUND ROLL SEGMENT

For the ground roll segment the following apply:

Airport Temperature:	T <sub>c1</sub>	=	T <sub>c2</sub>	=	T <sub>cap</sub>
Pressure Altitude MSL:	H <sub>1</sub>	=	H2	=	Hap
Initial Calibrated Airspeed:	V <sub>c1</sub>		16.0	kts	

Given the above, the remaining parameters for the ground roll segment are computed as follows:

Initial Thrust:	Th <sub>1</sub>	-	$E + F(V_{c1}) + G_1(H_1) + G_2(H_1)^2 + H(T_{c1})$
Final Calibrated Airspeed:	V <sub>c2</sub>	=	(C) (W) <sup>±</sup>
Final Airplane True Speed:	V <sub>t2</sub>	=	V <sub>c2</sub> /(SIGMA) <sup>×</sup>
Final Thrust:	$Th_2$	=	$E + F(V_{c2}) + G_1(H_2) + G_2(H_2)^2 + H(T_{c2})$
Segment Horizonta Length:	l S <sub>g</sub>	=	[(B) (THETA) (W/DELTA) <sup>2</sup> ]/[(N) Th <sub>2</sub> ]

where E, F, G<sub>1</sub>, G<sub>2</sub>, and H are engine-dependent coefficients from Data Base Number 11 for maximum takeoff thrust mode;

C is a coefficient from Data Base Number 11 which is appropriate to the takeoff flap/slat setting;

B is a coefficient from Data Base Number 11 which is appropriate to a specific airplane/flap-deflection combination, and varies only with the takeoff flap/slat setting; and

SIGMA, THETA, and DELTA, defined above, are constants equal to 1 at sea level.

#### CLIMB SEGMENT

For climb segments the following apply:

Initial Calibrated Airspeed:	V <sub>c1</sub> =	$V_{c2}$ of the previous segment
Final Calibrated Airspeed:	V <sub>c2</sub> =	V <sub>e1</sub>
Initial Thrust:	$Th_1 =$	$Th_2$ of the previous segment
Initial Temperature:	T <sub>c1</sub> =	$T_{c2}$ of the previous segment
Initial Pressure Altitude MSL:	H1 =	$H_2$ of the previous segment
Final Segment Altitude AGL:	Alt <sub>end</sub> =	As specified in the standard flight procedues

Given the above, the remaining parameters for the climb segment are computed as follows:

Final Segment Altitude MSL: Altand + Hap H<sub>2</sub> = Average Segment Havy  $0.5(H_1 + H_2)$ Altitude: = Final Segment  $[(T_{fap} - L(H_2)) - 32](5/9)$ Temperature: T<sub>c2</sub> -Average Segment  $[(T_{fap} - L(H_{avg})) - 32](5/9)$ T<sub>cavg</sub> Temperature: Average Calibrated  $V_{c1} = V_{c2}$ Airspeed: V<sub>cavg</sub> = Average Segment  $E + F(V_{cavg}) + G_1(H_{avg}) + G_2(H_{avg})^2 + H(T_{cavg})$ Thrust:  $Th_{avg} =$ Average Airplane W/{ [THETA] (g/((Rc)(L)))} Wavg Weight: = Sine of the  $k\{[(N) (Th_{avg}/W_{avg})] - R\}$ Flight Angle: SIN<sub>sag</sub> = 1.01 for  $V_{cavg} \le 200;$  and 0.95 for  $V_{cavg} > 200$ where k Cosine of the Flight Angle:  $(1 - SIN_{ang}^2)^{\frac{1}{4}}$  $COS_{ang} =$ Horizontal Segment  $(H_2 - H_1) / (SIN_{ang}/COS_{ang})$ Distance: S, Final Segment  $E + F(V_{c2}) + G_1(H_2) + G_2(H_2)^2 + H(T_{c2})$ Thrust: Th, = Final True  $V_{c2}/(SIGMA)$  \* V<sub>t2</sub> \* Speed: E, F,  $G_1$ ,  $G_2$ , and H are engine-dependent coefficients from Data where

Base Number 11 for the thrust mode defined in the standard takeoff procedure; and

R is a coefficient from Data Base Number 11 which is the nondimensional ratio of the airplane's drag coefficient to lift coefficient for a given flap setting and airplane configuration. The landing gear is assumed to be retracted.

#### ACCELERATION SEGMENT

ia j

For acceleration segments the following apply:

Initial Calibrated Airspeed:	V <sub>c1</sub>	*	$V_{c2}$ of the previous segment
Initial Airplane True Speed:	V <sub>t1</sub>	*	$V_{t1}$ of the previous segment
Initial Thrust:	Th	-	Th <sub>2</sub> of the previous segment
Initial Temperature:	T <sub>c1</sub>	=	$T_{c2}$ of the previous segment
Initial Pressure Altitude MSL:	H1	-	$H_2$ of the previous segment
Final Calibrated Airspeed:	V <sub>c2</sub>	=	As specified in the standard flight procedure
Rate-of-Climb:	V <sub>tx</sub>	-	As specified in the standard flight procedure

Given the above, computation of the remaining parameters is performed using an iterative procedure to arrive at the altitude increment, DelH. If the difference between DelH and DelH<sub>c</sub> (the computed altitude increment for the current iteration) is greater than one ft, DelH is set equal to DelH<sub>c</sub>, and the iterative process is repeated until a difference of one ft or less is achieved.

Initial A	lssumed			
Altitude	Increment:	DelH	*	250 ft

Start of Iterative Loop:

Final Segment Altitude MSL:	H <sub>2</sub>	#	H <sub>1</sub> + DelH
Final Segment Temperature:	T <sub>c2</sub>	=	$\{ [T_{fap} - L(H_2)] - 32 \} (5/9)$
Final True Speed:	V <sub>t2</sub>	=	V <sub>c2</sub> /(SIGMA) <sup>¥</sup>
Final Segment Thrust:	$Th_2$	=	$E + F(V_{c2}) + G_1(H_2) + G_2(H_2)^2 + H(T_{c2})$
Average Segment Thrust:	Th <sub>avg</sub>	=	0.5(Th <sub>1</sub> + Th <sub>2</sub> )
Average True Speed:	V <sub>tavg</sub>	=	$0.5(V_{t1} + V_{t2})$

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Average Segment Havg Altitude:  $H_1 + 0.5DelH$ Average Airplane  $W \{ [THETA]^{(g/((Rc)(L)))} \}$ Weight: Waye Sine of the Flight Angle:  $V_{tx}/(101.2686V_{tawn})$ SIN<sub>ang</sub> = Flight Angle: GAMMA = arcsin(SIN<sub>ang</sub>)  $0.042062(V_{t2}^2 - V_{t1}^2)$ Horizontal Segment Distance: S, =  $[(N) (Th_{avg}) / W_{avg}] - R_{avg} - SIN_{ang}$ Computed Altitude  $DelH_c = S_g[tan(GAMMA)](1/0.95)$ Increment: Deviation of the Computed Altitude Increment from the Altitude Increment Assumed at the Start of the Current Iteration Cycle DEV = abs [DelH\_ - DelH] At this point the status of the iterative process is checked. If DEV is less than 1 ft, then the iterative process is complete. Otherwise, Altitude DelH = Increment: DelH<sub>c</sub>

and the iterative process is repeated as above.

where E, F,  $G_1$ ,  $G_2$ , and H are engine-dependent coefficients from Data Base Number 11 for the thrust mode defined in the standard takeoff procedure; and

 $R_{avg}$  is a coefficient from Data Base Number 11 which is the nondimensional ratio of the airplane's drag coefficient to lift coefficient for a given flap setting and airplane configuration. The landing gear is assumed to be retracted.

#### THRUST REDUCTION SEGMENT

A thrust reduction segment of 1000 ft (horizontal distance) is introduced to allow for a smooth transition of the thrust associated with the Federal Aviation Regulations, Part 36 thrust cutback point. This segment replaces the first 1000 ft of horizontal distance of the next segment which may be either a climb or an acceleration segment. Computation of the parameters associated with the thrust reduction segment and the next segment is performed simultaneously. For the thrust reduction segment the following apply:

Initial Calibrated Airspeed:	V <sub>c1</sub>	æ	$V_{c2}$ of the previous segment
Initial Pressure Altitude MSL:	H1	=	H <sub>2</sub> of the previous segment
Initial Temperature:	T <sub>c1</sub>	z	$T_{c2}$ of the previous segment

Initial Thrust:

$Th_{r1} = Th_2$ of the previous sec	<b>jme</b> nt
--------------------------------------	---------------

 $V_{t2}$  of the previous segment

Initial Airplane True Speed:

Horizontal Distance of the Thrust Reduction Segment:  $S_r = 1000$  ft

Given the above, the final thrust for the cutback segment is computed as follows:

Thrust:  $Th_{r2} = E + F(V_{c1}) + G_1(A_1) + G_2(H_1)^2 + H(T_{c1})$ 

V<sub>tl</sub> =

where E, F, G1, G2, and H are engine-dependent coefficients from Data Base Number 11 for the thrust mode defined in the standard takeoff procedure.

#### Thrust Reduction Followed by an Acceleration Segment:

When the thrust reduction segment is followed by an acceleration segment, the initial thrust of the acceleration segment is set equal to  $Th_{r_2}$  and computation of the remaining parameters associated with the acceleration segment is performed as described previously. The remaining parameters of the thrust reduction segment are computed as follows and the thrust reduction segment replaces the first 1000 ft of the acceleration segment:

True Speed at the end of the thrust reduction segment:  $V_{tr2} = V_{t1} + (V_{t2} - V_{t1}) (1000/S_g)$ Segment Altitude MSL at the end of the thrust reduction

segment:  $H_{r2} = H_1 + DelH(1000/S_g)$ 

where  $V_{t2}$ ,  $S_g$ , and DelH are parameters computed above for an acceleration segment.

#### Thrust Reduction Followed by a Climb Segment:

When the thrust reduction segment is followed by a climb segment, the initial thrust of the climb segment is set equal to  $Th_{r_2}$  and computation of the remaining parameters associated with the climb segment is performed as described previously. The remaining parameters for the thrust reduction segment are computed as follows and the thrust reduction segment replaces the first 1000 ft of the climb segment:

True Speed at the end of the thrust reduction segment:  $V_{tr} = V_{t1} = V_{t2}$ Segment Altitude MSL at the end of the thrust reduction segment:  $H_r = H_1 + (H_2 - H_1) (1000/S_g)$ 

where  $V_{t2}$ ,  $H_2$  and  $S_q$  are parameters computed above for a climb segment.

#### EXCEPTIONS

The above computations assume the airplane is jet-powered and that the required thrust computations are performed in lbs-thrust. However, if the airplane is propeller-powered the following parameters are factored into the above computations: (1) propeller efficiency and installed net propulsive power for maximum takeoff thrust; and (2) propeller efficiency and installed net propulsive power for maximum climb thrust. In addition, for a select few airplanes, the thrust for a particular segment is given in the standard flight procedure as fixed and as such is not computed by the takeoff profile generator. Finally, for airplanes in Data Base Number 11 for which thrust is expressed in percent-RPM, an intermediate computation is performed to convert to lbsthrust.

#### B.2 Non-Standard Conditions

This section describes the computation of a non-standard-condition takeoff profile on a segment-by-segment basis. Non-standard conditions exist when either the airport elevation is not zero ft MSL and/or the airport temperature is not standard at the airport elevation. The following definitions, constants, and ratios, based upon the concept of density altitude, supplement those described for standard conditions and apply to all computations described herein:

Gravitational Constant:	g	z	32.17
Thermal Gas Constant:	Rc	I	1716.2
Temperature Lapse Rate:	L	=	0.003566 °F/ft or °R/ft
Airport Elevation MSL:	Hap	=	User-defined in ft
Non-Standard Temperature at Airport Elevation:	T <sub>fap</sub>	=	User-defined degrees F
Standard Temperature, °R:	Tro	*	518.67
Standard Temperature Lapsed to Airport Elevation, °R:	T <sub>rap</sub>	=	$T_{r0} - (L) (H_{ap})$
Temperature at Altitude, °R:	T <sub>r</sub>	E	$T_{rap}$ - [(L)( $H_x$ - $H_{ap}$ )]; where $H_x$ is the altitude MSL for segment point X
Standard Air Pressure:	Po	=	2116
Standard Air Pressure at Altitude:	Р	2	(P <sub>0</sub> ) (DELTA)
Standard Air Density:	Ro	2	0.002328
Air Density at Altitude:	R	=	$P/[(R_c)(T_r)]$
Non-Standard Density Ratio:	SIGMA,	ns ==	R/R <sub>0</sub>

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Non-Standard Temperature Ratio:	THETA <sub>ns</sub> =	SIGMA <sub>ns</sub> (1/{g/((Rc)(L)-1)})
Non-Standard Pressure Ratio:	DELTA <sub>ns</sub> =	THETA <sub>ns</sub> (g/[(Rc)(L)])

#### GROUND ROLL SEGMENT

For the ground roll segment the following apply:

Airport Temperature:	T <sub>c1</sub>	*	T <sub>c2</sub>	=	$(T_{fap} - 32)(5/9)$
Pressure Altitude MSL:	H <sub>1</sub>	=	H2	=	H <sub>ap</sub>
Initial Calibrated Airspeed:	V <sub>c1</sub>	=	16.0	kts	

Given the above, the remaining parameters for the ground roll segment under non-standard conditions are computed as in Section B.1, Standard Conditions, using the non-standard THETA, SIGMA, and DELTA, as appropriate.

#### CLIMB SEGMENT

The parameters for the climb segment under non-standard conditions are computed as in Section B.1, Standard Conditions, using the nonstandard THETA, SIGMA, and DELTA, as appropriate.

#### ACCELERATION SEGMENT

With the exception of the iterative process described below, the parameters for the acceleration segment under non-standard conditions are computed as in Section B.1, Standard Conditions, using the non-standard THETA, SIGMA, and DELTA, as appropriate.

Computation of the remaining parameters is performed using an iterative procedure to arrive at the horizontal distance of the segment,  $S_{gns}$ . If the difference between  $S_{gns}$  and  $S_{gc}$  (the computed horizontal distance for the current iteration) is greater than ten ft,  $S_{gns}$  is set equal to the arithmetic average of  $S_{gns}$  and  $S_{gc}$ , and the iterative process is repeated until a difference of ten ft or less is achieved.

Initial Assumed					
Horizontal Distance:	Sgns	=	S <sub>g</sub> computed conditions	for	standard

The equations for the acceleration segment under standard conditions are used to supplement the following non-standard computations:

Start of Iterative Loop:

Tangent of the Flight Angle: TAN<sub>ang</sub>= 0.95(DelH/S<sub>gns</sub>)

Sine of the Flight Angle:	SIN <sub>ang</sub> =	<pre>sin[arctan(TAN<sub>ang</sub>)]</pre>
Computed Horizo Distance:		$(\frac{1}{2}g)$ (0.95) $(V_{t2}^{2} - V_{t1}^{2})$
	S <sub>gr</sub> =	[N(Thavg)] - Ravg - SINang
Deviation of the	e	

Computed Horizontal Distance from the Horizontal Distance Assumed at the Start of the Current Iteration Cycle: DEV = abs[S<sub>gc</sub> - S<sub>gns</sub>]

At this point the status of the iterative process is checked. If DEV is less than ten ft, then the iterative process is complete. Otherwise,

Horizontal Distance:

- -

 $S_{ms} = 0.5 [S_{qc} + S_{ms}]$ 

and the iterative process is repeated as above.

where E, F,  $G_1$ ,  $G_2$ , and H are engine-dependent coefficients from Data Base Number 11 for the thrust mode defined in the standard takeoff procedure; and

 $R_{avg}$  is a coefficient from Data Base Number 11 which is the nondimensional ratio of the airplane's drag coefficient to lift coefficient for a given flap setting and airplane configuration. The landing gear is assumed to be retracted.

#### THRUST REDUCTION SEGMENT

The parameters for the thrust reduction segment under nonstandard conditions are computed as in Section B.1, Standard Conditions, using the non-standard THETA, SIGMA, and DELTA, as appropriate.

#### ERROR CHECKING

The non-standard portion of the profile generator maintains several built-in error checks which guard against the computation of improper takeoff profiles. Computation of takeoff profiles is not performed if any of the following conditions are detected:

- the computed flight angle for a climb segment is zero or negative;
- (2) the computed horizontal distance for an acceleration segment is zero or negative;
- (3) the number of iterations required to compute the horizontal distance of an acceleration segment exceeds five hundred; and

(4) the length of the computed ground roll segment exceeds the length of the runway by more than ten percent; if the computed segment exceeds the runway length by less than ten percent, the user is warned of the discrepancy as discussed in Section 2.1.

#### EXCEPTIONS

The exceptions noted in Section 2.1, Standard Conditions, also apply for non-standard conditions.

#### B.3 Runway Requirements/Operational Boundaries

Tables B-1 through B-9 present the length (ft) of the ground roll segment computed by the profile generator for all INM airplanes and stage weights. These tables are intended to give the user guidance on the operational boundaries and runway requirements of the profile generator for various airport temperatures, elevations, and runway lengths. These data are presented for nine combinations of airport elevation and temperature intended to cover the range of average yearly conditions at airports across the United States. Tables B-1 through B-3 present these data for 0 ft Above Mean Sea Level (MSL) elevation and three temperatures, 59°F, 40°F and 80°F, respectively. Tables B-4 through B-6 present these data for 3000 ft MSL elevation and three temperatures, 59°F, 40°F and 80°F, respectively. Tables B-7 through B-9 present these data for 6000 ft MSL elevation and three temperatures, 59°F, 40°F and 80°F, respectively. When the generator determines that a profile can not be computed, as discussed in Section B.2, Error Checking, a zero is inserted in the table, e.g., Table B-2, INM Airplane Number 71, Stage Weight 3.

