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Office of Environment
and Energy
Washington, D.C. 20591

HNM
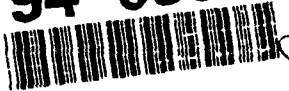## Heliport Noise Model
Version 2.2

User's Guide

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Research and Special Programs Administration
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13. ABSTRACT (Maximum 200 words)

The John A. Volpe National Transportation Systems Center (Volpe Center), in support of the Federal Aviation Administration, Office of Environment and Energy, has developed Version 2.2 of the Heliport Noise Model (HNM). The HNM is a computer program used for determining the impact of helicopter noise in the vicinity of terminal operations. This document, prepared by the Volpe Center's Acoustics Facility, is a User's Guide for HNM Version 2.2. It presents: (1) computer system requirements and installation procedures; (2) an overview of HNM capabilities and the user's implementation of these capabilities; (3) the elements of a heliport case study; (4) a step-by-step tutorial for preparing and running a case study; and (5) the interpretation of HNM Version 2.2 output. Also presented, in the Appendices of this document, are the following: (1) a discussion of the technical revisions made to several internal algorithms - primarily revisions which are transparent to HNM users; (2) a discussion of the helicopter noise Data Base used by the HNM; and (3) a summary of error messages in the HNM.

14. SUBJECT TERMS Heliport Noise, Helicopters, Computer Model, Noise Contours, Heliport Noise Model, Noise Level Prediction, FAR Part 150, Airport Noise, Integrated Noise Model	15. NUMBER OF PAGES 94
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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 Heliport Noise Model (HNM) Version 2.2 computer software used to predict noise impact around heliports. The Version 2.2 User's Guide, prepared by the Volpe Center's Acoustics Facility, presents computer system requirements as well as installation and operating procedures. HNM Version 2.2 enhancements are also discussed.

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SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
LENGTH				
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
AREA				
in²	square inches	645.2	millimeters squared	mm²
ft²	square feet	0.093	meters squared	m²
yd²	square yards	0.836	meters squared	m²
ac	acres	0.405	hectares	ha
mi²	square miles	2.59	kilometers squared	km²
VOLUME				
fl oz	fluid ounces	29.57	milliliters	ml
gal	gallons	3.785	liters	l
ft³	cubic feet	0.028	meters cubed	m³
yd³	cubic yards	0.765	meters cubed	m³

NOTE: Volumes greater than 1000 l shall be shown in m³.

Symbol	When You Know	Multiply By	To Find	Symbol
MASS				
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams	Mg
TEMPERATURE (exact)				
°F	Fahrenheit temperature	5(F-32)/9 or (F-32)/1.8	Celcius temperature	°C
ILLUMINATION				
fc	foot-candles	10.76	lux	l
fl	foot-Lamberts	3.426	candela/m²	cd/m²
FORCE and PRESSURE or STRESS				
lbf	poundforce	4.45	newtons	N
psi	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
LENGTH				
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
AREA				
mm²	millimeters squared	0.0016	square inches	in²
m²	meters squared	10.764	square feet	ft²
m²	meters squared	1.195	square yards	yd²
ha	hectares	2.47	acres	ac
km²	kilometers squared	0.386	square miles	mi²
VOLUME				
ml	milliliters	0.034	fluid ounces	fl oz
l	liters	0.264	gallons	gal
m³	meters cubed	35.71	cubic feet	ft²
m³	meters cubed	1.307	cubic yards	yd³
MASS				
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg	megagrams	1.103	short tons (2000 lb)	T
TEMPERATURE (exact)				
°C	Celcius temperature	1.8C + 32	Fahrenheit temperature	°F
ILLUMINATION				
lx	lux	0.0929	foot-candles	fc
cd/m²	candela/m²	0.2919	foot-Lamberts	fl
FORCE and PRESSURE or STRESS				
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	psi

(Revised January 1992)

* SI is the symbol for the International System of Units

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1. INTRODUCTION

The Heliport Noise Model (HNM) is a computer program that is intended to serve as an aid in assessing the impact of helicopter noise in the vicinity of terminal operations. HNM Version 2.2 is based upon Version 4 of the Federal Aviation Administration's (FAA) Integrated Noise Model (INM), a similar computer program for assessing the impact of fixed-wing aircraft noise[1,2]. The HNM differs from the INM in its ability to accommodate the greater complexity of helicopter flight activities compared to the activities of fixed-wing aircraft. In addition, the HNM, unlike the INM, provides a menu-driven interactive mode for entry of all input data. The menu-driven program facilitates the preparation of an input data file (case study), analogous to the input file for the INM. Although the menu-driven program displays options for use with a digitizing graphic tablet, these capabilities have not been thoroughly tested and are therefore disabled in HNM Version 2.2.

During October 1989, through February 1994, the John A. Volpe National Transportation Systems Center (Volpe Center), in support of the FAA, Office of Environment and Energy, developed Version 2.2 of the HNM. Kendrick and Company of Washington, D.C., under contract to the FAA, developed a prototype version of the HNM's menu-driven front-end. This prototype is the foundation of the current front-end in HNM Version 2.2.

A large majority of the User's Guide for the Version 2.2 computer software was reproduced from the HNM Version 1 User's Guide.[3] Section 1 of the HNM Version 2.2 User's Guide presents computer system requirements and installation procedures. A brief overview of capabilities and the user's implementation of these capabilities is also presented in Section 1. Section 2 describes the elements of a heliport case study. Section 3 is a step-by-step tutorial for preparing a case study. Section 4 describes the running of an existing case study. Section 5 discusses the interpretation of HNM Version 2.2 output. Appendix A describes the technical revisions made to several internal HNM algorithms - primarily revisions which are transparent to users. Appendices B and C, respectively, discuss the helicopter noise Data Base, and present a summary of error messages in the HNM.