1123414716344942393231843794579743073273946970.9647945797410773273946970.96479876464697310794344613240.95445974697407079765344641376414743745977977986707631344171541465116491649170776477707632393132313211316491649164916001707762721333931321131114664916497100170166001113464313411521454649664016001701660011337956454646715466493701811611017116114369133311399116464911318616170166011701811611436913331139913446491131464916491701464917014649114646764771546648113141748649170146491701464917014649170146491701464917014649170146491701470147014701470147014 <th></th> <th>1</th> <th>-<u></u><u></u></th> <th><u></u></th> <th>STAGE WEIGHT</th> <th></th> <th></th> <th></th>		1	- <u></u> <u></u>	<u></u>	STAGE WEIGHT			
1         414         6772         1223         5843         7955         7955         7955           2         4634         5964         1464         6111         7130         1917           3         3719         4677         4680         5917         4680         5917         648           4         2626         3264         3124         5951         6998         9433         6479           4         4321         4437         4493         1317         6483         5951         6998         9433         6477           4         4322         3139         3122         6191         6473         6477         6464         6473         6477         6464         6471         6477         6464         6471         6477         6464         6471         6473         6477         6464         6471         6473         6477         6464         6471         6473         6477         6464         6477         6464         6471         6477         6464         6477         6464         6471         6471         6474         6474         6474         6471         6474         6471         6474         6474         6471         6471	<b>3301 S</b>		<u>,                                     </u>	<del>,</del>				, <u> </u>
441         484         1889         0133         1939         1939         1437           1         3739         467         4644         587         6444         4611            4         2064         2354         3180         753         4639         519         545           5         3844         4357         4639         5357         4297         7445         5459           6         4030         4429         11376         6263         7957         5457            7         3541         4429         11376         6263         7957         5457            8         3279         3339         3437         4443         4471         4473             10         2394         3331         3479         4444         4471         5469         6443             13         3194         6464         6477         5469         6431         7148         1487           14         4467         6469         1634         4611         7148         1487           13         3194         6464         6477					<u></u>			<b>↓</b>
5         9713         4697         4691         9877         4644         4971         4           4         2014         3344         1314         1717         4630         1319         4649           5         1364         4517         4631         1527         4630         1517         4649           7         1364         6429         5134         16531         4684         5131            9         2721         1329         1324         1454         4644         5444         6477            14         2799         1324         1464         4646         4647              13         2664         1024         1464         4647         5669         4646             14         2617         1278         1464         4613         4647         4646         1477         444         5447              15         2017         1276         4646         4071         5469         1589         7038         4447           14         4647         6467         4584         1697 <td></td> <td>·</td> <td><u> </u></td> <td></td> <td></td> <td></td> <td></td> <td>·····</td>		·	<u> </u>					·····
4         2014         3124         3140         3132         4481         5139         6493           6         1030         4613         4614         527         6237         7144         4677           7         3643         6521         6327         6237         7145         6477           7         3643         6523         3777         6237         7146         6488           9         2779         3799         4148         6033         1992         7146         6484           14         2799         1324         1646         6424         5444         6437            13         3666         3334         3479         6464         6784         6787            14         3197         2464         6314         1998         6468         7138         6484           15         3135         1999                14         3157         1446         6479         5569         6413         7184         6493         7197           15         3157         1449         4443         1451         6449 <td>h</td> <td>÷</td> <td></td> <td><u> </u></td> <td><b></b></td> <td>f</td> <td></td> <td><b>{</b></td>	h	÷		<u> </u>	<b></b>	f		<b>{</b>
1         144         415         441         5337         6237         74.35         1447           4         4135         4471         5414         6531         6644         5411 $\cdots$ 7         3561         4425         1376         6453         7777         5577 $\cdots$ 8         3379         3138         3631         4531         7977         5577 $\cdots$ 9         3379         3134         3644         4434         5444 $\cdots$ $\cdots$ $\cdots$ 14         2679         3131         3644         4434         5444 $\cdots$ $\cdots$ $\cdots$ 33         3785         4654         4667         5469         5431         7164         1669           14         3270         3274         4445         4531         5621         7179         1467           14         6657         6457         4445         4533         5631         7164         1647           14         6657         6457         4541         1541         1547         1541         1547           15         3276         4545	h		f	<u>↓</u>		<u>+</u>		
4         4433         4433         4434         9531         9898         9433            7         1863         4422         1174         6433         7767         1867            8         3278         3339         3135         1433         1473            9         3279         3759         4466         6433         1992         7364         18484           10         2344         1314         1465         6464         6431         7399         1527           12         3066         6454         6459         6461         7399         1527           13         3179         6464         6931         1992         1167         100           14         1327         3135         1993         1017         100         100         100         100           14         1327         3138         1993         1017         1164         117         116         1449           130         3137         3264         4697         5460         4411         1160         1007         100           14         1327         1376         64641         1321				<u> </u>		+		
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1279         1739         44.4         6933         1992         71.16         8449           10         2795         3124         3654         4434         1446         4677            11         2846         3034         3185         4664         5734         4779            12         3489         3335         1473         4464         4791         3469         4101         71.06            13         3785         4644         4407         3469         4411         71.06            14         3279         3735         4464         4607         3540         4511         71.64         8417           14         3279         4544         3354         4554         7799         7799								<u> </u>
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1120142020202044044414 $\cdots$ $\cdots$ 1330643333317944445544574347989.87714317734444284498419896465978887888143177344442844984198964659781415327331646469755927.14698891537784664469755697.14698891737844654469755697.14691891845676487458485845799779919377336463951556176149817779920397735643954466983146375779921464959715461513176149822146572246114897553155317649767466923461148975321641377674669243964663272218441 $\cdots$ $\cdots$ $\cdots$ 253464668572318644576 $\cdots$ $\cdots$ 263444668665329974 $\cdots$ $\cdots$ $\cdots$ 273979656665329976 $\cdots$ $\cdots$ $\cdots$ 283464668559295976 $\cdots$ $\cdots$ $\cdots$ 293464669665351699 $\cdots$ $\cdots$ </td <td>h</td> <td>{</td> <td></td> <td></td> <td><u></u></td> <td></td> <td></td> <td></td>	h	{			<u></u>			
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13         2785         4884         4627         5489         6433         7130         8147           14         2327         2644         6454         4954         5989         6660         7644           18         2691         3335         3989               14         2378         3739         6146         6931         5992         7144         4049           17         3795         6964         6667         5500         6613         7309            18         5657         6964         6973         5528         6493         7979            19         3397         4189         6441         5528         6493         7644            24         5652         5339         5590         6441         7614         777         6464           23         6451         4697         5341         8111         6741         777         6464           24         5464         6930         6931         1694         5476             25         5464         6900         6911         1	11	2684						
14         237         344         4294         4954         1989         6665         7614           15         2633         3335         3395                16         3275         3739         4464         6453         5958         5959         7364         6889           17         3784         6847         6854         5554         6433         7346         6847           18         6467         6847         5554         5554         6759         7799            19         3997         6344         3954         6469         5334         6575         7799           24         3971         3644         3954         6433         7614         8922         36677           25         5652         5333         5950         6431         6411         7174         8469           24         5444         6453         7821         8441              25         6513         5964         6523         6464         6533         6978             26         6513	12	3000	3338		L			
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17178546944407540044117180814714656765676556855697999799 $\cdots$ 19395761896461352364337844 $\cdots$ 243371364635544609858465757799214669507155616133781460223663721365251035500644176134803 $\cdots$ 21461146975544551779766652350315500644176144807 $\cdots$ 2435446663653310058575 $\cdots$ $\cdots$ 2554496650653366949796 $\cdots$ $\cdots$ $\cdots$ 265433506455226644 $\cdots$ $\cdots$ $\cdots$ $\cdots$ 2759796544852356949796 $\cdots$ $\cdots$ $\cdots$ 2865356533669369339876 $\cdots$ $\cdots$ $\cdots$ 31333236466253659435266269 $\cdots$ $\cdots$ $\cdots$ 34352736444235556659376447679 $\cdots$ $\cdots$ $\cdots$ 33352632743594461153386299 $\cdots$ $\cdots$ $\cdots$ 343587346735244613535655765576557635358635863586	15	2693	3335	3959				
14         6467         6554         8554         9799         9799            19         3997         4485         6483         1528         6433         7864            20         3371         2654         3384         6469         8384         6975         7792           21         4669         1071         5161         6153         7616         6017         36657           22         5952         5383         1590         6443         7618         6017         6017           24         4619         5324         8441               25         6433         5564         5522         6464               26         5469         6552         6533         6068         979	16	3279						·
15         157         415         4413         1443         1443         744            24         3371         3654         3554         4609         5534         6575         7799           21         4649         5971         5443         65131         7614         9822         18687           21         5952         5355         5950         6441         7610         6801            21         4611         4697         5214         5511         6741         7767         6669           24         5644         6655         6513         8691         9876              24         5464         6655         6513         8991         9876              24         5464         6655         6513         8991         9876	17	3705	4054	4607			7180	8167
24         3271         3454         3554         4469         5334         6575         7799           21         4669         5071         5461         6333         7616         8022         3657           22         5052         5313         5500         6443         7613         8483            21         6611         4897         5314         5611         7777         6666           24         5964         6850         6931         8084         9076             24         5469         6950         6931         8084         9076             25         5456         6650         6933         6989         9076             26         4513         5906         5932         6146              27         5975         5464         6280         6759               28         5460         6250         6353         7699               31         3322         3464         4285         526	18	6967	6967	8556	8556	3799	9799	
21         4669         1071         5463         6131         7614         8022         12657           12         9552         5383         3500         6443         7616         8883            21         4611         487         5343         5511         6744         7747         4869           24         5564         6683         7821         8644              25         5464         6680         6531         6098         3676             26         5466         6690         6533         6098         3676              27         5379         6564         8023         6098         3676              28         5468         6690         6933         6098         3676 <td>19</td> <td>3997</td> <td>4369</td> <td>4943</td> <td>5838</td> <td>6813</td> <td>7868</td> <td></td>	19	3997	4369	4943	5838	6813	7868	
12         1952         5183         1950         4441         7614         4883            21         4611         4897         5343         5813         6741         7747         4865           24         5964         6463         7121         4843              25         6533         5696         6933         8698         5476             24         5464         6550         6933         8698         5476             27         5577         6564         6024         9074              28         5468         6550         6933         8698         5476             30         5263         6493         7659               31         3352         3846         6426         7659              32         3414         3727         4627         3526         6576         6571           33         3983         3467         3247         3546         6137 <td>20</td> <td>3371</td> <td>3656</td> <td>3954</td> <td>4609</td> <td>\$534</td> <td>6575</td> <td>7799</td>	20	3371	3656	3954	4609	\$534	6575	7799
21         4611         487         5341         5811         6741         7767         8869           24         5561         6613         7821         8643 $\cdots$ $\cdots$ $\cdots$ 25         6513         5064         5522         6446 $\cdots$ $\cdots$ $\cdots$ 26         5464         6055         6913         8098         9676 $\cdots$ $\cdots$ $\cdots$ 27         5575         6546         6050         6913         8098         9476 $\cdots$ $\cdots$ 28         4511         5594         5522         6146 $\cdots$ $\cdots$ $\cdots$ 30         5243         6129         6955         7699 $\cdots$ $\cdots$ $\cdots$ 31         3352         3646         4385         5366         6159 $\cdots$ $\cdots$ $\cdots$ 34         3657         3467         3549         4643         4765         5576         5770           34         3167         3467         3524         4611         5129 $\cdots$ $\cdots$ $\cdots$ 35         1364	21	4663	5071	5463	6353	7614	9032	10657
$34$ $594$ $645$ $721$ $841$ $\cdots$ $\cdots$ $\cdots$ $25$ $6513$ $5904$ $5522$ $6146$ $\cdots$ $\cdots$ $\cdots$ $27$ $5575$ $6564$ $6024$ $9974$ $\cdots$ $\cdots$ $\cdots$ $27$ $5575$ $6564$ $6024$ $9974$ $\cdots$ $\cdots$ $\cdots$ $29$ $5464$ $6050$ $6913$ $6998$ $9476$ $\cdots$ $\cdots$ $29$ $5464$ $6050$ $6913$ $6998$ $9476$ $\cdots$ $\cdots$ $29$ $5464$ $6050$ $6913$ $6998$ $9476$ $\cdots$ $\cdots$ $21$ $3322$ $3846$ $6215$ $5152$ $6264$ $6113$ $31$ $3352$ $3846$ $6455$ $5157$ $5576$ $5576$ $314$ $3677$ $3467$ $3924$ $6411$ $5134$ $6229$ $\cdots$ $3147$ $3646$	22	5052	5383	5900	6443	7610	8883	
25         43.3         5064         5522         4446             26         5469         6550         653.3         8098         9476             27         5575         6564         8224         9074              28         463.3         5084         5322         6146              30         5243         6110         6455         7599              31         3332         3845         6425         5266         6267             32         3614         3703         4935         4597         5342         6264         6511           33         3950         3274         3529         4611         5532         6299            34         3067         3467         3324         4435         5566              34         3187         3661                 34         3282         6035	23	4611	4897	5343	5811	6741	7747	8869
26         5440         6050         6913         8094         9476             27         5979         6964         8028         9074              28         4533         5004         5522         6146              29         5460         6050         6913         6099              30         5363         6130         6665         7699              31         3332         3464         6435         5266         6269             32         1414         3792         4913         4597         5362         6268         6511           33         3020         2274         3549         4662         4765         5576         5576           34         3067         3467         3924         4611         5338         6299             35         3586         3991         4439         5566               36         3187         3649 <td>34</td> <td>5961</td> <td>6863</td> <td>7821</td> <td>8841</td> <td></td> <td></td> <td></td>	34	5961	6863	7821	8841			
27         5575         6564         8028         9074              28         4513         5004         5522         6146              29         5469         6050         6513         8098         8476             30         5263         6120         6865         7639              31         3322         3846         4385         5266         6659             32         3444         3703         4623         4587         5362         6264         6411           33         3020         2274         2549         4062         4765         5576         1970           34         3067         3467         3924         4411         5128         6229            35         1505         3991         4489         5506               36         3187         3681         4135         5041               314         3292         4035         <	25	4513	5004	5522	6146			
28         4513         5004         5522         6146 $\cdots$ $\cdots$ $\cdots$ 29         5460         6050         6913         8098         9476 $\cdots$ $\cdots$ 30         5263         6120         6865         7699 $\cdots$ $\cdots$ $\cdots$ 31         3352         3446         4285         5206         6269 $\cdots$ $\cdots$ 32         3414         3703         4013         4597         3562         6244         6811           33         3020         3274         3549         4662         4765         5576         5570           34         3067         3467         3524         4641         5386 $\cdots$ $\cdots$ $\cdots$ 35         3596         3981         4499         5596 $\cdots$ $\cdots$ $\cdots$ $\cdots$ 34         3197         3613 $\cdots$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ 34         3197         4615         527 $\cdots$ $\cdots$ $\cdots$ $\cdots$ 34         31292         4035 $\cdots$	26	5460	6050	6913	8098	9476		
29         5469         6050         6913         8098         9475 $\cdots$ $\cdots$ 30         5263         6120         6965         7699 $\cdots$ $\cdots$ $\cdots$ 31         3352         3846         6425         5266         6169 $\cdots$ $\cdots$ 32         3414         3702         6025         4587         5362         6266         6811           33         3020         2274         3549         4062         4765         5576         5970           34         3087         3467         3524         6411         5128         6299 $\cdots$ 35         3566         3981         6489         5566 $\cdots$ $\cdots$ $\cdots$ $\cdots$ 36         3187         3681         6135         5061 $\cdots$ $\cdots$ $\cdots$ $\cdots$ 37         6221         4427         5609 $\cdots$ $\cdots$ $\cdots$ $\cdots$ 38         3252         4035 $\cdots$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ 39         3184         3746         6612	27	5979	6964	8028	9074			
$10$ $5243$ $6120$ $6565$ $7699$ $\cdots$ $\cdots$ $\cdots$ $31$ $3132$ $3846$ $4285$ $5206$ $6189$ $\cdots$ $\cdots$ $32$ $3444$ $3793$ $4013$ $4587$ $5362$ $6264$ $6411$ $33$ $3020$ $3274$ $3549$ $4062$ $4765$ $5576$ $5970$ $34$ $3067$ $3467$ $3924$ $4011$ $5128$ $6229$ $\cdots$ $35$ $3306$ $3981$ $4489$ $5506$ $\cdots$ $\cdots$ $\cdots$ $36$ $3187$ $3641$ $4135$ $5061$ $\cdots$ $\cdots$ $\cdots$ $37$ $4221$ $4627$ $5566$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ $37$ $4221$ $4625$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ $39$ $3184$ $3746$ $6612$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ <tr< td=""><td>28</td><td>4513</td><td>5004</td><td>5522</td><td>6146</td><td></td><td></td><td>•••</td></tr<>	28	4513	5004	5522	6146			•••
31333234464285 $5266$ $6169$ 32 $3414$ $2703$ $4015$ $4587$ $5362$ $6264$ $6811$ 33 $3020$ $2274$ $3549$ $4062$ $4765$ $5576$ $5970$ 34 $3067$ $3467$ $3924$ $4411$ $5128$ $6299$ 35 $3306$ $3981$ $4489$ $5566$ 36 $3147$ $3661$ $4135$ $5061$ 37 $4221$ $4427$ $5609$ 38 $2292$ $4035$ 39 $3134$ $3746$ $6612$ 40 $3614$ $4416$ $5227$ 41 $2124$ $2638$ $3133$ 43 $3614$ $4416$ $5227$ 44 $2124$ $2638$ $3133$ 45 $2075$ $3310$ $3893$ $4614$ 46 $3653$ $4186$ $4139$ 47 $3103$ $3893$ $4614$ 48 $3187$ $4704$ $5601$ 49 $3164$ $4135$ $4724$ $5991$ <t< td=""><td>29</td><td>\$460</td><td>6050</td><td>6913</td><td>\$098</td><td>9476</td><td></td><td></td></t<>	29	\$460	6050	6913	\$098	9476		
32         3414         3703         4015         4597         5343         6264         6611           33         3620         2274         3549         4062         4765         5576         5970           34         3067         3467         3924         4411         5328         6229            35         3506         3981         4489         5566              36         3187         3681         4135         5061               37         4221         4827         5609	30	5263	6120	6965	7699			
33         3620         3274         3549         4062         4765         5576         5970           34         3067         3467         3924         4411         5328         6299            35         3506         3981         4489         5506              34         3187         3681         4135         5064              37         4221         4827         5669                38         3292         4635                 39         3184         3746         4612                40         3634         4416         5227                41         2124         2638         3133                42         3075         3310         3893         4618	31	3352	3846	4285	\$206	6369		
14         3067         3467         3924         4411         5328         6299            35         3506         3991         4469         5506 </td <td>32</td> <td>3414</td> <td>3703</td> <td>4015</td> <td>4587</td> <td>\$362</td> <td>6268</td> <td>6811</td>	32	3414	3703	4015	4587	\$362	6268	6811
15       1506       1981       4489       5506 $\cdots$ $\cdots$ $\cdots$ 16       1187       1661       4135       5061 $\cdots$ $\cdots$ $\cdots$ 17       6221       4627       5609 $\cdots$ $\cdots$ $\cdots$ $\cdots$ 18       1229       4025 $\cdots$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ 18       1229       4025 $\cdots$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ 14       12124       2638       1133 $\cdots$ $\cdots$ $\cdots$ $\cdots$ 41       2124       2638       1313 $\cdots$ $\cdots$ $\cdots$ $\cdots$ 42       1075       1310       1893       4614 $\cdots$ $\cdots$ $\cdots$ 43       1614       4416       5227 $\cdots$ $\cdots$ $\cdots$ $\cdots$ 44       2124       2638       1133 $\cdots$ $\cdots$ $\cdots$ $\cdots$ 44       2124       2638       1132 $\cdots$ $\cdots$ $\cdots$ $\cdots$ 45       2075       3310       1893       4618 $\cdots$	33	3020	3274	3549	4062	4765	5576	5970
16         3187         3691         4135         5041              37         4221         4427         5609               38         3252         4035                38         3252         4035                39         3184         3766         4612               40         3634         4416         5227               41         2124         2638         3133               42         3075         3310         3893         4614              41         2124         2638         3133               42         3075         3310         3893         4618              44         2124         2638         3133          <	34	3067	3467	3924	4411	5328	6299	
$37$ $4221$ $4427$ $5609$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ $38$ $1292$ $4635$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ $39$ $3184$ $3746$ $6612$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ $40$ $3634$ $4416$ $5227$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ $41$ $2124$ $2638$ $3133$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ $41$ $2124$ $2638$ $3133$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ $43$ $3634$ $4416$ $5227$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ $43$ $3634$ $4416$ $5227$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ $44$ $2124$ $2638$ $2133$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ $44$ $2124$ $2638$ $2123$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ $45$ $2075$ $3310$ $3893$ $4614$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ $45$ $1653$ $4186$ $4839$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ $46$ $1653$ $4186$ $4939$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ $47$ $1303$ $3684$ $4096$ $4526$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ $47$ $1303$ $3648$ $4096$ $4526$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ $48$ $1897$ $4708$ $5601$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ <td>35</td> <td>3506</td> <td>3981</td> <td>4489</td> <td>5506</td> <td></td> <td></td> <td></td>	35	3506	3981	4489	5506			
38       3292       4635              39       3184       3746       4612             40       3634       4416       5227             41       2124       2638       3133             42       3075       3310       3893       4614            43       3634       4416       5227             44       2124       2638       3133             43       3634       4416       5227             44       2124       2638       3133             44       2124       2638       3133             45       2075       3310       3893       4618            45       3653       4186       4835	36	3167	3681	4135	5041			
39       3184       3746       4612              40       3634       4416       5227              41       2124       2638       3133              42       3075       3310       3893       4614             43       3634       4416       5227              44       2124       2618       3133              44       2124       2618       3133              45       2075       3310       3893       4618             45       2075       3310       3893       4618             45       2075       3310       3893       4618              46       3653       4186       4096 </td <td>37</td> <td>4221</td> <td>4827</td> <td>5609</td> <td></td> <td></td> <td></td> <td></td>	37	4221	4827	5609				
39       3184       3746       4612             40       3634       4416       5227             41       2124       2638       3133             42       3075       3310       3893       4614            43       3634       4416       5227             44       2124       2638       3133             44       2124       2638       3133             45       2075       3310       3893       4618            45       2075       3310       3893       4618            46       3653       4186       4839             47       3303       3688       4096       4526             48       3897       4708       5601	38	ŧ	4035					
40       3634       4416       5227              41       2124       2638       3133              42       3075       3310       3893       4618             43       3634       4416       5227             44       2124       2638       3133              44       2124       2638       3133               44       2124       2638       3133               45       3075       3310       3893       4618               45       3075       3310       3893       4618                45       3053       4186       4419            <				<u>├</u>	·			
41       2124       2638       3133             42       3075       3310       3893       4614            43       3634       4416       5227             44       2124       2638       3133             44       2124       2638       3133             45       2075       3310       3893       4614            45       2075       3310       3893       4614            45       2075       3310       3893       4614            45       2075       3310       3893       4614            46       3653       4186       4419             47       3303       3688       4096       4526             48       3897       4708       5601		<b>{</b>						
42       3075       3310       3893       4614            43       3634       4416       5227             44       2124       2638       3133             45       2075       3310       3893       4614            45       2075       3310       3893       4614            45       2075       3310       3893       4614            46       3653       4186       4419             47       3103       3688       4096       4526            48       3897       4708       5601             49       3685       4155       4728       5591            50       4002       4546       5131       6492            51       2646       2846       3091       3573       4217 <td></td> <td><u>{</u></td> <td>·</td> <td></td> <td></td> <td></td> <td></td> <td><u> </u></td>		<u>{</u>	·					<u> </u>
43       3634       4416       5227              44       2124       2638       3133              45       2075       3310       3893       4618             46       3653       4186       4439             47       3103       3688       4096       4526            48       3897       4708       5601             49       3685       4135       4728       5591            50       4002       4548       5131       6493            51       2646       2846       3091       3573       4217           52       2747       2960       3219       3692       4176       5123          53       2826               54       2569		f				<u>}</u>		<u> </u>
44       2124       2638       3133 <td< td=""><td></td><td></td><td>}</td><td>·</td><td></td><td></td><td></td><td></td></td<>			}	·				
45       2075       3310       3833       4618            46       3653       4186       4839             47       3303       3688       4096       4526            48       3897       4708       5601             49       3685       4135       4728       5991            50       4002       4548       5131       6492            51       2646       2846       3091       3573       4217           52       2747       2960       3219       3692       4376       5123          53       2826               54       2569		<b>├</b> ──────				h		<u>├</u>
46       3653       4186       4439              47       3103       3688       4096       4526            48       3897       4708       5601             49       3685       4135       4728       5991            50       4002       4548       5131       6492            51       2646       2846       3091       3573       4217           52       2747       2960       3219       3692       4376       5123          51       2826               51       2826                51       2826                51       2859                54       2859 <t< td=""><td></td><td>t</td><td></td><td></td><td></td><td></td><td></td><td><b> </b></td></t<>		t						<b> </b>
47       3103       3688       4096       4526            48       3897       4708       5601             49       3685       4155       4728       5991            50       4002       4548       5131       6493            51       2646       2846       3091       3573       4217           52       2747       2960       3219       3692       4376       5123          53       2826               54       2569		<b>h</b>			┟┅┈┈┈╌╌╴	f		f
48         3897         4708         5601 </td <td></td> <td></td> <td></td> <td>·</td> <td></td> <td></td> <td></td> <td><u> </u></td>				·				<u> </u>
49         3685         4155         4728         5991              50         4002         4548         5131         6493              51         2646         2846         3093         3573         4217             52         2747         2960         3219         3692         4376         5123            53         2826                 54         2569		<b></b>		· · · · · · · · · · · · · · · · · · ·				<u> </u>
50         4002         4548         5131         6493              51         2646         2846         3051         3573         4217             52         2747         2960         3219         3692         4376         5123            53         2826                 54         2569		<b></b>		<u> </u> -			·····	<u> </u>
51         2646         2846         3091         3573         4217             52         2747         2960         3219         3692         4376         5123            53         2826                 54         2569		<b></b>	ļ	<b>├</b> ────	·			<u>+</u>
52         2747         2960         3219         3692         4376         5123            53         2826                  54         2569					ł	<u> </u>		
53         2826 <td></td> <td></td> <td></td> <td></td> <td></td> <td>+</td> <td>h</td> <td>ŧ</td>						+	h	ŧ
54 2569		<u> </u>			<u></u>	<u> </u>		<u> </u>
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<u>55 3689 ··· ·· ·· ·· ··· ··· ··· ··· ··· ··· </u>								<u> </u>
	55	3689				L	L	L