1.1 Background

In the Aviation Noise Abatement Policy, November 18, 1976, the Secretary of Transportation and the Federal Aviation Administrator reiterated the responsibility of the FAA, established by a 1969 mandate from Congress, to reduce aircraft noise. This responsibility extends to promoting compatible land use in areas adjacent to airports and heliports, and providing technical and financial assistance to airport proprietors undertaking comprehensive noise abatement planning.

The HNM, like the INM, is part of the FAA's continuing effort

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to provide the technical means to analyze and abate aircraft noise. The HNM can determine both the cumulative noise measure for continuous contours and the cumulative noise measure for discrete receiver locations, required by Order 1050.1C, "Policies and Procedures for Considering Environmental Impacts", December 20, 1979. It can also be used for participation in the Airport Noise Compatibility Planning Program under Federal Aviation Regulations (FAR) Part 150. FAR Part 150 was expanded in March, 1988 to include heliports[4].

Heliport planners, helicopter operators, and local governments are encouraged to address the recurring problems of helicopter noise impact. The significance of these problems is underscored by increased public awareness of aircraft/airport noise in general, and, specifically, helicopter/heliport noise. Technologically feasible and economically reasonable solutions to these problems are being developed by all of those involved with helicopter and heliport noise issues, both private and governmental. The HNM is the most sophisticated tool available to analyze heliport noise impacts; and it is part of FAA's ongoing commitment to help resolve aircraft noise issues.

1.2 HNM Capabilities

The HNM is a computer program used for determining noise levels near heliports. The computed noise levels are expressed in terms of the Day-Night Average Sound Level, abbreviated DNL with a metric designation of L_{dn}. The L_{dn} is a measure of the total amount of acoustic energy received at a given receiver location over a 24-hour period, with all noise received between the hours of 2200 and 0700 local time "weighted" with a 10-dB penalty imposed because people are more sensitive to noise at night.

The data outputs from the HNM may be presented in terms of equal-level "contours" around the heliport (see Figure 5-13). Contours are presented in the form of a printout of the contour coordinates and as a plot of the contours. The HNM also allows for the computation of noise levels at specific receiver locations in the heliport vicinity. The output from this type of computation is a printed "Grid Report" (see Figures 5-10 and 5-11). The HNM also produces a number of supporting reports, e.g., "Echo Reports" (see Figures 5-1 through 5-9), to aid the user in developing an accurate representation of input data for the HNM. File FOR17.DAT is a user-accessible ASCII version of the Data Base. No provision is available for the user to add to, or modify, the existing Data Base.

1.3 Computer System Requirements

HNM Version 2.2 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;
- 540 KB of Random Access Memory (RAM) or 3 MB of RAM, if operating the HNM from a RAM disk, as discussed in Section 1.4.1 below;
- Math co-processor, Series 80287;
- Microsoft-compatible Disk Operating System (MSDOS) Version 3.3; and
- EGA color monitor.

In addition, the CONFIG.SYS file on the PC slated for HNM Version 2.2 installation must contain the following lines: BUFFERS=30; and FILES=30.

1.4 Installation

The files on the HNM Version 2.2 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 HNM Version 2.2 on your PC:

- <u>**UNPACK <SOURCE DRIVE> <TARGET DRIVE>**</u>

For example, the command UNPACK A C will install, from the A drive, HNM Version 2.2 on the C drive in a subdirectory called HNM22. Note: The UNPACK batch file will, without prompting, overwrite the contents of subdirectory HNM22, if one exists on the user-specified target drive.

1.4.1 RAM Disk Installation

Operation of HNM Version 2.2 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 HNM Version 2.2 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 HNM Version 2.2, 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 5¼ inch A-drive, a 3½ 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 HNM software on the RAM drive by designating it as the target drive for installation. For example:

- **A:\UNPACK A D**

The above command will automatically install the HNM from the A-drive onto a subdirectory (HNM22) 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\JOIN D: C:**

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, if the HNM 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.

1.5 Screen Displays for Use With the Keyboard

The HNM includes an interactive, menu-driven input program, with context-sensitive help, for data entry and for direct processing operations. The menus are of two types: selection among choices displayed on the screen, and "fill-in-the-blank" forms for alphanumeric entry.

1.5.1 Selection Menus

Figure 3-1 shows the "HNM Main Menu" for Version 2.2. It is an example of a selection menu. A list of choices, in this case a list of program functions, is displayed. The user selects a choice by highlighting the desired function and selecting ENTER.

1.5.2 Alphanumeric Entry Menus

Figure 3-4 is an example of a "fill-in-the-blank" menu for the entry of alphanumeric data. A full-screen editing capability is provided. The user can move within a field with the up/down and left/right arrow keys.
Many of the alphanumeric data entry screens provided by the HNM are similar to each other. In situations where this similarity could result in confusion, the function of the current menu is defined by a title in the top center of the display. The menu titles are referred to throughout the User's Guide.

2. ELEMENTS OF A HELIPORT CASE STUDY

HNM Version 2.2 requires that user input data be entered via the menu-driven, interactive, graphical user interface, or using a commercially available text editor, as with the INM. This section describes the data required to produce an example case study. These requirements are illustrated by data for a specific case called "Example Heliport". "Example Heliport" is the case study provided with the HNM Version 2.2 distribution diskette. It is synonymous with the TESTCASE.INP file (see Figure 4-1).

2.1 General Description of Heliport Case Study Elements

In order to run the HNM, the user is required to provide data describing the heliport and its associated activity. These data are described in the following sub-sections:

2.1.1	Heliport Altitude and Temperature
2.1.2	Heliport Definition
2.1.3	Helicopter Definition and the Noise Data Base
2.1.4	Helicopter Profiles
2.1.5	Takeoff Profiles
2.1.6	Landing Profiles
2.1.7	Taxi Profiles
2.1.8	Description of Takeoff Tracks and Operations
2.1.9	Description of Landing Tracks and Operations
2.1.10	Description of Taxi Tracks and Operations

The minimum data required for a specific case study include the heliport altitude, temperature and definition; and the specification of at least one helicopter, including a description of its profile(s), track(s), and associated number of operations. Table 2-1 presents the operating modes for profile and track segments.