### TABLE B-1: RUNNAY REQUIREMENTS/OPERATIONAL BOUNDARIES OF THE PROFILE GENERATOR, TEMPERATURE 59°F , ELEVATION 0 FT MSL

B-11

·	STAGS WEIGHT								
2004 #	1	2	3	•	5	6	7		
56	4136								
\$7	3130								
50	3498								
57	3725								
60	2972		<u>}</u>						
61	4945								
62	3898								
63	2697	1397	4586						
66	1794		•••						
65	1211			·					
66	3860	4921	5483						
67	2638								
68	2560								
69	1239								
70	3181	4201	5396						
70	1520	1856	2234						
72	1320	2332							
73	2082								
74	632					•••	•••		
75	738								
77	<u></u>								
	699								
78	10532	{		h					
79	4153	6477							
0	\$158	7065							
81	4565	6732							
82	\$120	7651							
83	3768	4193	4551	5313	6355	7861	9137		
84	4084	4421	4756	\$\$90	6711	8052	9291		
85	3657	4252	4730	5763					
86	3569	4125	4636	5657		•••			
87	2753	2985	3237	3708	4351	5096	5457		
88	2942	3608	4350						
89	3324	4085	4821						
90	3187	3894	4678						
91	11242								
92	9308								
93	3244	3596	4111	4820	5645				
34	3004	3331	3676	4092					
95	3062								
36	4190								
97	3640	4331	5158	5984					
98	4136								
>>	2427								
100	4513	5004	5522	6146					
101	5460	6050	6913	8098	9476				
102	3968	4287	4619	5445	6343	7459	\$833		
103	4202	4543	4899	5784	6749	7950	9430		
104	3000								
105	3000								
106	3000								
107	3000				•				

# TABLE B-1: RUNWAY REQUIREMENTS/OPERATIONAL BOUNDARIES OF THE PROFILE GENERATOR, TEMPERATURE 59°F ELEVATION 0 FT MSL (CONTINUED)

[	STAGE WEIGHT								
2304 8	ļ	r	<del>,</del>		r				
ļ	1	2	3		5	•	7		
1	4358	4732	5223	5842	7545	7788			
2	4254	4603	4968	5843	7020	8439	9733		
3	3422	3732	4241	4662	6112	6322			
4	2406	2692	2981	3451	4142	4884	6163		
5	3538	3824	4122	4837	5793	6942	7984		
6	4193	4672	5438	6551	8098	9433			
7	3963	4429	5176	6263	7767	8547			
•	2721	3109	3523	4193	4671				
9	3017	3440	3827	4520	5512	6611	7434		
10	2799	3128	3656	4424	5486	6037	••••		
11	2470	2791	3133	3686	4081				
12	2760	3070	3569	4293	5294	6172	•••		
23	3409	3729	4238	4368	5964	6606	7514		
14	3088	9866	3868	4559	5510	6127	7005		
15	2478	3068	3642	•					
16	3017	3440	3827	4520	5512	6611	7434		
17	3409	3729	4238	4968	5964	6606	7514		
18	6410	6410	7872	7872	9015	9015			
19	3677	4038	4547	5371	6268	7239			
20	3101	3364	3638	4260	5091	6049	7175		
21	4295	4666	5026	5844	7005	8309	9804		
22	4648	4952	5428	5928	7001	\$172			
23	4242	4505	4916	5346	6202	7127	8159		
24	5968	6863	7821	6841					
			5080		┟─────				
25	4152	4604		5654			•••		
26	\$023	5566	6360	7450	\$718				
27	5500	6407	7386	\$347					
28	4152	4604	5080	5654					
29	5023	5566	6360	7450	\$718				
30	4842	5630	6408	7083					
31	3084	3539	3942	4785	5860				
32	3141	3407	3694	4220	4933	5767	6266		
33	2778	3012	3265	3737	4384	5130	5492		
34	2822	3189	3610	4058	4902	\$795			
35	3226	3663	4130	5065		•••			
36	2928	3382	3799	4631					
37	3883	4440	\$160						
38	3029	3712							
39	2930	3446	4243						
40	3343	4062	4809						
41	1954	2427	2883			•••			
42	2829	3045	3581	4249					
43	3343	4062	4809						
44	1954 .	2427	2883						
45	2829	3045	3581	4249					
46	3361	3851	4452						
47	3038	3393	3768	4164					
48	3585	4332	5153				•••		
	3390	3822	4349	5512					
49			•	h	t				
49 50	3681	4184	4720	5974					
		4184 2619	4720	5974 3287	3879				
50	3681				<u> </u>		·····		
50 51	3681 2434	2619	2843	3287	3879				
50 51 52 53	3681 2434 2326 2600	2619 2722	2843 2961	3287 3395	3879 4024	4712			
\$0 51 52	3681 2434 2526	2619 2722 	2843 2961	3287 3395 	3879 4024	4712			

# TABLE B-2: RUNWAY REQUIREMENTS/OPERATIONAL BOUNDARIES OF THE PROFILE GENERATOR, TEMPERATURE 40\*F ELEVATION 0 FT MSL

B-13

<b></b>	STAGE VEIGHT								
2301 6	1	2	3	•	5	6	,		
\$6	4136	+							
37	2880								
50	3218	<del>f</del>							
39	3427		<u> </u>				<u> </u>		
60	2734		<u> </u>						
61	4550			·					
62	3586			•					
6	2435	3968	4141						
64	1651								
65	1093	4443	5312						
<u> </u>	3485								
67	2362	ļ ····							
68	2311					ļ	•		
69	1119								
70	2873	3794	4872						
71	1372	1676	•						
72	1618	2106							
73	1880								
74	\$70	ļ							
75	667						•••		
76	1431	•••							
דד	632								
78	9689								
79	3820	5958							
80	4746	6500							
81	4068	6079				•••			
82	4624	0				•			
83	3467	3858	4187	4888	5847	7232	8406		
84	3757	4967	4376	5143	6174	7408	8547		
85	3364	3912	4352	\$307					
86	3284	3795	4265	5204		•			
87	2533	2746	2978	3411	4002	4688	5020		
88	2707	3320	4002						
89	3058	3758	4435				•••		
90	2932	3583	4304				•••		
91	10327								
92	8563								
93	2984	3308	3782	4434	5194				
94	2764	3065	3382	3764					
95	2817						•••		
96	3855								
97	3349	3985	4745	5505					
98	3805								
99	2233								
100	4513	5004	5522	6146					
101	5460	6050	6913	8098	9476		·		
102	3369	3639	3920	4618	5378	6321	7479		
103	3501	3784	4079	4812	5611	6605	7827		
103	3000								
	3000								
105		· · · · · · · · · · · · · · · · · · ·	<b>├</b> ────	<u> </u>					
106	3000				<u> </u>		<u> </u>		
107	3000			L		·			

# TABLE B-2: RUBMAY REQUIREMENTS/OPERATIONAL BOUNDARIES OF THE PROFILE GENERATOR, TEMPERATURE 40°F ELEVATION 0 FT MSL (CONTINUED)