2.1.1 Heliport Altitude and Temperature

The altitude and temperature data consist of the heliport altitude Above Mean Sea Level (MSL) in feet (ft), and the average daily heliport temperature for the period under consideration. If the scenario reflects a typical hot day, then the average summer temperature should be entered. However, most scenarios will require the average annual temperature. The temperature units may be either Fahrenheit (F), Celsius (C), or Rankine (R) as specified by the user. As with INM, temperature and altitude are used to compute an atmospheric acoustic impedance correction.

2.1.2 Heliport Definition

The definition of the helipads and the boundaries of the heliport establish the heliport geometry and its

2-1

OPERATING MODE	PROFILE DATA				TRACK DATA			ADDITIONAL DATA (6)		
(Notes)	DIST. FROM START (ft) (1)	ENDING ALTITUDE RE. GRD. (ft) (2)	ENDING AIRSPEED IAS-kt OR DURATION (SEC) (2,3)	THRUST NAME	ENDING (ft) (2,4)	LOCATIONS (ft) (2,4)	HEADING RE. + Y AXIS (DEG) (1,4)	HORIZ. ACCEL. (A) (g) (1)	GRAD. (RUN/ RISE) (1,5)	HORIZ. TRANSI- TION (5)
STATIC OPERATIONS (S)										
GROUND IDLE	0 or CFT	0	DUR	GIDLE	X	Y	HEAD (DEF.P)	0	0	NA
FLIGHT IDLE	CFT	0	DUR	FIDLE	DEF.P	DEF.P	HEAD (DEF.P)	0	0	NA
IGE - HOVER	CFT	ALT	DUR	HIGE	DEF.P	DEF.P	HEAD (DEF.P)	0	0	NA
VERTICAL ASCENT	CFT	ALT	DUR or CALC	VASC	DEF.P	DEF.P	HEAD (DEF.P)	0	NA	NA
OGE - HOVER	CFT	ALT	DUR	HOGE	DEF.P	DEF.P	HEAD (DEF.P)	0	0	NA
MOVING WITH CONSTANT VELOCITY (MC)										
TAXI	CFT	PRIOR ALT	VEL (10kt DEF)	HIGE	X	Y	CFT	0	0	FROM 0-Vt & to
CLIMBOUT @ Vy	CFT	ALT	Vy	TO	CFPT (7)	CFPT (7)	CFT	0	GVY	NA
CRUISE @ Vc	CFT	ALT	Vc	LFLO	ARRIV-CFT	ARRIV-CFT	CFT	0	0	FROM Vy to Vc
DESCENT @ Va	CFT	ALT	Va	APPR	X	Y	CFT	0	GVA	TO VA FROM Vc
MOVING WITH ACCELERATION (MA)										
ACCELERATION HORIZONTAL ACCELERATE to Vy	CFT	PRIOR ALT	VEL (Vy DEF.)	ACLH	X or CFT	Y or CFT	CFT	CFT or A (.1g DEF)	0	NA
ACCELERATION CLIMB to Vy	CFT	ALT or CFT	VEL (Vy DEF.)	ACLC	X or CFT	Y OR CFT	CFT	*	GAC or CFT	NA
DECELERATION DESCENT to 0	CFT	ALT	0	DCLD	X	Y	CFT	*	GDD or CFT	NA
IGE HORIZONTAL DECELERATE to 0	CFT	PRIOR ALT	0	DCLH	X	Y	CFT	*	0	NA

Notes:
(1) CFT means Calculated From Track.
(2) Initial values at beginning of segment are ending values of prior segment.
(3) DEF means Default, and IAS-kt means Indicated Air Speed in Knots.
(4) DEF.P means Default is Prior Definition.
(5) CFPT means Calculated From Profile and Track.
(6) NA means Not Applicable.
(7) HNM will extend last cruise segment 2 nautical miles beyond its starting point unless otherwise defined for departures, and similarly beyond ending point for arrivals.
(8) Additional data that must be considered in defining an appropriate profile-track model for any specific case.

relationship to the surrounding area. First, the user must define a cartesian coordinate system with which to describe the heliport. The units for distance can be specified in feet (ft), meters (m), or international nautical miles (nm), i.e., 6,076.12 ft. The positive X and Y-axes must run true west-to-east and true south-to-north, respectively, as on a typical map. The placement of the origin point (0,0) is arbitrary.

After selection of the origin, the user may employ simple trigonometric techniques or a graph paper overlay to determine the X- and Y-values of the helipads and the points on the heliport boundary. Figure 2-1 presents the coordinate system with the positive Y-axis pointing
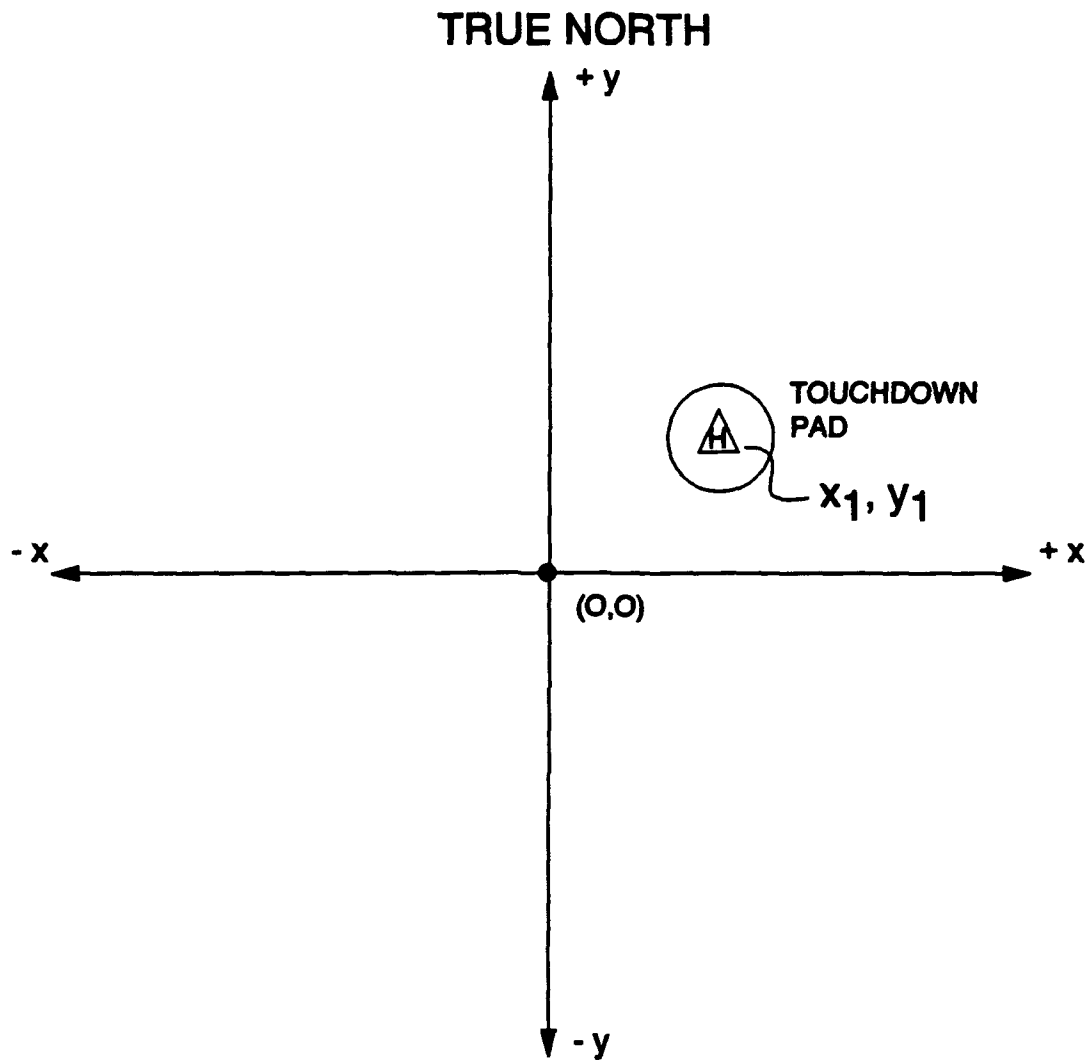
TRUE NORTH

FIGURE 2-1: HNM COORDINATE SYSTEM

towards true north. Any X-coordinate of a point to the west of the origin and any Y-coordinate to the south of the origin must be a negative number.

In addition, although the user has the selectability to characterize the terrain over which sound propagates as either hard or soft, the HNM Data Base currently contains data for propagation over soft terrain only. Consequently, hard is not a valid selection and the user will be notified as such. Examples of soft surfaces include grass-covered terrain and wooded areas.

2.1.3 Helicopter Definition and the Noise Data Base

At least one helicopter type must be selected from the HNM Data Base for each case study. Along with each helicopter type, a nominal value for its main rotor RPM is presented in the Data Base. This value may be changed by the user, as appropriate. Table 2-2 is a summary of the helicopters in the HNM Version 2.2 Data Base. The table also gives the maximum weight of each helicopter. A helicopter is selected by its name as listed in this table or from the "Helicopter Selection Menu" of the interactive data-entry program (see Section 3.3).

The HNM Data Base contains noise data sets for seven operating modes: four for essentially stationary operations and three for moving operations. The noise data for the four stationary modes are as follows:

GIDLE - Ground Idle
FIDLE - Flight Idle (also used for ground wheeled taxi)
HIGE   - Hover in Ground Effect (also used for airborne taxi)
HOGE   - Hover Out of Ground Effect

The noise data for the stationary modes consist of tables of A-weighted Sound Exposure Levels (SEL) at eight distances ranging from 200 to 10,000 ft. Static directivity is accounted for by a set of coefficients which were derived from measured data.

The noise data for the three moving operations are as follows:

TO   - Takeoff
APPR - Approach for Landing
LFLO - Level Flyover

The noise data for the moving modes consist of tables of A-weighted Sound Exposure Levels (SEL) at eight distances ranging from 200 to 10,000 ft. To account for in-flight directionality, three sets of SEL data at each of the above eight distances are included (i.e., left, center,

2-4

TABLE 2-2: HELICOPTERS STORED IN THE HNM DATA BASE

Storage	Name	Description	Maximum Weight(lbs.)
1	B212	Bell 212 (UH-1N)	10,500
2	S61	Sikorsky S-61 (CH-3A)	19,000
3*	S64	Sikorsky S-64 (CH-54B)	42,000
4	CH47D	Boeing Vertol 234 (CH-47D)	48,500
5	H500D	Hughes 500D	2,550
6	BO105	Boelkow BO-105	5,070
7*	B47G	Bell 47G	2,950
8	SA330J	Aerospatiale SA-330J	15,432
9	B206L	Bell 206L	4,000
10	A109	Augusta A-109	5,730
11	SA341G	Aerospatiale SA-341G	3,970
12*	H300C	Hughes 300C	1,900
13	S65	Sikorsky S-65 (CH-53)	37,000
14	S70	Sikorsky S-70 (UH-60A)	20,250
15	S76	Sikorsky S-76	10,000
16	SA365N	Aerospatiale SA-365N	8,488
17	SA355F	Aerospatiale SA-355F	5,070
18	SA350D	Aerospatiale SA-350D	4,300
19	B222	Bell 222	7,800
20**	R22HP	Robinson R22HP	1,300
21**	BK117	Boelkow BK-117	6,283

*   Indicates no data in Data Base.