Im $a$ $a$ $a$ $s$ $6$ 1413564732522154427545778825631546859016541813410024340644413491955177260750942858319835414100492058015420245424896574568818245641934671561465514098942273963462951766261776785478272131093523419346719358340864545534565487852102799312836564424548660371129333315372.43784447123278364742395099628873321340494430503459017084784614366840254594541565447277152943364443261635834086454553696548785217408944305034595170847846	7  11561  7321 9486   8630 
141584732522354427345778825053546959016941833810624140644413491955377360750942858319835414100492058015420245424896574566818245641934671543465514098942273963442951746263776785478272131093523419346719358340864545536965487852102799312836364424548660371129331315272.437848471232783647423950996288731213404944305034590170847846141668402545345369654872771529433646454553696548785217404944305034590170847846	 11361  7321 9484   0630 
2         5633         5464         5501         6541         8138         10624           3         4064         4433         4919         5537         7260         7509           4         2858         3198         3541         4100         4920         5801           5         4202         4542         4896         5745         6481         8245           6         4193         4671         5614         6551         8098         9422           7         3963         4429         5176         6263         7767         8547           8         2721         3109         3523         4193         4671            9         3583         4086         4545         5365         6548         7852           10         2799         3128         3656         4424         5486         6037           11         2933         1315         372         4378         6548         7322           12         3278         3647         4239         5099         6288         7332           13         4049         4430         5034         5901         7084         7846 <td>11561  7321 5484   8830 </td>	11561  7321 5484   8830 
3         4064         4413         4919         5537         7260         7509           4         2858         3198         3541         4100         4920         5801           5         4202         4542         4896         5745         6481         8245           6         4153         4672         5618         6265         7767         8567           7         3963         4429         5176         6265         7767         8567           8         2721         3109         3523         4193         4671            9         3583         4086         4545         5369         6548         7852           10         2799         3128         3636         4424         5486         6037           11         2933         1315         372.         4278         4847            12         3278         3647         4239         5095         6288         7332           13         4049         4430         5034         5901         7084         7846           14         3668         4025         4594         5415         5448         7277	 7321 9484   8630 
4         2858         3198         3541         4100         4920         5801           5         4202         4542         4896         5745         6681         8245           6         4193         4671         5414         6551         8098         9422           7         3963         4429         5176         6263         7767         8547           8         2721         3109         3523         4193         4671            9         3583         4086         4545         5369         6548         7852           10         2799         3128         3636         4424         5486         6037           11         2933         3115         372.         4378         4847            12         3278         3647         4239         5099         6288         7332           13         4049         4430         5034         5901         7084         7846           14         3668         4025         4534         5415         5169         6548         7277           15         2943         3644         4326	7321 9484   8830 
5         4202         4342         4896         5745         6881         8245           6         4193         4671         5418         6551         8098         9433           7         3963         4429         5176         6263         7767         8547           8         2721         3109         3523         4193         4671            9         3583         4086         4545         5365         6548         7852           10         2799         3128         3636         4424         5486         6037           11         2933         1315         3721         4178         4847            12         3278         3647         4239         5099         6288         7312           13         4049         4430         5014         5901         7084         7846           14         3668         4025         4534         5455         5169         6544         7277           15         2943         3644         4326              14         3668         4025         4534         5165         6544         <	9484   8830 
6         4193         4671         5434         6551         8098         9423           7         3963         4429         5176         6263         7767         8547           8         2721         3109         3523         4193         4671            9         3583         4086         4545         5365         6548         7852           10         2799         3128         3636         4424         5486         6037           11         2933         1315         372.         4378         4447            12         3278         3647         4239         5099         6288         7332           13         4049         4430         5514         5901         7084         7846           14         3668         4025         4534         5415         6544         7277           15         2943         3644         4326              16         3581         4086         4545         5369         6548         7852           17         4049         4430         5034         5901         7084         7846 <td>  8830 </td>	  8830 
7         3963         4429         5176         6263         7767         8547           8         2721         3109         3523         4193         4671            9         3583         4086         4545         5369         6548         7952           10         2799         3128         3656         4424         5486         6037           11         2933         3315         372.         4378         4847            12         3278         3647         4239         5099         6288         7332           13         4049         4430         5014         5901         7084         7846           14         3668         4025         4594         5415         6544         7277           15         2943         3644         4326              16         3583         4086         4545         5369         6548         7852           17         4049         4430         5034         5901         7084         7846	  9630 
8         2721         3109         3523         4193         4671            9         3583         4086         4545         5365         6548         7852           10         2799         3128         3656         4424         5486         6037           11         2933         1315         272.         4378         4847            12         3278         3647         4239         5099         6288         7332           13         4049         4430         5034         5901         7084         7846           14         3668         4025         4594         5415         6544         7277           15         2943         3644         4326              16         3583         4086         4545         5369         6548         7852           17         4049         4430         5034         5901         7084         7466	•••• ••30 
9         3383         4086         4545         5365         6548         7852           10         2799         3128         3636         4424         5486         6037           11         2933         3315         372.         4378         4847            12         3278         3647         4239         5099         6288         7332           13         4049         4430         5014         5901         7084         7846           14         3668         4025         4594         5415         6546         7277           15         2943         3644         4326              16         3583         4066         4545         5369         6548         7852           17         4049         4430         5034         5901         7084         7846	<b>8830</b>
10         2799         3128         3636         4424         5486         6037           11         2933         3315         372.         4378         4847            12         3278         3647         4239         5099         6286         7332           13         4049         4430         5014         5901         7084         7846           14         3668         4025         4594         5415         6546         7277           15         2943         3644         4326              16         3583         4066         4545         5369         6548         7852           17         4049         4430         5034         5901         7084         7846	
11         2933         1315         172.         4378         4447            12         3278         3647         4239         5099         6288         7332           13         4049         4430         5034         5901         7084         7846           14         3668         4025         4594         5415         6544         7277           15         2943         3644         4326              16         3583         4066         4545         5369         6548         7852           17         4049         4430         5034         5901         7084         7446	
12         1278         1647         4239         5099         6288         7332           13         4049         4430         5014         5901         7084         7846           14         1668         4025         4594         5415         6544         7277           15         2943         3644         4126              16         3583         4086         4545         5369         6548         7852           17         4049         4430         5034         5901         7084         7446	
13         4049         4430         5034         5901         7084         7846           14         3668         4025         4594         5415         6544         7277           15         2943         3644         4326              16         3583         4086         4545         5369         6548         7852           17         4049         4430         5034         5901         7084         7846	
14         3668         4025         4594         5415         6544         7277           15         2943         3644         4326              16         3583         4086         4545         5369         6548         7852           17         4049         4430         5034         5901         7084         7466	
15         2943         3644         4326              16         3583         4086         4545         5369         6548         7852           17         4049         4430         5034         5901         7084         7846	8925
16         3583         4086         4545         5369         6548         7852           17         4049         4430         5034         5901         7084         7846	8320
17 4049 4430 5034 5901 7084 7846	
	8830
<u> </u>	8925
18 7614 7614 9350 9350 10708 10708	
19 4368 4797 5401 6380 7445 8598	
20 3683 3995 4321 5037 6047 7185	8523
21 5102 5542 5970 6942 8321 9870	11646
22 5521 5882 6447 7041 8315 9707	
23 5039 5351 5839 6350 7366 8465	9692
24 5968 6863 7821 8841	
25 4932 5468 6034 67161-	
26 5967 6612 7554 8849 10355	
27 6533 7610 8773 9915	
28 4932 5468 6034 6716	
29 5967 6612 7554 8849 10355	
30 5751 6688 7611 8413	
31 3663 4203 4683 5689 5960	
32 3731 4047 4387 5012 5860 6850	7443
33         3300         2578         3878         4439         5207         6094	6524
36         3488         4029         4526         5518	
37 4613 5274 6129	
38 3558 4409	
39 3480 4093 5040	
40 3971 4825 5712	
41 2321 2883 3424	
42 3361 3617 4254 5047	
43 3971 4825 5712	
44 2322 2883 3424	
45 3361 3617 4254 5047	
46 2992 4574 5288	
47 3609 4030 4476 4946	
48 4258 5145 6121	
49 4027 4540 5166 6547	
50 4373 4970 5607 7095	
52 2892 3111 3377 3904 4608	
52 3002 3236 3519 4036 4783 5600	
53 3088	
54 2808	
<b>55</b> 4031	

#### TABLE B-3: RUNNAY REQUIREMENTS/OPERATIONAL BOUNDARIES OF THE PROFILE GENERATOR, TEMPERATURE 80°F , ELEVATION 0 FT MSL

	STAGE WEIGHT								
<b>338K 0</b>	1	2	3	•	s	6	, , , , , , , , , , , , , , , , , , , ,		
56	4136					·			
57	3421								
30	3823								
	4071								
59									
60	3248	<u> </u>							
61	5404								
62	4260								
63	3006	3787	5111						
64	1961	ļ							
65	135		[						
66	4302	5485	6558		<u> </u>				
67	2941								
	2853								
69	1381								
70	3546	4683	6014						
71	1694	2069	0						
72	1997	2599							
73	2321					•			
74	704					•••			
75	\$23								
76	1766					•••			
77	780				·				
78	11509					•			
79	4538	7077							
00	\$637	7720				~- <b>~</b>			
<b>81</b>	5022	7504				•			
82	\$707	8528				•••			
83	4118	4582	4973	5806	6945	8390	9984		
84	4463	4031	\$197	6109	7334	8799	10152		
85	3996	4646	\$169	6304			•••		
36	3901	4508	\$066	6182					
87	3009	3262	3537	4052	4754	5569	5963		
	3215	3943	4754						
89	3633	4464	\$268	•					
90	3483	4255	\$112			•••			
92	12306								
92	10171								
93	3544	3929	4493	5267	6169				
94	3283	3640	4017	4472					
95	3346								
96	4579								
97									
98	3978	4733	5637	6539					
			5637	653 <b>9</b> 					
>>	3978	4733	·						
	3978 4520	4733							
<b>,,</b>	3978 4520 2652	4733  			•••				
99 100	3978 4520 2652 4513	4733  5004	  5522	  6146	•••		····		
99 100 101	3978 4520 2652 4513 5460	4733  5004 6050	 5522 6913	 6146 8098	  9476		···· ··· ···		
99           100           101           102	3978 4520 2652 4513 5460 4777	4733  5004 6050 5163	 5522 6913 5564	 6146 6098 6563	  9476 7651	   9004	  10667		
99           100           101           102           103	3978           4520           2652           4513           5460           4777           5189	4733  5004 6050 5163 5613	 5522 6913 5564 6055	 6146 8098 6563 7156	 9476 7651 8356	  5004 9858	  10667 11708		
99           100           101           102           103           104	3978 4520 2652 4513 5460 4777 5189 3000	4733  5004 6050 5163 5613 	 5522 6913 5564 6055 	 6146 6098 6563 7156 	 9476 7651 8358 	  9004 9858 	  10667 11708 		

# TABLE B-3: RUNMAY REQUIREMENTS/OPERATIONAL BOUNDARIES OF THE PROFILE GENERATOR, TEMPERATURE 80°F ELEVATION 0 FT MSL (CONTINUED)