**   Indicates directivity data only in Data Base.

and right). The left and right data are corrected to elevation angles of 45 degrees. The center data are for an elevation angle of 90 degrees.

For level flyovers, the data are given for a single typical speed. Values of SEL at other speeds are computed in the HNM using constants stored in the first three positions of the LFLO data table.

Appendix B contains a complete description of the HNM Version 2.2 Data Base. Note that the HNM, unlike the INM, does not provide for insertion of alternative noise data.

2.1.4 Helicopter Profiles

The three types of profiles used in the HNM are as follows:

- Takeoff Profiles
- Landing Profiles
- Taxi Profiles

For examples of these profiles see Figures 2-2 and 2-3.

Since there are many ways to operate a helicopter, it is not feasible to incorporate a number of standard profiles in the HNM . Rather, it is necessary that the HNM use profiles appropriate to each specific helicopter type as it operates at a heliport. Since entry of profile data is a regular requirement in the use of the HNM, the menu-driven screens significantly assist the user.

For each segment of a helicopter profile, the user will be required to provide the following four items:

- Operating mode (thrust name).

- Ground distance of the point from start of the operation in user specified units (ft, m or nm).

- Altitude in ft above the heliport.

- The velocity in knots (kt) at the point or, for static operations, duration in seconds of the operation at the point.

Each profile must contain at least three segments, but no more than fourteen.
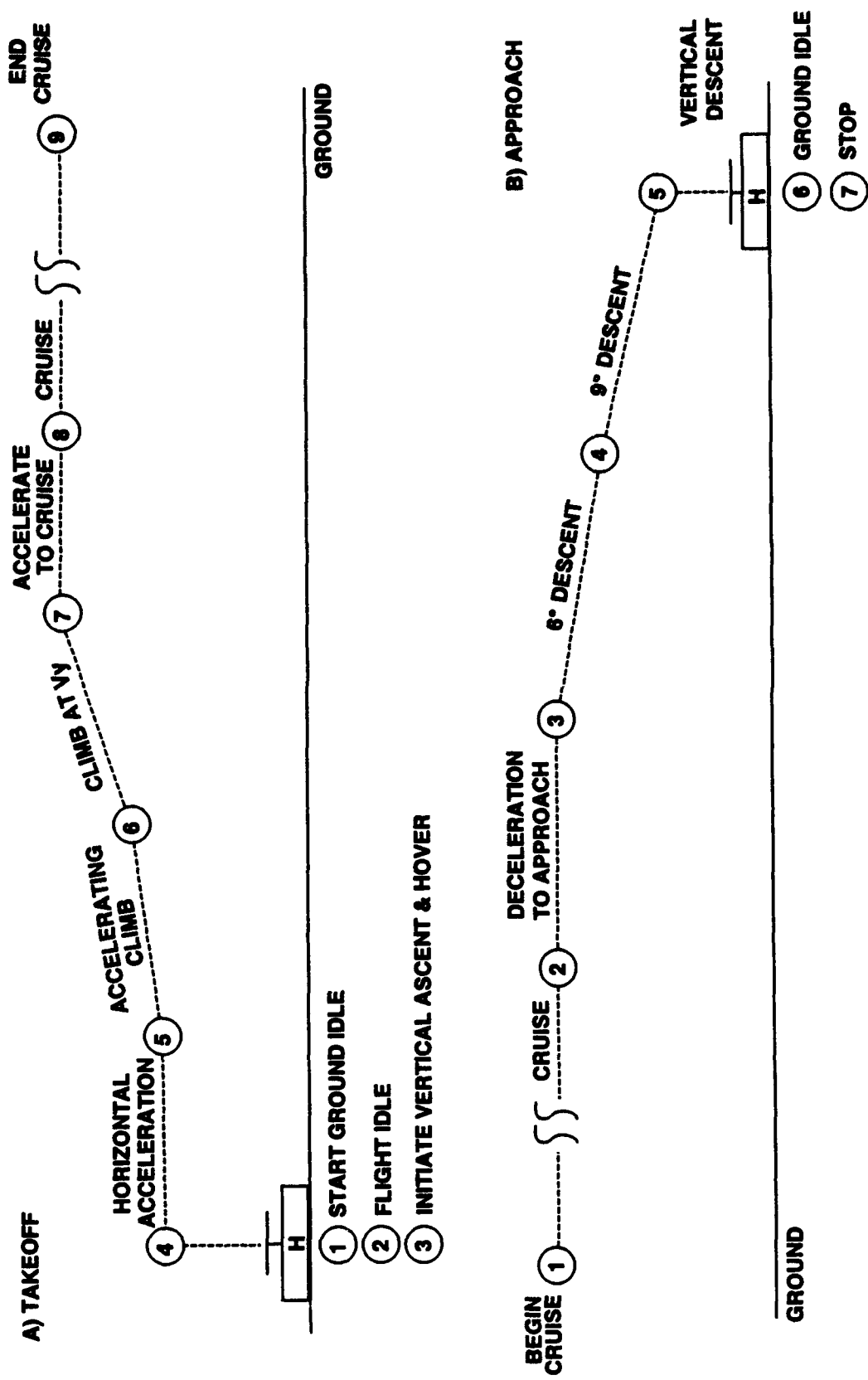
FIGURE 2-2. ILLUSTRATION OF TAKEOFF AND APPROACH PROFILES

A) INITIAL PHASE (TAKEOFF PORTION)

TAXI AT CONSTANT VELOCITY

(4) -

VERTICAL
ASCENT

| H | GROUND

(1) START GROUND IDLE

(2) VERTICAL ASCENT

(3) INITIAL GROUND TAXI MOTION

B) TERMINATION PHASE (LANDING PORTION)