ImageImageImageImageImageImageImageImage11.111.111.111.111.111.111.1111.111.111.111.111.111.111.1111.111.111.111.111.111.111.1111.111.111.111.111.111.111.1111.111.111.111.111.111.111.1111.111.111.111.111.111.111.1111.111.111.111.111.111.111.1111.111.111.111.111.111.111.111.1111.111.111.111.111.111.111.111.111.1111.111.111.111.111.111.111.111.111.1111.111.111.111.111.111.111.111.111.111.1111.11		1	··		STAGE WEIGHT		<u> </u>	
1         9196         9712         920         9843         9445         9718            1         4577         644         6154         6151         6157         6464         11114           4         2255         3641         6151         6551         6597         757         758         2257           4         2255         3641         6517         5540         6461         3227           5         4493         6471         5541         6999         6462         777           14         2771         1169         3212         6419         6711         777         14647         7777           14         2771         1169         3212         6454         6451         7787         6461         7777           14         2799         1213         3454         6451         7785         6411         7771         1164         7771         1164         7771         11647         7771           13         6744         1319         9494         9512         9497         7771         11647           14         6434         6451         1377         6461         771         11647	2300 8	<u> </u>	<u> </u>			,		
3         5756         6422         6736         7955         1442         11134         11139           3         6657         5644         5054         6051         6277         5444         6277           4         6255         3541         4651         6467         5669         6273         5335         6141         6237           4         6451         5454         5659         5973         533         6113         6777         5367         6114         6771           7         3643         6471         5330         6121         7775         5467         6771           8         6428         4429         5376         6413         6771         6775         6467         6771           10         7764         6432         5484         5484         6497         6771         6467         6771           11         3781         6447         15177         6151         7771         614         6771         6774         6774         6771         6774         6771         6774         6771         6774         6771         6774         6771         6774         6771         6774         6774         6773         <		÷						
1         4437         1844         1334         4011         4647         1844         4441         327           1         4451         3849         4464         4641         4272           1         4451         3859         5454         6459         773         515         1555           4         4531         4571         4539         1512         4151         4671            3         2721         2169         3123         2454         4454         6461         777         1547            4         4224         4253         3109         6521         7314         4141         777             13         4744         3125         5846         6451         3457          771         1444         5126         7314         4147         777           14         4314         4537         517         5177         5141         7371         5144         7371           14         4314         4537         5177         5177         15147         777         15147         777         15147         777         15147         777         15147					<u> </u>			
1         1111         1441         4417         1446         6449         1417         1448         6449         1311         1312           1         4413         1441         6449         1311         1314         1344           1         1313         1419         1314         6531         777         1843            1         1319         1319         1319         1418         1414         1411         1411           10         1328         1314         3464         6431         1414         1411         1411           11         1338         13761         6421         1414         1414         1417             12         6444         1414         4974         14381         7971         4141         1917           13         1413         4131         4         6431         1771         4144         1917           14         1431         4131         4         177         4141         1917         1414         1917           15         1443         4555         1994         1521         1399         1302         10000           16				<b> </b>				
1         449         1449         1440         649         797         111         11949           4         6131         469         411         514         6631         6694         4131 $\cdots$ 7         1951         4673         5176         6633         777         657 $\cdots$ $\cdots$ 8         6731         3109         3539         4533         4471 $\cdots$ $\cdots$ 9         6269         3131         3546         4521         4545         1784         6497 $\cdots$ 10         2799         3131         3546         4521         4545         1784         6497 $\cdots$ $\cdots$ 11         3334         3761         4221         4545         1979         1135         1467 $\cdots$		+	<u> </u>	<b></b>				
4       4433       4471       1433       6191       6093       9433          7       364       4439       8374       6433       7787       857          9       6622       4999       3389       6533       7785       8513       9713         10       2799       3134       3644       6431       5444       6497          11       3384       6431       4776       5895       7922       8437          13       3646       6431       6775       5895       7922       8467          14       4314       6431       517       5185       7923       8437          15       3648       6431       757       6461       1284           15       4644       6464       13661       12784       1284           16       6435       7792       8467       1364       1464       1464       1464             17       6445       6437       7325       7937       8437       1463		·	h		<u> </u>			
1         1413         4435         5334         6363         7767         1517            4         3722         3169         3432         4431         4471             1         4622         4692         3539         6502         7735         8813         9913           10         2798         3138         3646         4643         5646         6697            11         3334         3646         4431         4541         5845         7332         8647            13         4646         4517         5771         6103         7773         1345         9677           14         4634         4535         8594         6522         7258         8411         9913           17         4746         5535         8594         6522         7258         8411         9913           14         4624         4535         8594         6522         7258         8411             14         4624         4535         7564         13298         13649             14         4624         4543 <td></td> <td><u> </u></td> <td></td> <td></td> <td></td> <td></td> <td>[</td> <td></td>		<u> </u>					[	
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12144421477419857924497134744517559465216928920164714013465375377621077731125984131461421161440216357537762227353484498111515466522735348449814164624655458946522735348449814176744555458946522735348449814184644186611266112268122041951605864641473576777106409784216051647471557977942911641226265647471557974842911641127892459584467715579202562737485833113083137182667787485833113083137182774644929112341163428673574816535793029678474826439933731632464515534675492497363 <td< td=""><td>10</td><td>2799</td><td></td><td></td><td></td><td></td><td>6037</td><td></td></td<>	10	2799					6037	
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14 $4136$ $4537$ $5177$ $6101$ $7271$ $8191$ $9167$ $15$ $3631$ $4213$ $0$ $14$ $6321$ $9169$ $4592$ $7959$ $6418$ $9913$ $17$ $4744$ $5345$ $9964$ $6422$ $9169$ $9262$ $13467$ $18$ $6464$ $14645$ $10661$ $12208$ $12208$ $193169646664817977136693041304479444454647977136499543216455792281667977136491109421645164537927812911644110942167546453782184412357446106645372368139944311094246755744578337937942911644110942464537821844410041001256755744578337930117426675574456459953734582364577377542464597177341356497264591238484281497659857382$607$	12	3848	4281	4976	5985	7382	\$607	
15         161         4211         0               16         4028         4535         5309         6012         7335         8618         9913           17         4744         5155         5804         6021         7326         9320         12467           18         6644         4644         10661         10664         12208         12208            19         5136         4647         1644         5464         6491         1264         1208            20         6133         7922         4266         9764         11611         12788           21         6693         6335         7922         4264         9764         11611         12788           23         5744         6430         6453         7214         8393         10015         11714             24         6785         7485         4893         10015         11714             25         5823         7485         5831         10015         11714             26         6785	13	4748	5195	5904	6921	\$308	9202	10467
$146$ $4634$ $4435$ $1149$ $4022$ $7253$ $4414$ $9913$ $17$ $4744$ $5155$ $5844$ $6221$ $9262$ $3264$ $31647$ $18$ $5166$ $6464$ $10661$ $136461$ $132294$ $112294$ $11167$ $30$ $6130$ $4479$ $4444$ $5645$ $6773$ $8477$ $8454$ $31$ $6001$ $6313$ $7022$ $41664$ $9784$ $11111$ $117990$ $32$ $6225$ $6474$ $7315$ $7236$ $3323$ $8642$ $112018$ $31$ $6764$ $6329$ $7221$ $41647$ $7315$ $8457$ $7536$ $31$ $5744$ $6100$ $6633$ $7236$ $3323$ $8642$ $112018$ $34$ $5843$ $6437$ $7821$ $8414$ $\cdots$ $\cdots$ $\cdots$ $34$ $5843$ $6457$ $7235$ $7336$ $3333$ $8642$ $112018$ $34$ $5843$ $6457$ $7221$ $8451$ $1353$ $11718$ $\cdots$ $\cdots$ $34$ $5831$ $6457$ $7235$ $7336$ $31718$ $\cdots$ $\cdots$ $\cdots$ $37$ $7664$ $4927$ $12244$ $1424$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ $39$ $6738$ $7485$ $8531$ $10015$ $11718$ $\cdots$ $\cdots$ $\cdots$ $39$ $6738$ $7485$ $8531$ $10015$ $13718$ $\cdots$ $\cdots$ $\cdots$ $31$ $6422$ $7242$ $6429$ $8577$ $\cdots$	14	4136	4537	\$177	6101	7371	8195	9367
17         4744         5155         1964         4821         1936         9222         19447           18         6644         6644         10661         11200         11204            13         5146         5664         6313         7537         19797         11046            20         4156         6473         7123         7177         1943         11041         1.2709           21         6465         6574         7215         7987         9433         11084            22         6465         6574         7215         7987         9433         11081            23         5744         6437         7125         7950              24         5956         6437         7125         7950              25         5823         6437         7125         7950              26         6738         7465         8953         10215         11718             27         7664         8929         10254         11614<	15	3403	4213	0				
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13         1140         5454         6111         7337         1797         10160            30         4130         4477         4444         54645         4775         8647         9543           31         6001         6533         7722         91.664         9784         11.024            32         6265         6674         7315         7997         94.20         1.004            31         5744         6400         6655         7216         8193         964.3         1.1031           34         5823         6487         7233         7936              34         5823         6487         7235         7930              36         5823         6487         7235         7930              37         7664         9529         10254         11614              38         5823         6457         7325         7930               39         6452         7482	17	4748	\$195	5904	<b>69</b> 21	8308	9302	10467
$30$ $4134$ $4479$ $4444$ $5463$ $6775$ $8847$ $9543$ $31$ $6003$ $6339$ $7022$ $8.56$ $9789$ $11643$ $11700$ $32$ $4265$ $4674$ $7135$ $7917$ $8429$ $11644$ $\cdots$ $33$ $5764$ $6130$ $6655$ $7216$ $8329$ $9643$ $11684$ $34$ $5569$ $6481$ $7821$ $8441$ $\cdots$ $\cdots$ $\cdots$ $35$ $5823$ $6457$ $7125$ $7930$ $\cdots$ $\cdots$ $\cdots$ $37$ $7666$ $8929$ $10254$ $11614$ $\cdots$ $\cdots$ $\cdots$ $38$ $5823$ $6457$ $7125$ $7936$ $11718$ $\cdots$ $\cdots$ $39$ $6755$ $7445$ $8551$ $10035$ $11718$ $\cdots$ $\cdots$ $30$ $6422$ $7822$ $6629$ $9537$ $\cdots$ $\cdots$ $\cdots$ $31$ $4324$ $4661$ $5524$ $6755$ $9566$ $31$ $4324$ $4661$ $5524$ $6755$ $8566$ $32$ $4136$ $4550$ $6533$ $5614$ $6685$ $7655$ $8566$ $33$ $3644$ $3994$ $4234$ $4646$ $5644$ $6649$ $7127$ $34$ $4551$ $4592$ $6306$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ $31$ $4124$ $4567$ $5731$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ $31$ $3164$ $4597$ $7312$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ $34$ <td>3.0</td> <td>8684</td> <td>8684</td> <td>10661</td> <td>10661</td> <td>13208</td> <td>12206</td> <td></td>	3.0	8684	8684	10661	10661	13208	12206	
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31         5744         410         6455         7216         8191         9641         11088           24         3964         6451         7821         8441              25         5823         6457         7123         7930              36         6785         7445         8531         33015         13718             37         7666         6929         10394         11634               38         3923         6457         7125         7930               30         6521         7922         8629         9337               31         4136         4550         4933         5614         6515         7695         8140           33         3666         3989         4324         4444         5444         5444         7127           34         1605         4672         4407         3127         6249         7283            35         4159         5	21	6001	6519	7022	8166	9788	11611	13700
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26         6755         7465         8832         10015         11714             27         7664         6929         10234         11614              28         5523         6457         7125         7930              29         6735         7485         8531         10015         11718             30         6521         7382         8629         9337              31         9324         4550         6933         5614         6583         7695         8346           32         4134         4550         6933         5614         6583         7695         8346           33         3665         4072         6407         5177         6249         7183            34         3605         4514         5952         6206              35         4135         4721         5320         6324              36         13936         6451         5509 <td< td=""><td>24</td><td>5964</td><td>6863</td><td>7821</td><td>\$841</td><td></td><td>•••</td><td>•••</td></td<>	24	5964	6863	7821	\$841		•••	•••
$27$ 766689291023411614 $\cdots$ $\cdots$ $\cdots$ $28$ 5823645771257930 $\cdots$ $\cdots$ $\cdots$ $\cdots$ $29$ 6735746585511001511718 $\cdots$ $\cdots$ $30$ 6521798266299537 $\cdots$ $\cdots$ $\cdots$ $31$ 43244961552867148218 $\cdots$ $\cdots$ $32$ 4386455045935524658466497117 $34$ 366546724647317762497383 $\cdots$ $35$ 4159472153206520 $\cdots$ $\cdots$ $\cdots$ $36$ 392645345696 $\cdots$ $\cdots$ $\cdots$ $\cdots$ $37$ 46284601 $\cdots$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ $38$ 40815509 $\cdots$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ $40$ 468156516690 $\cdots$ $\cdots$ $\cdots$ $\cdots$ $41$ 273233684690 $\cdots$ $\cdots$ $\cdots$ $\cdots$ $42$ 2957425950095941 $\cdots$ $\cdots$ $\cdots$ $43$ 467453556191 $\cdots$ $\cdots$ $\cdots$ $\cdots$ $44$ 479557924849 $\cdots$ $\cdots$ $\cdots$ $\cdots$ $42$ 2957425950095941 $\cdots$ $\cdots$ $\cdots$ $43$ 468151285191 $\cdots$ $\cdots$ $\cdots$ $\cdots$ $44$ 47955792<	25	5823	6457	7125	7930			
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29         6755         7485         8551         10015         11728             30         4521         7842         8629         9537              31         4324         4961         5528         6716         8218             32         4135         4550         4933         5614         6555         7695         8360           33         3665         3999         4236         4648         5664         6669         7117           34         3665         4072         4607         3177         6249         7383            35         4159         4721         5320         6520              36         3926         4534         5992         6206              37         5428         6207         7212               38         4081         5631         6590               40         4651         5653         5690        <	27	7666	8929	10294	11634			
$10$ $6521$ $7892$ $8629$ $9537$ $\cdots$ $\cdots$ $\cdots$ $31$ $4124$ $4961$ $5528$ $6716$ $8218$ $\cdots$ $\cdots$ $32$ $4196$ $4550$ $64331$ $5614$ $6585$ $7695$ $8160$ $33$ $3606$ $3999$ $4226$ $4448$ $5664$ $6669$ $7117$ $34$ $2605$ $4072$ $4607$ $5177$ $62e9$ $7383$ $\cdots$ $35$ $4159$ $4721$ $5320$ $6520$ $\cdots$ $\cdots$ $\cdots$ $36$ $3926$ $6534$ $5592$ $6206$ $\cdots$ $\cdots$ $\cdots$ $37$ $5428$ $6207$ $7212$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ $38$ $4081$ $5000$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ $39$ $3955$ $6663$ $5741$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ $40$ $4651$ $5631$ $6590$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ $41$ $2712$ $3164$ $4001$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ $42$ $1957$ $4259$ $5009$ $5943$ $\cdots$ $\cdots$ $\cdots$ $44$ $2712$ $3164$ $4001$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ $451$	28	5823	6457	7125	7930			***
11         4324         4961         5528         6736         8218             32         4196         4550         4933         5634         6585         7695         8360           33         3666         3969         4236         4648         5644         6649         7117           34         3665         4672         4667         5177         6249         7383            35         4159         4721         5330         6520              36         3936         4334         5092         6266              37         5428         6207         7212               38         4061         5000                 39         3955         6663         5741               40         4651         5651         6650               41         2712         3364         4001 <td>29</td> <td>6755</td> <td>7485</td> <td>8551</td> <td>10015</td> <td>11718</td> <td></td> <td>•</td>	29	6755	7485	8551	10015	11718		•
12         4196         4550         4933         5634         6585         7695         8360           33         1606         1909         4236         4448         5644         6649         7117           34         3605         4072         4607         5177         6249         7383            35         4159         4721         5120         6520              36         3926         4534         5092         6206              37         5428         6207         7212                38         4081         5000                 39         3955         6663         5741 <td>30</td> <td>6521</td> <td>7582</td> <td>8629</td> <td>9537</td> <td></td> <td></td> <td></td>	30	6521	7582	8629	9537			
33         3666         3969         4336         4446         5644         6645         7117           34         3605         4072         4607         5177         6249         7383            35         4159         4721         5320         6520               36         3926         4534         5092         6206               37         5424         6207         7212                 38         4081         5090	31	4324	4961	5528	6716	8216		
$14$ $1605$ $4072$ $4607$ $5177$ $6249$ $7383$ $\cdots$ $15$ $4153$ $4721$ $5320$ $6520$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ $16$ $1926$ $4534$ $5092$ $6206$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ $37$ $5428$ $6207$ $7212$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ $38$ $4081$ $5000$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ $39$ $3955$ $4663$ $5741$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ $40$ $4651$ $5651$ $6690$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ $41$ $2712$ $3364$ $4001$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ $42$ $3957$ $4259$ $5009$ $5943$ $\cdots$ $\cdots$ $\cdots$ $44$ $2712$ $3364$ $4001$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ $44$ $2712$ $3364$ $4001$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ $45$ $3957$ $4259$ $5009$ $5943$ $\cdots$ $\cdots$ $\cdots$ $44$ $2712$ $3364$ $4001$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ $46$ $474$ $5135$ $6131$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ $46$ $4674$ $5135$ $5009$ $5943$ $\cdots$ $\cdots$ $\cdots$ $46$ $4674$ $5135$ $5009$ $5943$ $\cdots$ $\cdots$ $\cdots$ $46$ $474$ $5135$ $5131$ $\cdots$ $\cdots$ $\cdots$ $\cdots$ $47$	32	4196	4550	4933	5634	6585	7695	8360
15       4159       4721       5320       6530            36       3936       4534       5092       6206            37       5428       6207       7212             38       4001       5000              39       3965       6663       5741             40       4651       5651       6690             41       2712       3364       4001             42       1957       4259       5009       5943            43       4651       5651       6690             44       2712       3364       4001             44       2712       3365       6191             45       3957       4259       5009       5943	33	3606	3905	4236	4848	5684	6649	7117
15       4159       4721       5320       6530            36       3936       4534       5092       6206            37       5428       6207       7212             38       4001       5000              39       3965       6663       5741             40       4651       5651       6690             41       2712       3364       4001             42       1957       4259       5009       5943            43       4651       5651       6690             44       2712       3364       4001             44       2712       3365       6191             45       3957       4259       5009       5943	34	3605	4072	4607	5177	6249	7383	
37       5428       6207       7212             38       4081       5000               39       3965       4663       5741              40       4651       5653       6690              41       2712       3368       4001              42       3957       4259       5609       5943            43       4651       5651       6690             44       2712       3368       4001             44       2712       3368       4001              45       3957       4259       5009       5943             46       4674       5355       6191 <td>35</td> <td>4159</td> <td></td> <td>5320</td> <td>6520</td> <td></td> <td>•••</td> <td>• • •</td>	35	4159		5320	6520		•••	• • •
37       5428       6207       7212             38       4081       5000               39       3965       4663       5741              40       4651       5653       6690              41       2712       3368       4001              42       3957       4259       5609       5943            43       4651       5651       6690             44       2712       3368       4001             44       2712       3368       4001              45       3957       4259       5009       5943             46       4674       5355       6191 <td>36</td> <td>3926</td> <td>4534</td> <td>5092</td> <td>6206</td> <td></td> <td></td> <td></td>	36	3926	4534	5092	6206			
39         3965         4663         5741               40         4651         3651         6690               41         2712         3368         4001               42         3957         4259         5009         5543              43         4651         3651         6690               44         2712         3368         4001               44         2712         3368         4001               45         3957         4259         5009         5543              45         3957         4259         5009         5543              46         4674         5355         6191               47         4094         4571         5076         5608          -		<b></b>	6207	7212				
39         3965         4663         5741               40         4651         3651         6690               41         2712         3368         4001               42         3957         4259         5009         5543              43         4651         3651         6690               44         2712         3368         4001               44         2712         3368         4001               45         3957         4259         5009         5543              45         3957         4259         5009         5543              46         4674         5355         6191               47         4094         4571         5076         5608          -	38	4081	5000					
40       4651       5651       6690             41       2712       3368       4001             42       3957       4259       5009       5943            43       4651       5651       6690             44       2712       3368       4001             44       2712       3368       4001             44       2712       3368       4001             44       2712       3368       4001             45       3957       4259       5009       5943             46       4674       5355       6191             47       4094       4571       5076       5608            48       4795       5792       6189		<b></b>		5741		<u> </u>		
41       2712       3364       4001             42       3957       4259       5009       5943            43       4651       5651       6690             44       2712       3368       4001             44       2712       3368       4001             45       3957       4259       5009       5543             46       4674       5355       6191              47       4094       4571       5076       5608             48       4795       5792       6489              49       4548       5128       5834       7391             50       5029       5715       6447       4157								•••
42       3957       4239       \$009       5543            43       4651       5651       6690             44       2712       3368       4001             45       3957       4259       5009       5543            46       4674       5355       6191             46       4674       5355       6191             47       4094       4571       5076       5608            48       4795       5792       6889             49       4548       5128       5814       7391            50       5029       5715       6447       4157            51       3259       3506       3806       4199       5191           52       3287       3541       3851       4414       5229 <td></td> <td><u></u></td> <td></td> <td></td> <td><u>├</u></td> <td> </td> <td></td> <td></td>		<u></u>			<u>├</u>			
41       4651       5651       6690             44       2712       3368       4001             45       3957       4259       5009       5543            46       4674       5355       6191             47       4094       4571       5076       5608            48       4795       5792       6489             49       4548       5128       5814       7391            50       5029       5715       6447       6157            51       1259       3506       3806       4199       5191           52       3287       3541       1851       4414       5229       6119          53       3377               54       3281								
44       2712       3364       4001             45       3957       4259       5009       5543            46       4674       5355       6191             47       4094       4571       5076       5608            48       4795       5792       6489             49       4548       5128       5834       7391            50       5029       5715       6447       8157            51       3259       3506       3806       4199       5191           52       3287       3541       3851       4414       5229       6119          54       3281				<u></u>	h			
45         3957         4259         5009         5943              46         4674         5353         6191               47         4094         4571         5076         5608              48         4795         5792         6489               49         4548         5128         5814         7391              50         5029         5715         6447         8157              51         3259         3506         3406         4399         5191             52         3287         3541         1451         6414         5229         6119            53         3377                 54         3281								
46       4674       5355       6191             47       4094       4571       5076       5608            48       4795       5792       6489             49       4548       5128       5434       7391            50       5029       5715       6447       8157            51       1259       1506       3406       4199       5191           52       1287       3541       1851       4414       5229       6119          53       3377               54       1281								
47       4094       4571       5076       5608            48       4795       5792       6889             49       4548       5128       5834       7391            50       5029       5715       6447       8157            51       1259       1506       1806       4199       5191           52       3287       1541       1851       4414       5229       6119          53       3377               54       1281				<u>}</u>	<u> </u>			·
48         4795         5792         6489                49         4548         5128         5834         7391               50         5029         5715         6447         8157              51         3259         3506         3806         4399         5191             52         3287         3541         3451         4414         5229         6119            53         3377                 54         3281		<u> </u>						·
49         4548         5128         5834         7391             50         5029         5715         6447         8157             51         1259         2506         3806         4399         5191             52         3287         3541         3851         4414         5229         6119            53         3377                 54         3281		<b></b>			·			
50         5029         5715         6447         8157              51         1259         1506         3806         4199         5191             52         3287         3541         1851         4414         5229         6119            53         3377                54         3281		<u></u>						
51         1259         1506         3806         4199         5191             52         3287         3541         3851         4414         5229         6119            53         3377                54         3281	<u> </u>	·····				<u> </u>		
52         3287         3541         3851         4414         5229         6119            53         3377                 54         3281								
53         3377 <td></td> <td>·</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>		·						
54 3281			<u> </u>	f	f		<u> </u>	
┉┉┉┉┉┼┉┉┼┼┉┉┼┼┉┉┼┼┉┉╌┼┙╴┉┉┉┼┉┝╴╴╴╴╴╴╴┝╴╴╴╴╴╸┝╴╴╴╴╴╴						<u>├</u>	<u></u>	·
<u>35 4770 ··· ·· ·· ·· ·· ·· ·· ·· ·· ·· ·· ·· ·</u>				<u> </u>		· · · · · · · · · · · · · · · · · · ·		
	55	4770		<u> </u>	l	l		

# TABLE B-4: RUBMAY REQUIREMENTS/OPERATIONAL BOUNDARIES OF THE PROFILE GENERATOR, TEMPERATURE 59\*F ELEVATION 3000 FT MSL

B-17

54 57	1				STAGE WEIGHT								
		2	3	•	5	6	,						
37	4136					•••	•••						
	3647												
58	4240												
59	4790												
60	3458			·									
61	5394												
62	4798												
63	3261	4100	5545										
64	2156	•••		•••									
65	1464		•••	•			•••						
66	4667	5951	7115	•••		•••							
67	3191					•••							
68	3095			•	•••		•••						
69	1499												
70	3847	5081	6525										
71	1838	2245	0										
72	2167	2820											
73	2518			•••									
74	764												
75	893				•••								
76	1916			•••									
77	\$46												
78	13454												
79	5094	7944											
80	6328	8665											
01	5441	6141											
82	6192	9252											
83	4637	5160	5599	6535	7815	9662	11228						
84	5043	5459	5872	6900	8281	9932	11457						
85	4503	5235	5823	7099									
86	4233	4890	5494	6698									
87	3464	3755	4071	4654	5471	6408	6861						
	3717	0	0		•••		•••						
83	3949	4849	\$718										
90	4003	4896	5881		•••								
91	13820		•••										
92	11445				•••								
93	4029	4466	5106	5985	7008								
94	3800	4214	4650	\$176									
95	3660												
96	5268												
97	4698	5591	6659	7725									
98	5066												
99	2913												
100	4513	5004	\$522	6146									
101	5460	6050	6913	8098	9476								
102	4968	\$367	5783	6816	7939	9335	11051						
103	5183	5603	6041	7131	0316	9796	11616						
104	3000												
105	3000					•••							
	3000					•••							
106				l	h								

# TABLE B-4: RUNNAY REQUIF MENTS/OPERATIONAL BOUNDARIES OF THE PROFILE GENERATOR, TEMPERATURE 59°F ELEVATION 3000 FT MSL (CONTINUED)

	r	· · · · · · · · · · · · · · · · · · ·		STAGE WEIGHT	_,		
110f 8							<u> </u>
	1	2	3	•	5	6	7
1	4358	4732	5223	5862	7565	7788	
3	5290	5724	6176	7263	8723	10484	12088
3	4256	4642	5150	\$796	7597	7857	
4	2995	3350	3709	4293	\$152	6073	7661
5	4315	4664	5027	5896	7059	8456	9723
6	4193	4671	5438	6351	8094	9433	•••
7	3963	4629	\$176	6263	7767	8547	
•	3721	3109	3523	4193	6671		
,	3706	4226	4700	5550	6767	8112	9120
10	2799	3128	3656	4626	5486	6037	
11	3062	3460	3884	4368	5057		
12	3540	3939	4578	5506	6791	7918	•••
13	4368	4780	5432	6367	7643	8466	9630
14	3805	4174	4763	5613	6781	7539	8617
15	3130	3875	0				
16	3706	4226	4790	5550	6767	\$112	9120
17	4368	4780	5432	6367	7643	8466	9630
18	7989	7989	9808	9808	11231	11231	•••
19	4747	\$213	5870	6934	8093	9347	
20	3799	4121	4456	5193	6233	7403	8779
21	5521	5997	6460	7513	9005	10682	12604
22	5764	6140	6729	7348	8675	10124	
23	5284	5611	6122	6657	7721	8871	10154
24	5968	6863	7821	\$841		••••	
25	5357	5940	6554	7295			•••
26	6215	6886	7867	9214	10780		•
27	7052	8215	9470	10703			•••
28	5357	5940	6554	7295		•••	
29	6215	6886	7867	9214	10780		
30	5993	6976	7938	\$774			•
31	3978	4564	5086	6179	7560		
32	3860	4186	4538	5283	6058	7079	7691
33	3317	3596	3897	4460	5229	6117	6547
34	3316	3746	4238	4763	5749	6792	
35	3826	4343	4895	5998			
36	3607	4165	4678	\$701			
37	4994	5710	6635	•			+
38	3754	4600					
39	3648	4290	5262				
40	4279	5199	6155				
41	2495	3099	3681				
42	3640	3918	4608	5467			
43	4279	5199	6155				
44	2495	3099	3681	•••			
45	3640	3918	4608	5467			
46	4300	4927	5696				
47	3766	4206	4670	5160			•••
43	4411	5329	6337				
49	4184	4717	\$367	6799			
50	4626	5257	5931	7505			
51	2998	3225	3502	4047	4775		
52	3023	3257	3542	4060	4809	5628	
53	3107						
54	3019						
55	4388						
	**************************************	•	••••••••••••••••••••••••••••••••••••••	·	<u> </u>	• · · · · · · · · · · · · · · · · · · ·	

# TABLE B-5: RUNWAY REQUIREMENTS/OPERATIONAL BOUNDARIES OF THE PROFILE GENERATOR, TEMPERATURE 40°F RLEVATION 3000 FT MSL

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B-19

[	T	······································		STAGE WEIGHT			
2384 8	1	2	3	•	s	6	7
36	4136						
\$7	3355						
54	3901						
39	4407	<u> </u>					
60	3381	•••		·			
61	5514				<u> </u>		
62	4414						
63	2945	3710	5007	•••			·
	1983						
65	1322						
66	4214	5373	6424			·	
67	2001						
	2795	<u> </u>					
69 	1353		5892				
70	3474	4588	0				
71	1660	2027	<u>├──</u> ──				
72	1957	2546					
73	2274						
74	690					h	•••
75	896						
76	1730						
17	764						
78	12377						
79	4686	7308					
80	\$822	7972		•••			
81	4920	7351					
82	5591	8354					
83	6266	4747	5151	6012	7189	8885	10329
	4639	5022	5402	6348	7618	9137	10540
45	4143	4816	\$357	6531			
86	3895	4499	5054	6162		•••	
87	3186	3455	3745	4290	5033	5895	6312
	3420	4193	0		ļ		
	3633	4461	5261				
90	3687	4505	5411				
91	12695						
92	10529	ļ			····		
93	3706	4100	4697	5506	5443		
94	3496	3877	4278	4762			
95	3367						
96	4846						
97	4322	5143	6126	7107			
98	4661						
<b>99</b>	2680						
100	4513	5004	5522	6146			
101	5460	6050	6913	8098	9476		
102	4224	4563	4915	5790	6742	7923	9374
103	4333	4683	5047	5953	6939	8166	9675
104	3000						
105	3000		•				
106	3000						
	3000						

#### TABLE B-5: RUNNAY REQUIREMENTS/OPERATIONAL BOUNDARIES OF THE PROFILE GENERATOR, TEMPERATURE 40°F, ELEVATION 3000 FT MSL (CONTINUED)

			<u></u>	STAGE VEIGHT			
2301 E			·····	·····	····		<u></u>
	1	2	,,	•	\$	6	,
1	4358	4732	5223	5842	7565	7788	
2	6283	6799	7336	\$628	10362	12453	14358
3	5056	5514	6117	6885	9023	9332	
•	3857	3979	4405	5100	6120	7213	9099
5	5126	5540	5971	7003	4385	10044	21549
6	4193	4671	5438	6351	8098	9433	
7	3963	4429	\$176	6263	7767	8547	····
8	2721	3109	3523	4193	4671		
9	4402	5020	5583	6592	8037	9636	10833
10	2799	3128	3656	4424	5486	6037	
11	3637	4110	4613	5426	6007		
12	4205	4678	5438	6341	1066	9405	
13	5189	5677	6452	7563	9079	10056	11438
14	4519	4958	5658	6667	8055	8955	10236
15	3718	0	0				
16	4402	5020	5583	6392	\$037	9636	10833
17	5289	\$677	6452	7563	9079	10056	11436
10	9489	9489	11650	11650	13340	13340	
19	5638	6192	6973	8237	9613	11102	
20	4513	4895	\$293	6168	7403	8794	10428
21	6558	7123	7673	8924	10696	12688	14971
22	6846	7293	7993	\$728	10384	12025	
23	6277	6665	7272	7908	9171	10537	12062
24	5968	6863	7821	8941			
25	6363	7056	7785	8666			····
26	7342	8179	9344	10944	12805		
27	8377	9758	11249	12713			
28	6363	7056	7785	\$666			
29	7382	\$179	9344	10944	12805		
30	7126	8286	9429	10422			
31	4725	5422	6041	7339	8980		
32	4545	4973	5390	6157	7196	8409	9136
33	3940	4272	4629	5297	6211	7265	7777
34	3939	4450	5034	5657	6829	8068	
35	4545	\$159	5014	7125			
36	4297	4962	5573	6792			
37	5911	6782	7601		·	<u>}</u>	<u> </u>
38	4460	5464					
39	4333	5096	6274				
40	5082	6176	7311				
41	2964	3681	4372				
42	4324	4654	5473	6494			
43	5082	6176	7311				
	2964				<u>├</u>		·
44							
45	·····	3681	4372	ļ			
	4324	4654	5473	6494			
46	4324	4654	5473 6766	6494			
47	4324 5108 4473	4654 5852 4995	5473 6766 5547	6494  6129	 	···-	
47	4324 5108 4473 5240	4654 3852 4995 6330	5473 6766 5547 7528	6494  6129 	  	···-	···· ····
47 48 49	4324 5108 4473 5240 4970	4654 5852 4995 6330 5603	5473 6766 5547 7528 6375	6494  6129  4076		···· ···· ····	  
47 48 49 50	4324 5108 4473 5240 4970 5495	4654 5852 4995 6330 5603 6245	5473 6766 5547 7528 6375 7045	6494  6129  8076 8914	   	···· ···· ····	
47 48 49 30 51	4324 5108 4473 5240 4970 5495 3561	4654 5852 4995 6330 5603 6245 3832	5473 6766 5547 7528 6375 7045 4159	6494  6129  8076 8914 4807	   5672	···· ···· ···· ····	  
47 48 49 50	4324 5108 4473 5240 4970 5495	4654 5852 4995 6330 5603 6245	5473 6766 5547 7528 6375 7045	6494  6129  8076 8914	   	···· ···· ····	
47 48 49 30 51	4324 5108 4473 5240 4970 5495 3561	4654 5852 4995 6330 5603 6245 3832	5473 6766 5547 7528 6375 7045 4159	6494  6129  8076 8914 4807	   5672	···· ···· ···· ····	   
47 48 49 30 51 52	4324 5108 4473 5240 4970 5495 3561 3593	4654 5852 4995 6330 5603 6245 3431 3871	5473 6766 5547 7528 6375 7045 4159 4210	6494  6129  8076 8914 4807 4825 	   5672 5716	···· ···· ···· ····	    

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#### TABLE B-6: RUNNAY REQUIREMENTS/OPERATIONAL BOUNDARIES OF THE PROFILE GENERATOR, TEMPERATURE \$0°F, ELEVATION 3000 FT MSL

<u> </u>	1		<u></u>	STAGE WEIGHT		<u></u>	
3384 0	1	2	3	<u>г</u>	5		7
54	6136						
\$7	3985						
58	4633						
59	5234						
60	3779			•••			
61	6330						
62	\$243	<u> </u>					
63	3635	4580	6181				
64	2356						
65	1632				•••		
66	5203	6633	7930				
	3556						
67	3450						
<u>60</u>		<u> </u>					
69	1670		7273				
70	4289	5663		ļ		<u> </u>	
71	2049	2502	0				
72	2415	3143			L	<u> </u>	
73	2807						
74	851					•••	
75	395						
76	2136						
77	943			•••			
78	14703						•••
79	5366	8681					
80	6925	9469	•••	•••			
<u>\$1</u>	6473	9074			•••		
82	6902	10313					
83	5067	5638	6118	7142	8540	10559	12269
	5511	5965	6417	7540	9049	19653	12519
85	4921	5721	6363	7758	•••		•••
86	4626	5344	6003 .	7320			•••
87	3785	4103	4449	5096	\$979	7002	7497
\$8	4962	0	•				
89	4315	\$299	6249	*			•••
90	4380	5351	6427				
91	15127						
92	12506						
93	4402	4380	\$579	6540	7659		
94	4153	4605	5081	3656			
95	3999						
96	5756						
97	5134	6109	7276	8442			
98	5536						
99	3183				•••		
100	4\$13	5004	5522	6246			
101	5460	6050	6913	8098	9476		
102	5970	6451	6952	8200	9557	11245	13320
103	6372	6892	7433	8782	10254	12089	14351
104	3000						
105	3000						
106	3000						
107	3000						

# TABLE B-6: RUBNAY REQUIREMENTS/OPERATIONAL BOUNDARIES OF THE PROFILE GENERATOR, TEMPERATURE \$0°F ELEVATION 3000 FT MSL (CONTINUED)

<b></b>	1		<u> </u>	STAGE WEIGHT			
2380 8		<u> </u>	<u> </u>	<del>,</del>			
	1	2	3	4	5	6	7
1	4358	4732	5223	5842	7545	7788	
3	7231	7823	8441	9925	11917	14319	16507
3	5819	6346	7039	7922	10380	20735	
•	4096	4581	5072	\$870	7043	6300	10467
5	\$763	6227	6711	7870	9419	11279	12966
·	6193	4671	5438	6551	\$608	9433	•••
7	3963	4429	5176	6263	7767	8547	
•	2721	3109	3523	4193	4671		
,	4949	5642	6274	7406	9027	19818	12160
10	2799	3126	3656	4424	5486	6037	•••
22	6162	4680	5252	6176	6837		
12	4961	\$\$20	6416	7717	9518	11098	
13	6117	6692	7605	8915	10702	11656	13484
14	5128	5625	6418	7561	9132	10151	11600
15	0	0	•				
26	4949	3642	6274	7406	9027	10818	12160
17	6117	6692	7605	8915	10702	11854	13484
18	10886	10286	13362	13362	15298	15298	••••
19	6694	7351	\$279	9780	11415	13185	
20	5095	5525	5974	6961	8352	9918	11758
21	7753	8422	9072	10550	12646	15002	17702
22	7867	\$316	9112	9948	11741	13698	
23	7189	7634	8328	9054	10499	12061	13803
24	5968	6863	7821	8841			
25	7483	8298	9156	10191			
26	\$729	9671	11049	12942	25142		
27	9952	11592	13365	15105			
28	7483	8298	9156	10191			
29	\$729	9671	11049	12942	15142		
30	8423	9795	11146	12320			
31	5605	6432	7167	8708	10655		
32	5191	5629	6101	6967	8140	9510	10331
33	4347	4712	5105	5840	6845	8004	8566
34	4329	4887	5529	6221	7493	8848	
35	4985	5656	6372	7804			
36	4868	5620	6311	7689			
37	7016	8023	9323				
38	5089	6235					
39	4966	3840	7188	<u> </u>			
40	5983	7270	8607				
41	3481	4323	5135				
42	5121	5512	6483	7632			
43	5983	7270	8607				
44	3481	4323	5135				
44	5121	4 <i>323</i> 5512	6483	7692			
		5512 6887	+			<u> </u>	·
46	6011		7962		l		
47	5288	5905	4557	7245			
48	5939	7173	4529				•••
49	5650	6368	7245	9176			
50	6354	7220	\$145	10305			
51	4040	4346	4718	5451	6431		
52	3970	4276	4649	5327	6308	7378	
53	4103						•••
54	4172						
55	6104						

#### TABLE B-7: NUMMAY REQUIREMENTS/OPERATIONAL BOUNDARIES OF THE PROFILE GENERATOR, TEMPERATURE 59°F, ELEVATION 6000 FT MSL

			<u></u>	STAGE MEIGHT			
<b>3304 8</b>	1	2	3	•	5	6	7
56	4136						
\$7	4399			•••			
58	5180						
59	6192	•••		•••			••••
60	4168			•			
61	7322						
62	6054			•••	•••		
63	3960	4989	6733	•••			
64	2613			•••			
65	1778						
66	\$467	7225	8639				
67	3874						
4	3758				•••		
69	1820			•••			
70	4672	6169	7923			•••	•••
71	2232	2726	•				•
72	2631	3424				•••	
73	3057					•••	
74	928						
75	1084					•••	•••
76	2327						•••
77	1027			•••			••••
78	17276					•••	•••
79	6260	9762		•••	•••		
80	7779	10648					
81	6626	3885					
82	7519	11234		•••			•••
83	5744	6391	6934	8092	9673	11956	11009
84	6267	6783	7296	8571	10283	12329	14210
85	5582	6488	7215	8794			•••
86	\$073	5858	6578	8016			•
97	4381	4749	5148	5497	6918	8101	8674
88	0	0	0				•••
89	4739	5815	6854	•••			•••
90	5068	6190	7434	•••			
91	17102			•••		• • •	
92	14072				•••	•••	
93	5034	\$580	6378	7475	8753	•••	
94	4832	5359	5913	6582	•••		
95	4448				•••		
96	6659						•••
97	6095	7253	8639	10023			
98	6323						
<b>99</b>	3528						
100	4513	5004	5522	6146	•	•	
101	5460	6050	6913	8098	9476		
102	6256	6758	7281	8581	3994	11750	13906
103	6435	6955	7498		10319	12149	14402
104	3000				•••		
	3000					·	
105	3000						
105	3000						

#### TABLE B-7: RUMMAY REQUIREMENTS/OPERATIONAL BOUNDARIES OF THE PROFILE GENERATOR, TEMPERATURE 59°F , ELEVATION 6000 PT MSL (CONTINUED)

[]			<u> </u>	STAGE WEIGHT			
TIME &				<b></b>			
	1	2	3		5	6	7
1	4358	4732	5223	5842	7545	7788	
2	6652	7197	7766	9131	10964	13173	15186
3	5354	5838	6476	7288	9549	9476	
•	3768	4215	4666	5400	6479	7636	9630
5	5302	5729	6174	7240	8665	16376	11928
	4193	4671	5438	6551	\$094	9433	
	3963	4429	\$176	6263	7767	8547	•••
•	2721	3189	3523	6193	4671		
,	4553	5190	\$772	6813	8304	9952	11187
10	2799	3128	3656	4424	5446	6037	
11	3811	4305	4832	5682	6230		
73	4564	5678	5902	7100	8756	10210	
13	5627	6157	6997	\$202	9846	10986	12405
14	4718	\$175	5904	6956	\$401	9338	10671
15	0	•	•			•••	
16	4553	\$190	5772	6813	8304	9952	11187
17	\$627	6157	6997	\$202	9846	10906	12405
18	10014	10014	12293	12293	14074	14074	
19	6158	6763	7616	8997	10501	12129	
20	4687	5083	5496	6404	7684	9124	10817
21	7132	7748	8346	9706	11634	13861	16285
22	7182	7650	6363	9152	10801	12602	
2)	6614	7023	7661	#330	9659	11096	12698
24	5968	6863	7621	8841			
25	6885	7634	8423	9376			
26	\$030	##94	10165	11906	13930		
27	9155	10665	12295	13896			•••
28	6885	7634	8423	9376			
29	8030	8898	10165	11906	13930		
30	7749	9011	10254	11334			
31	5157	5917	6594	8011	9803		
32	4775	5178	5613	6409	7489	8749	9504
33	3999	4335	4697	\$373	6297	7364	7881
34	3982	4497	5086	5714	6894	8140	
35	4586	5203	5862	7179			•••
36	4472	5263	5798	7064			
37	6455	7381	8577				
38	4682	\$736	•••		•••		
39	4569	5373	6613	•			
40	5504	6689	7918		<u> </u>		
41	3202	3977	4724				
42	4717	5071	5964	7077		<u> </u>	
43	5504	6689	7918				
44	3202	3977	4724				
45	4712	5071	5964	7077			
46	5530	6336	7325				
		5432	6032	6665	1		
47	4864						
48	5464	6599	7846				•••
			7846	8442			
48	5464	6599					
48	5464 5198	6599 5859	6665	8442			
48 49 50	5464 5198 5845	6599 5859 6643	6665 7493	8442 9480			
48 49 50 51	5464 5198 5845 3717	6599 5859 6643 3998	6665 7493 4340	8442 9480 5015	  5917	··· ···	
48 49 50 51 52	5464 5198 5845 3717 3651	6599 5859 6643 3998 3933	6665 7493 4340 4276	8442 9480 5015 4900	 5917 5802	  6786	

#### TABLE B-8: RUNWAY REQUIREMENTS/OPERATIONAL BOUNDARIES OF THE PROFILE GENERATOR, TEMPERATURE 40°F, ELEVATION 6000 FT MSL

[	<u> </u>		<u></u>	STAGE WEIGHT		<u></u>	
2384 8	1	2	3	•	5	6	7
56	6136						
\$7	4047						
58	4766						
59	5697	t					
68	3834						
61	6736						
62	5567						
63	3576	4505	6080				
64	2404						
65	1606	<u>+</u>					
66	5117	6524	7800				
67	3498	····					
68	3394						
63	1643	+					
70	4218	5571	7154				
71	2015	2461	0				
72	2376	3092					
73	2761						
74	836						•••
75	979	<u> </u>					
76	2101						
77	927						
78	15893	<u> </u>	<u> </u>				
79	5759	8981		••••			
80	7156	9796					
81	5974	6926					
82	6785	10144		•••			
13	5285	5879	6379	7444	6899	10999	12777
84	5766	6240	6712	7885	9460	11342	13080
85	5135	5969	6638	\$090			
16	4667	5389	6052	7374			
07	4030	4369	4736	5425	6364	7453	7980
	0	0	0				
89	4360	5349	\$305				
90	4662	5695	6840				
91	15711						
92	12946						
93	4631	5133	5868	6877	8052		
94	4446	4930	5440	6055			
95	4092						
96	6126						
97	5607	6673	7948	9221			
98	5817						
	3245	<u> </u>					•••
100	4513	5004	5522	6146			
101	5460	6050	6913	8058	9476		
102	5327	5754	6198	7301	8499	3788	11815
103	5395	5830	6283	7410	8636	10160	12035
	<u> </u>			t			
	3000					,	
104	3000	<u>↓</u>	f				
104	3000						
104	·	<u>↓</u>	f			···-	