TAXI AT CONSTANT VELOCITY

(1) - (2)

VERTICAL
DESCENT

GROUND | H |

(3) GROUND IDLE

(4) STOP
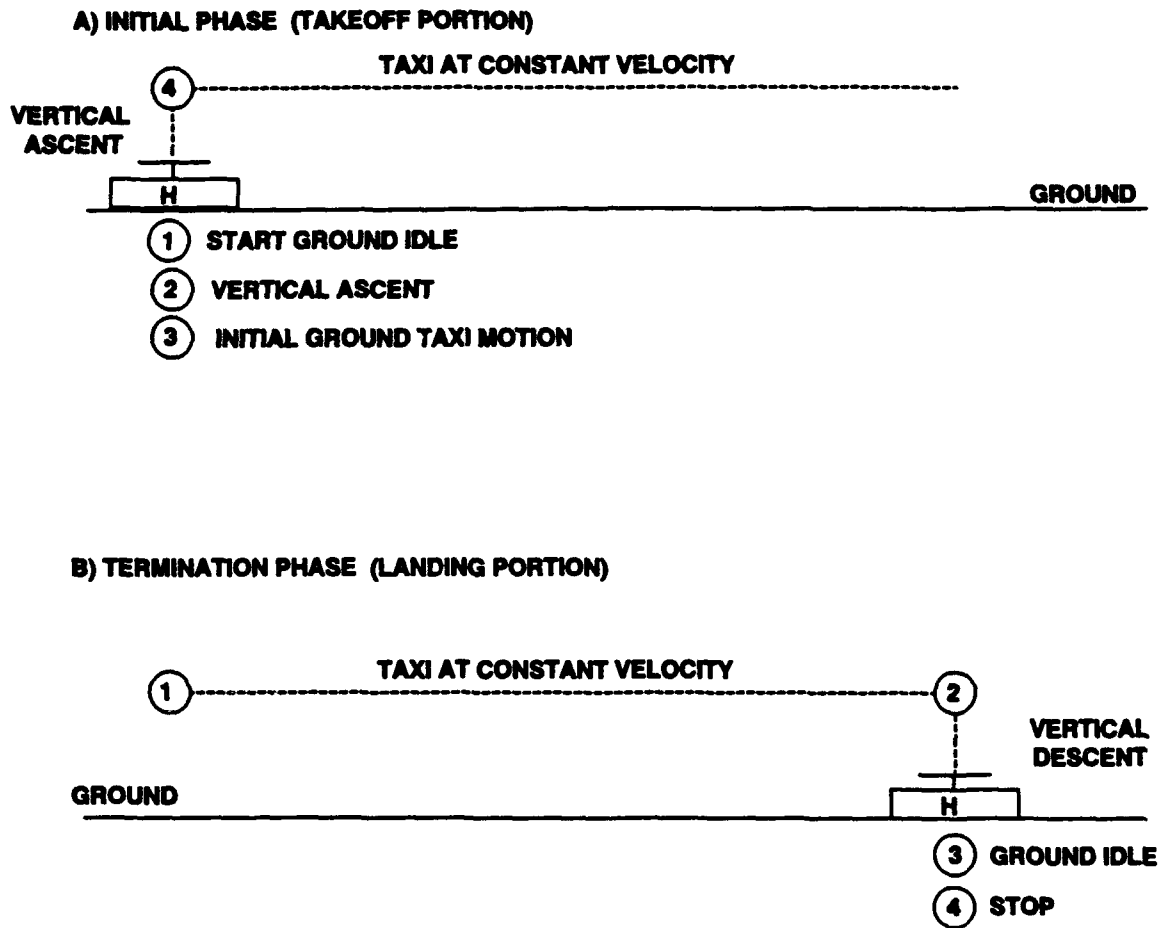
FIGURE 2-3: ILLUSTRATION OF AN HNM AIRBORNE TAXI PROFILE

2.1.5 Takeoff Profiles

Figure 2-4 is a flow chart which can accommodate the elements of several possible takeoff procedures. Specific procedures may skip some of these elements or add additional elements, as appropriate.

There are a total of 13 helicopter operating modes available in the HNM. Of these, nine modes may be appropriate for use in takeoff profiles (See Table 2-3). Table 2-4 contains a takeoff profile for "Example Heliport". It contains nine profile points which define eight profile segments and five operating modes, i.e., thrusts. At the last point, Point 9 in Table 2-4, no value of thrust is necessary.

For static operations not involving horizontal movement, the duration entered at a point is the duration of the operation initiated at the point. For example, for Point 1 at a distance of zero ft, thirty seconds is the duration of the operation at HIGE thrust. For Point 6 at a distance of 562 ft from the helipad and an altitude of 30 ft, the velocity is 60 kt, and it resulted from the acceleration of the previous segment.

2.1.6 Landing Profiles

Figure 2-5 is a flow chart which can accommodate the elements of several possible landing procedures. Specific procedures may skip some of these elements or add additional elements, as appropriate.

Of the 13 helicopter operating modes identified in the HNM, eight modes may be appropriate for use in landing profiles (see Table 2-5). Table 2-6 contains a landing profile for "Example Heliport". It contains seven profile points which define six segments. At the last point, Point 7 in Table 2-6, no value of thrust is necessary.