#### TABLE B-8: RUNWAY REQUIREMENTS/OPERATIONAL BOUNDARIES OF THE PROFILE GENERATOR, TEMPERATURE 40°F, ELEVATION 6000 FT MSL (CONTINUED)

	1		·	STAGE WEIGHT		·····	
X304 0		•••••			·	<b></b>	•
	1	3	3	•	5	6	7
1	4358	4732	5223	5842	7545	7766	
2	7902	8549	9224	10846	13023	15647	18038
3	6359	6935	7692	8657	11342	11730	
4	4476	5006	5542	6415	7696	9070	11438
5	6297	6805	7334	8600	10293	12325	14168
6	4193	4671	5438	6351	8098	9433	
7	3963	4429	5176	6263	7767	8547	
	2721	3109	3523	4193	4671		
,	5408	6165	6856	8093	9864	11822	13288
10	2799	3128	3656	4424	3486	6037	
11	4526	5114	5739	6749	7471		
		6032	7011	8433	10401	12127	
12	5421	<u> </u>	#311	9742	11695	12954	
13	6684	7313	<u>↓</u>		<u>}</u>	÷	14735
34	5604	6147	7013	\$262	3979	11092	12676
15	<u> </u>	0	0				
16	5408	6165	6856	8093	9864	11822	13288
17	6684	7313	8311	9742	11695	12954	14735
18	11895	11895	14601	14601	0	0	
19	7315	8033	9047	10687	12474	14408	
20	5567	6038	6529	7607	9127	10838	12849
21	\$472	9203	9913	11529	13819	16393	19344
22	8531	9087	9957	10871	12830	14969	
23	7856	8342	9100	9894	11473	13179	15083
24	5968	6863	7821	8841			
25	8178	9068	10005	11137			
26	9539	10569	12074	14142	16567		
27	10875	12668	14604	16506		<u> </u>	t
28	8178	9068	10005	11137			•••
29	9539	10569	12074	14142	16547		
30	9204	10703	12180	13463			
31	6125	7029	7832	9516	11644		
		<b></b>	<u> </u>		h	<u> </u>	
32	5672	6151	6667	7613	8895	10392	11289
33	4750	5149	5579	6382	7480	8747	9361
34	4730	5342	6042	6787			
35	5447	6280		f	\$180	9669	
36			6963	8528	8180 		
37	5227	6151	6907	8528 8415		h	<u> </u>
38	5227 7667	<u> </u>	<u> </u>				
		6151	6907	8415			
39	7667	6151 8767	6907 10188	8415		  	
	7667 5562	6151 8767 6823	6907 10188	8415 		  	
39	7667 5562 5427	6151 8767 6413 6382	6907 10188  7855	8415  		  	
39 40	7667 5562 5427 6538	6151 8767 6813 6382 7945	6907 10188  7855 9405	8415  	  	   	
39 40 41	7667 5562 5427 6538 3804	6151 8767 6813 6382 7945 4724	6907 10188  7855 9405 5611	8415   	    	    	    
39 40 41 42	7667 5562 5427 6538 4804 5556	6151 8767 6813 6382 7945 4724 6024	6907 10188  7855 9405 5411 7084	8415    8406	    	     	
39 40 41 42 43	7667 5562 5427 6538 4804 5596 6538	6151 8767 6813 6382 7945 4724 6024 7945	6907 10188  7855 9405 5611 7084 9405	8415    8406 	     	     	 
39 40 41 42 43 44	7667 5562 5427 6538 3804 5556 6538 3804	6151 8767 6813 6382 7945 4724 6024 7945 4724	6907 10188  7855 9405 5621 7084 9405 5611	8415    8406 	      	      	       
39           40           41           42           43           44           45           46	7667 5562 5427 6538 404 5596 6538 3404 5596 6569	6151 8767 6813 6382 7945 4724 6024 7945 4724 6024 7526	6907 10188  7855 9405 5611 7084 9405 5611 7084 8701	8415   8406  8406  8406	        	        	        
39           40           41           42           43           44           45           46           47	7667 5562 5427 6538 404 5596 6538 3804 5596 6569 5778	6151 8767 6813 6382 7945 4724 6024 7945 4724 6024 7545 6024 7526 6452	6907           10188              7855           9405           5611           7084           9405           5611           7084           8701           7165	8415   8406  8406  7917	        	        	        
39           40           41           42           43           44           45           46           47           48	7667 5562 5427 6538 3404 3536 6538 3404 5596 6569 5778 6490	6151 8767 6813 6382 7945 4724 6024 7945 4724 6024 7525 6452 7838	6907           10188              7855           9405           5611           7084           9405           5611           7084           9701           7165           9320	8415   8406  8406  7917 	        	        	        
39           40           41           42           43           44           45           46           47           48           49	7667 5562 5427 6538 9804 5556 6538 3804 5556 6569 5778 6490 6174	6151 8767 6813 6382 7945 4724 6024 7945 4724 6024 7526 6452 7838 6359	6907           10188              7855           9405           5611           7084           9405           5611           7084           9405           5612           7084           9701           7165           9320           7917	8415   8406  8406  7917  10027	        	        	        
39       40       41       42       43       44       45       46       47       48       49       50	7667 5562 5427 6538 9804 5556 6538 3804 5556 6559 5778 6490 6174 6943	6151 8767 6813 6382 7945 4724 6024 7945 4724 6024 7526 6452 7838 6959 7890	6907 10188  7855 9405 5411 7084 9405 5411 7084 8701 7145 9320 7917 6901	8415   8406  8406  7917  10027 12261	        	        	        
39       40       41       42       43       44       45       46       47       48       49       50       51	7667 5562 5427 6538 3604 5556 6538 3804 5556 6559 5778 6450 6174 6943 4415	6151 8767 6413 6382 7945 4724 6024 7945 4724 6024 7526 6452 7838 6955 7890 4749	6907 10188  7855 9405 5411 7084 9405 5411 7084 8701 7145 9320 7917 6901 5156	8415   8406  8406  7917  10027 11261 5957	        	        	        
39       40       41       42       43       44       45       46       47       48       49       50	7667 5562 5427 6538 9804 5556 6538 3804 5556 6559 5778 6490 6174 6943	6151 8767 6813 6382 7945 4724 6024 7945 4724 6024 7526 6452 7838 6959 7890	6907 10188  7855 9405 5411 7084 9405 5411 7084 8701 7145 9320 7917 6901	8415   8406  8406  7917  10027 12261	        	        	        
39           40           41           42           43           44           45           46           47           48           49           50           51	7667 5562 5427 6538 3604 5556 6538 3804 5556 6559 5778 6450 6174 6943 4415	6151 8767 6413 6382 7945 4724 6024 7945 4724 6024 7526 6452 7838 6955 7890 4749	6907 10188  7855 9405 5411 7084 9405 5411 7084 8701 7145 9320 7917 6901 5156	8415   8406  8406  7917  10027 11261 5957	        	        	        
39           40           41           42           43           44           45           46           47           48           43           50           51           52	7667 5562 5427 6538 1604 5556 6538 3804 5556 6559 5778 6490 6174 6943 4415 4339	6151 8767 6413 6382 7945 4724 6024 7945 4724 6024 7526 6452 7838 6955 7890 4749 4674	6907 10188  7855 9405 5621 7084 9405 5621 7084 8701 7165 9320 7917 6901 5156 5082	8415   8406  8406  7917  10027 11261 5957 5823	        	        	        

### TABLE B-9: RUNWAY REQUIREMENTS/OFERATIONAL BOUNDARIES OF THE PROFILE GENERATOR, TEMPERATURE 80°F , ELEVATION 6000 FT MSL

B-27

[	-		<u> </u>	STAGE WEIGHT			
Z301 #	1	2	3	•	5	6	7
56	4136						
\$7	4807		·				
58	3661						
59	6766	<u> </u>	<u> </u>		•••		
60	4555						
61	8001						
62	6615		•••				
63	4414	5561	7505			•	
64	2855					····	
65	1982					•	
		8054	9629				
66	6317					•••	•••
67	4328						
68	4189	<u> </u>	<u>├</u>				
69	2028				· · · · · · · · · · · · · · · · · · ·		
70	\$207	6876	4631				
71	2487	3038	0		· · ·		
72	2933	3817					
73	3408						
74	1034					•	
75	1208		•••				
76	2593		•••				
77	1145						
78	18878						
79	6840	10668					
80	8580	11636	•				
81	7374	11018					
\$2	8381	0				•••	
83	6277	6983	7577	8842	10570	13065	15177
84	6848	7412	7973	9386	11237	13473	15537
85	6100	7090	7884	9609			
86	5544	6401	7188	\$759			
87	4787	5190	5626	6444	7559	8853	9478
64	0	0	0				
89	\$178	6354	7489				
90	5538	6764	8124				
91	18717					•-•	
92	15377						
93	5501	6097	6970	8169	9565		
94	5281	5856	6462	7193			
95	4860						•••
96	7277						
97	6660	7926	9440	10953			•••
98	6909				•••		
99	3855						•
100	4513	5004	5522	6146			
101	5460	6050	6913	8092	9476		
102	7503	\$107	8737	10302	12006	14124	16729
103	7878	8519	9187	10851	12665	14926	17713
104	3000						
105	3000						
106	3000						

# TABLE B-9: RUNNAY REQUIREMENTS/OPERATIONAL BOUNDARIES OF THE PROFILE GENERATOR, TEMPERATURE 80°F , ELEVATION 6000 FT MSL (CONTINUED)

#### APPENDIX C

#### AIRPLANE RUNUP OPERATIONS

This Appendix discusses the adaptation of an existing INM equation for use in computing runup noise within INM Version 4.11. This equation, also used in the Time-Above-Threshold (TA) equation, can be used to approximate the maximum A-weighted sound level  $(L_{MMAX})$  and the maximum tone-corrected perceived noise level  $(PNLT_{MAX})$  for a one-second time period as follows:

$$L_{\text{LMMY}} = \text{SEL} - 10\log_{10} \left[ \left( (500\pi) / (V) \right) (.001R_0)^{(k)} \right] \text{ and} \tag{1}$$

$$PNLT_{max} = EPNL - 10\log_{10} \left[ \left( \left( 500\pi \right) / (V) \right) \left( .001R_0 \right)^{(k)} \right] + 10, \quad (2)$$

where	SEL	=	the Sound Exposure Level from the Noise-Power-Distance data base (dBA);
	EPNL	=	the Effective Perceived Noise Level from the Noise-Power- Distance data base (dB);
	v	=	the airplane velocity (ft/sec);
	R <sub>0</sub>	=	the closest point of approach from airplane to receiver (ft);
	k	=	a constant exponent with a fixed value of 0.6 in the INM; and for Equation (2),
	10	2	a duration correction as discussed in Section 2.3,

Equation (2).

The above equations assume: (1) an approximate shape of an airplane's sound level time history; and (2) symmetry in the time history trace around the  $L_{AMAX}$  or  $PNLT_{MAX}$ , as appropriate. The  $L_{AMAX}/PNLT_{MAX}$  values computed with these equations were verified using measured  $L_{AMAX}/PNLT_{MAX}$  data in the literature.<sup>1</sup>

Given the computed  $L_{AMAX}/PNLT_{MAX}$  and the user-defined duration and location for a runup, the SEL/EPNL for the runup is computed by multiplying the acoustic energy associated with the  $L_{AMAX}/PNLT_{MAX}$  by the user-defined duration, and converting the total runup energy to a decibel value as follows:

$$SEL_{RUNUP} = 10\log_{10}[(DUR) 10exp(L_{AMAX}/10)]$$
 and

(3)

where	SEL <sub>RUMUP</sub>	Ξ	the Sound Exposure Level for the runup (dBA);
	EPNL <sub>RUNUP</sub>	=	the Effective Perceived Noise Level for the runup (dB);
	DUR	=	the user-defined duration of the runup (seconds);
	Lamax	=	the maximum A-weighted sound level computed, using Equation (1);
and	PNLT <sub>MAX</sub>	=	the maximum tone-corrected perceived noise level computed, using Equation (2).

The SEL<sub>RUNUP</sub> value from Equation (3) is then used to compute the noise exposure due to runup operations for all INM noise metrics, except NEF and WECPNL. The noise exposure due to runup operations for NEF and WECPNL are computed using the EPNL<sub>RUNUP</sub> value from Equation (4).

#### C.1 Verification

The runup enhancement within INM Version 4.11 was verified using measured runup noise level data for the A320 airplane with the newer CFM56-5-A1 engine, and the B747 airplane with the older JT9D-7A engine.<sup>2,3</sup> The measured data for the A320 agree extremely well with INM-predicted data, i.e.,  $\pm$  3 dB with a mean difference of .6 dB and a standard deviation of 2.2 dB, for receivers located at angles of 0, 45, 90, 120, 135, and 180 degrees relative to the nose of the airplane. Note: At 180 degrees, the data used for comparison with the predicted levels were obtained by linear extrapolation of measured data. The agreement between measured and predicted data at the above six receiver locations was essentially independent of thrust for thrusts of 78, 86, and 90 percent N1. At the 150 degree location, the agreement was only modest. INM Version 4.11 overstated the noise by approximately 6 dB at thrust levels of 86 and 90 percent N1, and by almost 12 dB at 78 percent N1. Similar results were observed for the B747 airplane at all receiver locations.

The agreement between measured and predicted runup noise levels could be improved if the INM maintained a detailed data base of measured runup directivity patterns for all airplanes as a function of distance and thrust. In lieu of developing such a substantial and potentially costly data base, the simplified

C-2

(4)

directivity pattern discussed in Appendix A is a reasonable approximation of runup directivity.

### C.2 References

- <sup>1</sup> Bishop, D.E., Beckman, J.M., Bucka, M.P., <u>Revision of Civil</u> <u>Aircraft Noise Data for the Integrated Noise Model (INM)</u>, Report No. 6039, Project No. 04453, Canoga Park, CA: BBN Laboratories Incorporated, September 1986.
- <sup>2</sup> <u>A320 Noise Definition Manual NDM</u>, FRANCE: Airbus Industrie, 1990.
- <sup>3</sup> An Excerpt from the Model B747 Flight Manual, <u>A-Weighted</u> <u>Noise Level Contours</u>, Seattle, WA: Boeing Commercial Airplane Company, 1986.

### APPENDIX D

### INM INPUT TESTCASE

This Appendix presents a copy of the INM Input Testcase, revised to reflect several INM Version 4.11 enhancements. The revised Testcase includes an airplane runup definition, and an approach runway threshold definition. The entry related to data base selection, contained in the PROCESS section of previous versions of the Input Testcase, has been deleted; the ACDB11.EXE computer program, included with the INM Version 4.11 release, should be used to access/print all elements of Data Base Number 11. The Input Testcase contained herein is included with the Version 4.11 release. BEGIN.

#### COMMENTS:

TITLE «AMMUAL AVERAGE EXPOSURE AT AN EXAMPLE OF A MEDIUM HUB AIRPORT> AIRPORT «EXAMPLE MHA>

#### ALTITUDE 0 TEMPERATURE 59 F

#### RUBINAYS

COLUMN 1	<b></b>							
RW	09L-27R	0	0	1	0	9487	-497	READING=93
RW	27L-09R	4203	-1410	1	0	-6920	-1044	HEADING=272
RM	35-17	7355	1366 D	r 100 1	0	6407	6742	

#### AIRCRAPT:

 TYPES

 AC 747200

 AC DC1030

 AC DC270

 AC 7579W

 AC 727015

 AC DC330

 AC MD81

 AC 737300

 AC SAR80

 AC S-76 CURVE-250C30 PARAM-HELI STAGE 1=HORFLT CATEGORY-PGA

#### NOISE CURVES

NC 250C3 BPNL	0	3 BY 8	3 BY 6
THRUSTS	1	2	3
200	90.2	91.2	97.2
400	85.8	87.2	93.1
600	83.1	84.5	90.6
1000	79.4	80.7	87.4
2000	73.7	75.1	82.6
4000	67.6	68.2	77.2
6000	63.1	63.8	73.7
10000	56.8	57.4	68.7
SEL			
THRUSTS	1	2	3
200	88.6	90.0	95.6
400	84.2	85.6	91.5
600	81.5	82.9	89.0
1000	77.8	79.1	85.8
2000	72.1	73.5	81.0
4000	66.0	66.6	75.6
6000	61.5	62.2	72.1
10000	55.2	55.6	67.1

#### APPROACH PARAMETERS

ХP	heli	WEIGHT=10000 ENGINE=2 STOP=1 PINSP=160 TAXI=160
		LNDFFS=3

INT.MM.

#### PROFILES APPROACH

PF	ALT3D SEG	ENTS=7							
	DISTANCES	20.	10.	5.	3.	1.	164	STOP	
	ALTITUDES	6000	3236	1644	1007	370	0	0	
	SPEEDS	TERMSP	INTSP	APPSP	FINSP	LNDSP	REVSP '	TAXI	
	THRUSTS	INTFIS	APPFAS	LNDFFS	LNDFLS	REV	IDLE		
PF	COPTR SEG	MENTS=7							
	DISTANCES	3.9	3.1	2.4	1.6	0.8	1	0	0
	ALTITUDES	2500	2000	1500	1000	500		0	0
	SPEEDS	PINSP	FINSP	FINSP	FINSP	FINSF	FINS	P TA	KI
	THRUSTS	LNDFFS	LNDFFS	LNDFPS	LNDFFS	LNDFFS	LNDFP	s	

#### ECHO.

FT.