For static operations not involving horizontal movement, the duration entered at a point is the duration of the operation initiated at the point. For example, for Point 5 at a distance of zero ft and an altitude of three ft, three seconds is the duration of the operation at HIGE thrust. For Point 3 at a distance of 4,819 ft from the landing helipad and an altitude of 1,000 ft, 60 kt is the velocity, resulting from the deceleration of the previous segment.
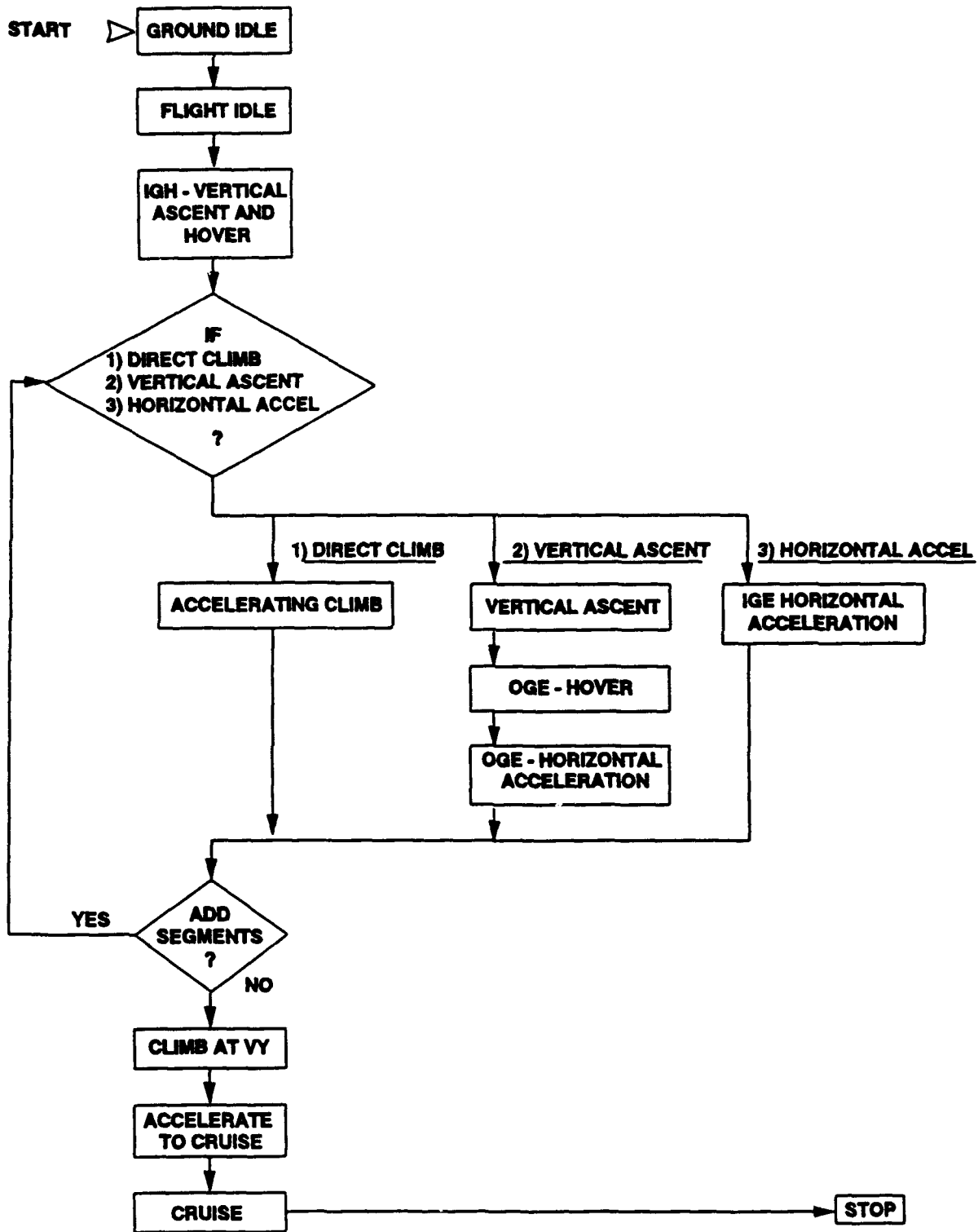
FIGURE 2-4: HNM HELICOPTER DEPARTURE OPERATING MODE INPUT OPTIONS

TABLE 2-3: OPERATING MODES AND THRUST NAMES USED FOR TAKEOFF PROFILES

Operating Mode	Thrust Name	Default Thrust Name in the Data Base
Ground Idle	GIDLE	GIDLE
Flight Idle	FIDLE	FIDLE
Hover In Ground Effect	HIGE	HIGE
Hover Out of Ground Effect	HOGE	HOGE
Vertical Ascent	VASC*	HIGE/HOGE**
Takeoff at Constant Velocity (Vy)	TO	TO
Accelerating Horizontal Takeoff	ACLH*	TO
Accelerating Climbing Takeoff	ACLC*	TO
Level Flyover (Cruise)	LFLO	LFLO

Notes:

* The Data Base is designed to provide offset constants to add to the default noise curve. In the Data Base, these constants are zero until experimentally determined.

** If the final altitude is greater than 1.5 times the rotor diameter, HOGE is used by the RNM. Otherwise, HIGE is used.

TABLE 2-4: TAKEOFF PROFILE FOR "EXAMPLE HELIPORT"

Description'	Distance (ft)	Altitude (ft)	Duration IAS(kt) or SEC	Velocity or Thrust
1. Startup and Idle	0	0	30 (SEC)	HIGE
2. Flight Idle Checks	0	0	30 (SEC)	HIGE
3. Vertical Ascent to 15 ft. and Hover	0	0	3 (SEC)	VASC
4. Horizontal Accel. to 30 kt (0.2g)	0	15	16 (kt)	ACLH
5. Climb and Accel. to 60 kt at 30 ft.	100	15	30 (kt)	ACLH
6. Climb at 1,700 ft./min.	562	30	60 (kt)	TO
7. Accel. to Cruise	4,032	1,000	60 (kt)	TO
8. Begin Cruise	6,786	1,000	100 (kt)	LFLO
9. End of Cruise	99,999	1,000	100 (kt)	