#### PROFILES TAKEOFF

PF HORFLT SEGM	ENTS=8	WEIGHT	-10000	ENGINES	5=2				
DISTANCES	0	1376	4126	6876	6877	9626	10000	15000	
ALTITUDES	0	0	500	1000	1000	1500	1500	1500	
SPEEDS	32	160	160	160	160	160	160	160	
THRUSTS	2	2	2	2	1	1	1		

Note: Standard conditions have been defined. To implement the takeoff profile generator see Section 2.1. In addition, the elevation enhancement has not been selected. To implement elevation see Section 2.2.

Note: A runway touch-down point of 1054 ft has been defined for approach operations on Runway 35 (i.e., 100 ft for the user-defined DT plus 354 ft for the fixed touch-down point).

.

INT.M.

TAREOFFS BY FREQUENCY:

```
TRACE TRI RMY 09L STRAIGHT 4.1 LEFT 5 H 1.6 STRAIGHT 50

OPER 747200 RUMUP 1 D=10 STAGE 1 D=1.1 STAGE 2 D=1.1 STAGE 3 D=1.1

OPER DC1030 STAGE 1 D=1.5 STAGE 2 D=2.5 STAGE 4 D=2

OPER 757PW STAGE 2 D=1.5

OPER 727Q15 STAGE 1 D=3 N=.5 STAGE 2 D=2.6 N=.6

STAGE 3 D=1.2 N=.1

OPER 727Q15 D=36 N=.5 STAGE 2 D=2.6 N=.5
          OPER DC930 STAGE 1 D-26.5 N=.5 STAGE 2 D-6 N=.5
          STAGE 3 D=1.5
OPER MD41 STAGE 2 D=1.0
OPER 737300 STAGE 1 D=1.5 N=.5

        TRACK TR2 RWY 27R STRAIGHT 4.1 LEFT 86 D 1.6 STRAIGHT 50

        OPER DC1030 STAGE 1 D=1.5 STAGE 2 D=3 STAGE 3 D=1

        STAGE 4 D=1 STAGE 5 D=.5 STAGE 6 D=.5

        OPER DC870 STAGE 1 D=2 N=.5 STAGE 2 D=3.5 N=1

                                     STAGE 3 D=1 STAGE 4 D=2.5 STAGE 5 D=1
          STAGE 6 D=.5
OPER A300 STAGE 2 D=2 STAGE 3 D=1
OPER 727Q15 STAGE 1 D=6 N=1 STAGE 2 D=4.4 N=1.4 STAGE 3 D=1.8
                                                      N= . 4
      TRACK TR3 RWY OOR STRAIGHT 1.3 LEFT 15 D 1.0 STRAIGHT 1.4
                                            RIGHT 57 D 1.8 STRAIGHT .5 RIGHT 50 D 1.6
STRAIGHT 50

      STRAIGHT 50

      OPER DC670
      STAGE 1 D=2 N=.5 STAGE 2 D=3.5 N=1 STAGE 3 D=1
STAGE 4 D=1.5 STAGE 5 D=.5

      OPER 757PW
      STAGE 3 D=2.5

      OPER 727Q15
      STAGE 1 D=21 N=2.5 STAGE 2 D=16.5 N=4
STAGE 3 D=6 N=.5

      OPER DC930
      STAGE 1 D=26.5 N=.5 STAGE 2 D=8 N=.5 STAGE 3 D=1.5

      OPER DC91
      STAGE 1 D=26.5 N=.5 STAGE 2 D=8 N=.5 STAGE 3 D=1.5

         OPER ND81 STAGE 1 D= 3 N=.5
OPER 737300 STAGE 2 D=.5
    TRACK TR4 RWY 27R STRAIGHT 4.1 LEFT 230 H 2.2 STRAIGHT 50
OFER SABR60 STAGE 1 D=3 H=.1
    TRACK TRS RWY 35 STRAIGHT 50
OPER SABREO STAGE 1 D=30.5 N=2.5
OPER BEC58P STAGE 1 D=13 N=1
     TRACK TR6 RWY 17 STRAIGHT 50
         OPER SABREO STAGE 1 D=12.5 N=.5
OPER BECSEP STAGE 1 D=30 N=3
    TRACK TR7 RWY 17 STRAIGHT 1.5 RIGHT 265 H .25 STRAIGHT 3
LEFT 245 H 1.0 STRAIGHT 50
OPER S-76 STAGE 1 D=5
LANDINGS BY TERCENTAGE:
         OPER 747200 PROF=STD3D D=3 N=0
OPER DC1030 PROF=STD3D D=22 N=2
OPER DC870 PROF=ALT3D D=22 N=2

        OPER
        A300
        PROF=STD3D
        D=2
        N=1

        OPER
        757PW
        PROF=STD3D
        D=6
        N=1

        OPER
        727015
        PROF=ALT3D
        D=70
        N=10

         OPER DC930 PROF-ALT3D D=70 N=4
OPER MD81 PROF-STD3D D=4 N=.5
        OPER 737300 PROF-STD3D D=1.5 N=.5
OPER SABR&0 PROF-STD3D D=25 N=2
OPER BEC5&F PROF-STD5D D=42 N=5
         OPER S-76
                                 PROF=COPTR D=5
    TRACK THE RWY 27R STRAIGHT 50 RIGHT 82 D 1.5 STRAIGHT 4.2
                                            PERCENT COM-72 GA-0
    TRACK TR9 RWY 09R HEADING 260 STRAIGHT 50 RIGHT 272 H 1.5
                                            STRAIGHT 7 PERCENT COM=28 GA=0
    TRACK TRIO RWY 35 STRAIGHT 50 PERCENT COM-0 GA-30
    TRACK TR11 RWY 17 STRAIGHT 50 PERCENT COM=0 GA=70
TOUCHNGOS BY FRROUENCY:
    TRACK TR14 RWY 17 STRAIGHT 3 LEFT 180 D 2.0 STRAIGHT 6
        LEFT 180 D 2.0 STRAIGHT 3
OPER BEC58P STAGE 1 PROF STD5D D=23
```

COMMENTS :

Mote: A runup operation has been defined for the B747-200 airplane. The runup takes place at the start of Runway 09L and lasts for 10 seconds. (i.e., in terms of average yearly duration).

#### PROCESSES :

22.

No.

NONARN.

GRID MEF LDW TA START--3000 1500 STEP-1000 700 SIZE-2 BY 3

GRID LEO TA DEA-75 START-11000 3000 STEP-0 0 SIZE-1 BY 1 DETAIL

CONTOUR LDW AT 65 75 PLOT SIZE=11 8.5 SCALE=8000

DD.

#### APPENDIX E

#### WINM USER'S MANUAL

This Appendix contains a copy of the User's Manual for the WINM computer software, an INM Version 4.11 plotting program for use with Microsoft Windows. The WINM software and its User's Manual, contained herein, were prepared by the SysTeam Corporation under contract to the FAA.



Windows Plotting Program Supplement to Integrated Noise Model Version 4.11

# **User's Manual**

November 17, 1993

Prepared by:

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SysTeam Corporation Gaithersburg, MD

Prepared for:

Federal Aviation Administration Washington, DC

FAA Contract # DTFA01-92-Y-01042 Task Order #1

# **1.0 INTRODUCTION**

This User Guide is a combined tutorial-manual that comes to you as part of WINM 4.11.

# 2.0 OPERATIONAL REQUIREMENTS

### Software/Hardware Requirements

WINM has the same software and hardware requirements as Microsoft Windows 3.x.

# 3.0 INSTALLATION

Before you start, make sure that you have all the material supplied with WINM 4.11 and check that your equipment matches the list in Chapter 2.

## **Installation Procedure**

WINM comes with four files under the directory \INM411. These files will be installed as part of the primary INM installation. They are:

WINM.EXE	- The window plot program for INM
INMINPUT TST	- Test case version of input data
CONTOURS.TST	- Test case version of contour data
INMCOLOR.DATA	- Color control file

Windows Installation of WINM

- Start up Windows by typing WIN.
- Open Windows' Program Manager.
- Open the Windows *File* menu. Select *New*.
- The New Program Object dialog box will appear.
- Select Program Group and click on OK.
- The Program Group Properties dialog box will appear.
- Type WINM in the Description field. Click on OK.
- Open the Windows *File* menu. Select *New*.
- The New Program Object dialog box will appear.
- Select Program Item and click on OK.

• The *Program Item Properties* dialog box will appear. Enter the text in the fields as indicated:

For Window 3.1 environment: Description: WINM v4.11 Command line: C:\INM411\WINM Working Directory: C:\INM411 Shortcut Key: None

For Windows 3.0 environment: Description: WINM 4, 11 Command line: C:\INM411\WINM Shortcut Key: None

- Click on OK.
- Run WINM by double clicking the WINM icon.

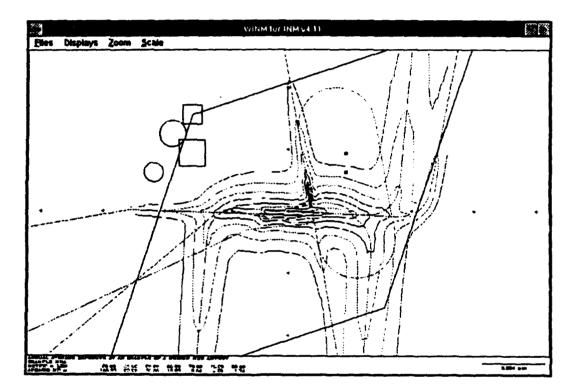
# 4.0 TUTORIAL

## About the Tutorial

The tutorial has been structured so that the exercises will give you progressive familiarity with the operations that you will carry out within WINM 4.11.

# 4.1 Loading INM Files

The starting point for this exercise is the default screen you see as soon as you start WINM 4.11 from the Windows *Program Manager*.



By default, WINM uses two default INM input files. To load a different set of input files,

- Place the mouse pointer arrow on *Files* in the menu bar; and
- Click once on the left mouse button.
- In the menu, click the mouse pointer on *Load*.

See the Load dialog box.

	t osd .
INM Input filename (FOR83.DAT):	anninput 151
INM contour filename (FOR33.DAT):	coatours.TST
P OK T	Cancel

## About the Load Dialog Box

This menu option loads the INM input file and INM contour file. By default, test files "inminput.TST" "contours.TST" are chosen. Examples of standard input files are in the square brackets.

For this exercise, the default selections will not be changed. If you desire to select another set of INM input files in the future, use the *Tab* key to highlight the appropriate text field, then press the *Backspace* key to delete the default entry. Type in the appropriate file name. When correct, click on OK. For now, click on *Cancel* to close this window and continue with the tutorial.

# 4.2 Adjusting the Data Display Information

In the menu, click the mouse pointer on Displays.

See the Displays dialog box.

Displays	
Runways	🗆 Label
Flight Tracks	Label
Noise Contours	🗌 Label
○ Fill Contours	
Noise Sensitive Area	Label
APDY	<u>)X</u>

## About the Displays Dialog Box

This menu option allows the user to select which data display information is to be shown. Select any option one at a time and click on Apply to see its effect immediately. Experiment with as many combinations as you like. Text labels may be independently selected for each displayed item type by clicking on the Label box next to each item.

## 4.2.1 Runways

This radio button turns on/off the display of the runways.

# 4.2.2 Flight Tracks

This radio button turns on/off the display of the flight tracks.

# 4.2.3 Noise Contours

This radio button turns on/off the display of the noise contours.

# 4.2.4 Fill Contours

This radio button turns on/off the option to fill the contours.

# 4.2.5 Noise Sensitive Area

Although every one of these options depends on the INM input files selected, the Noise Sensitive Area is a special option. This menu option displays userdefined sensitive noise areas. These areas are defined after the END statement of the INM input data file (FOR03.DAT), and each can be either a polygon, square, circle, or point. The area can be defined in NM or FEET and a descriptive text label for label description of the area can be inserted after an asterisk (\*) at the end of the line. The user can input/modify these data before or after running the noise model (but not during running the WINM program). The following shows an example of the descriptive text labels as seen in the default INM input filename 'inminput.TST':

#### NOISE-AREA

P NM -10.0 -10.0 -5.0. 5.0 10.0 10.0 5.0 -5.0 \* Poly Area C NM -7.0 2.0 0.5 \* Circle 1 C NM -6.0 4.0 0.7 \* Circle 2 R NM -5.0 5.0 0.5 0.5 \* Rect 1 R NM -5.0 3.0 0.7 0.7 \* Rect 2 M NM 3.0 3.0 \* Point 1 M NM 3.0 2.0 \* Point 2 M FT 3000.0 1000.0 \* Point 3 M FT 5000.0 2000.0 \* Point 4

The formats for these areas are defined as follows:

## NOISE-AREA

- P <NM> <X1> <Y1> <X2> <Y2> ... <Xn> <Yn> \* <Polygon Label> Polygon area defined in NM followed by a series of X, Y points in NM with a label of 'Polygon Label'.
- C <FT> <Xc> <Yc> <Radius> \* <Circle Label> Circle area defined in FT with its center at Xc, Yc, and its Radius with a label of 'Circle Label'.
- R <FT> <Xc> <Yc> <Width> <Height> \* <Rectangular Label> Rectangle area defined in FT with its center at Xc, Yc, and its Width and Height from the center with a label of 'Rectangular Label'.

## M <NM> <X> <Y> \* <Point Label>

Mark point defined in NM at X, Y with a label of 'Point Label'.

Click on OK to leave the Displays dialog box.

# 4.3 Zoom

## About the Zoom Menu

WINM 4.11 offers you the capabilities to zoom in/out of various sections of the display for specialize viewing.

We will now become familiarized with the zooming capabilities within WINM 4.11.

- Place the mouse pointer arrow on **Zoom** in the menu bar; and
- Click once on the left mouse button.

You will see the drop-down Zoom menu appear.

• In the menu, click the mouse pointer on Zoom In.

A zoom box will appear in the center of the screen.

- Move the mouse to expand/shrink the zoom box.
- If you desire to move the zoom area, hold down the right button and drag the zoom box to a different area.
- Click the left button to accept zoom.

Note! At any time, click the right button to cancel the zoom box.

Zoom Out works similar to Zoom In.

- Place the mouse pointer arrow on *Zoom* in the menu bar; and
- Click once on the left mouse button.

You will see the drop-down **Zoom** menu appear.

• In the menu, click the mouse pointer on Zoom Out.

A zoom box will appear.

- Move the mouse to expand/shrink the zoom box.
- If you desire to move the zoom area, hold down the right button and drag the zoom box to a different area.

• Click the left button to accept zoom.

Note! At any time, click the right button to cancel the zoom box.

Zoom Control allows you more precise zoom control.

- Place the mouse pointer arrow on the Zoom menu; and
- Click once on the left mouse button.

You will see the drop-down Zoom menu appear.

• In the menu, click the mouse pointer on *Zoom Control*.

See the Zoom Control dialog box.

Zoom C	ontrol
Scole unit	Tick marks 1
Eoks	Cancel

This menu option allows you to set the scale value to a specific scale (i.e. 3.352 nm per scale unit) and to set the number of tic marks between the scale unit marks (default is 1). You can change these values anytime.

For now, let's continue with the exercise. Click on *Cancel* to leave the *Zoom Control* dialog box.

# 4.4 Scale

## About the Scale Menu

WINM 4.11 offers you the capabilities to change the scale on which the display units.

We will now become familiarized with the scaling capabilities within WINM 4.11.

- Place the mouse pointer arrow on *Scale* in the menu bar; and
- Click once on the left mouse button.

You will see the drop-down Scale menu appear.

• In the menu, click the mouse pointer on any of the menu selections to see its effect to the scale shown at the bottom right-hand corner.

We have now covered the major capabilities of WINM 4.11.

Let's print the display to a printer.

- Place the mouse pointer arrow on *Files* in the menu bar; and
- Click once on the left mouse button.

You will see the drop-down *Files* menu appear.

• In the menu, click the mouse pointer on *Print*. A submenu will appear.

## 4.5 Print

## About the Print Menu Option

This menu option allows a hard copy output to a printer. The printout will go to the default printer which can be set via **Printers** in **Control Panel**.

## Actual Scale

This menu option allows the user to print the current screen for scaling. The scale unit will reflect 1 inch on the hardcopy printout.

## Screen Zoom

This menu option allows the user to print the current screen at the current zoom factor. The left and right edges of the hardcopy printout will be set to match the left and right edges of the screen display. If the printer's page orientation is set to 'Landscape' in the Windows *Print Manager*, then the top and bottom edges of the hardcopy printout will be set to match the top and bottom edges of the screen display as well.

To print what is displayed, select Screen Zoom.

You can now exit the program.

- Place the mouse pointer arrow on *Files* in the menu bar; and
- Click once on the left mouse button.

You will see the drop-down *Files* menu appear.

• In the menu, click the mouse pointer on Exit.

This menu option exits the program. The current display setup (contours on/off, tracks on/off, etc.) will be saved when the program is restarted, this setup will be recalled.

CONGRATULATIONS!! You have completed the tutorial.

# 5.0 Others

### Move Origin

The user can move the origin by clicking on a point using the mouse's right button, holding it down, and dragging it to a new location.

### **Colors for Display**

The user can modify the colors displayed on screen by modifying the appropriate fields in the file INMCOLOR.DAT. For every increment of 16 colors (up to 256), a new fill pattern will be automatically introduced. The user can modify the color file until the desired colors/patterns are found. Note that the ordering of these colors as they appear in the file is very crucial. An example is as follows:

4	/* Runway_Clr */
2	/* Landing_Track_Clr */
3	/* Takeoff_Track_Clr */
6	/* Touchngo_Track_Clr */
255	/* Level_40_Less_Clr */
237	/* Level 41 To 45 Clr */
173	/* Level_46_To_50_Clr */
27	/* Level_51_To_55_Cir */
102	/* Level_56_To_60_Clr */
85	/* Level_61_To_65_Cir */
68	/* Level_66_To_70_Clr */
50	/* Level_71_To_75_Clr */
140	/* Level_76_To_80_Clr */
17	/* Level_81_Greater_Clr */

### Help

Help is not available directly from the program. For technical problems, please contact your distributor.

# 6.0 Program Limitation.

- Maximum 2000 points per noise contour.
- Runways information input is in FEET (from INM input file).
- Tracks information input is in NM (from INM input file).
- Shade pattern on hard copy may not be the same as on the screen due to the incompatibility number of colors support by the display and the printer.