2-11

FIGURE 2-5: HNM HELICOPTER LANDING OPERATING MODE INPUT OPTIONS
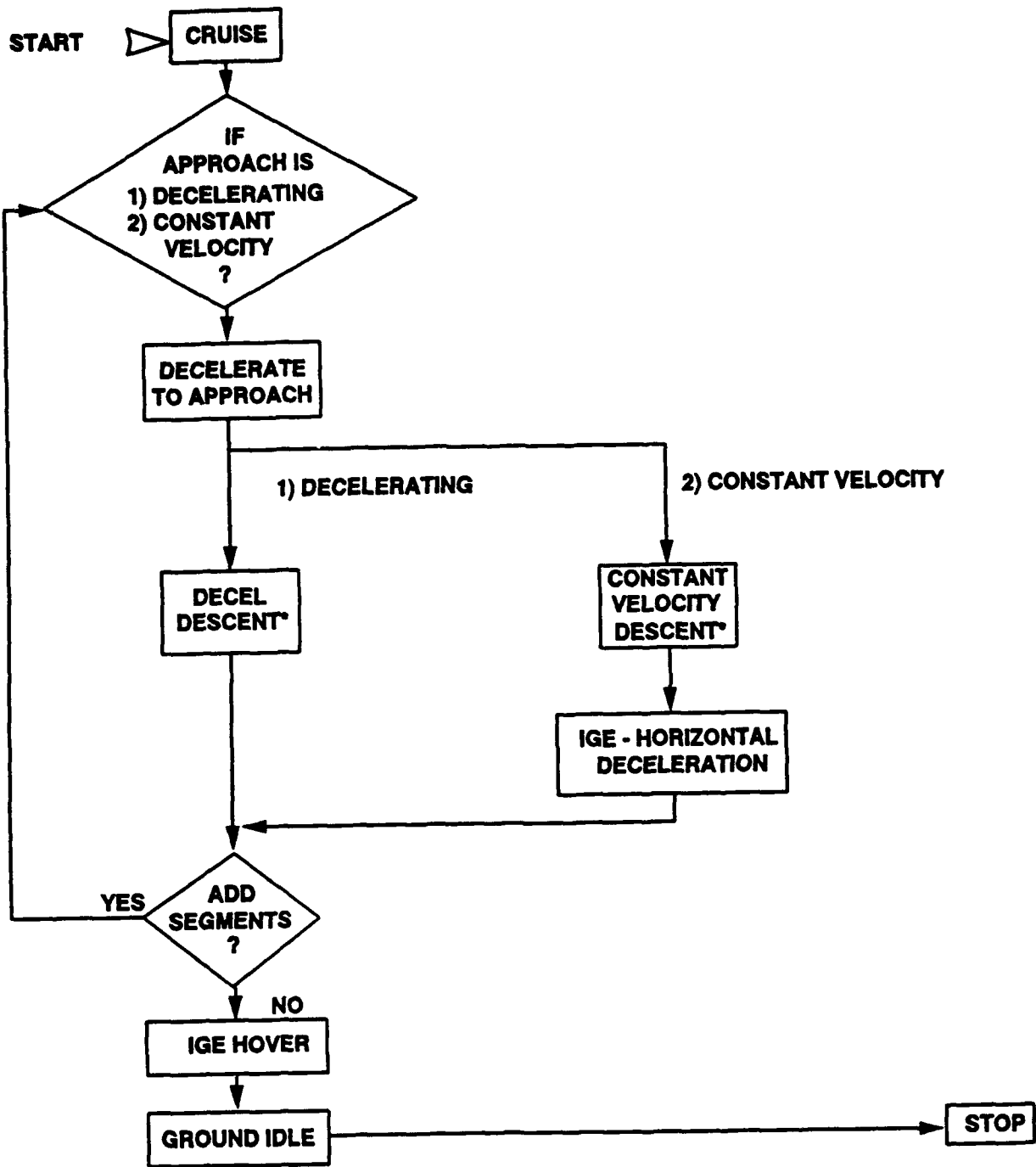
* MAY HAVE MORE THAN ONE SEGMENT

TABLE 2-5: OPERATING MODES AND THRUST NAMES USED FOR LANDING PROFILES

Operating Mode	Thrust Name	Default Thrust Name in the Data Base
Ground Idle	GIDLE	GIDLE
Flight Idle	FIDLE	FIDLE
Hover In Ground Effect	HIGE	HIGE
Hover Out of Ground Effect	HOGE	HOGE
Descent at Constant Velocity (Vy)	APPR	APPR
Decelerating Descent	DCLD*	APPR
Horizontal Deceleration	DCLH*	APPR
Level Flyover (Cruise)	LFLO	LFLO

* The Data Base is designed to provide offset constants to add to the default noise curve. In the Data Base, these constants are zero until experimentally defined.

TABLE 2-6: LANDING PROFILE FOR "EXAMPLE HELIPORT"

Description'	Distance (ft)	Altitude (ft)	Duration IAS(kt) or SEC	Velocity or Thrust
1. Cruise	99,998	1,000	100 (kt)	LFLO
2. Decel. to Approach	10,535	1,000	100 (kt)	DCLH
3. 6° Descent to 500 ft.	4,819	1,000	60 (kt)	APPR
4. 9° Decel. Descent	3,062	500	60 (kt)	DCLD
5. Hover and Vertical Descent	0	3	3 (SEC)	HIGE
6. Ground Idle	0	0	60 (SEC)	HIGE
7. Stop	0	0	0	

2.1.7   Taxi Profiles

Figure 2-6 is a flow chart which can accommodate the elements of several possible taxi procedures. Any specific procedure may omit elements or add additional elements, as appropriate.

All 13 helicopter operating modes identified in Tables 2-3 and 2-5 are appropriate for use in taxi profiles. Table 2-7 contains a taxi profile for "Example Heliport". It contains eight profile points which define six segments. The constant-velocity segment for the initial phase, i.e., the "takeoff" portion of the taxi operation, is combined with the constant-velocity segment for the termination phase, i.e., the "landing" portion of the taxi operation.

2-13
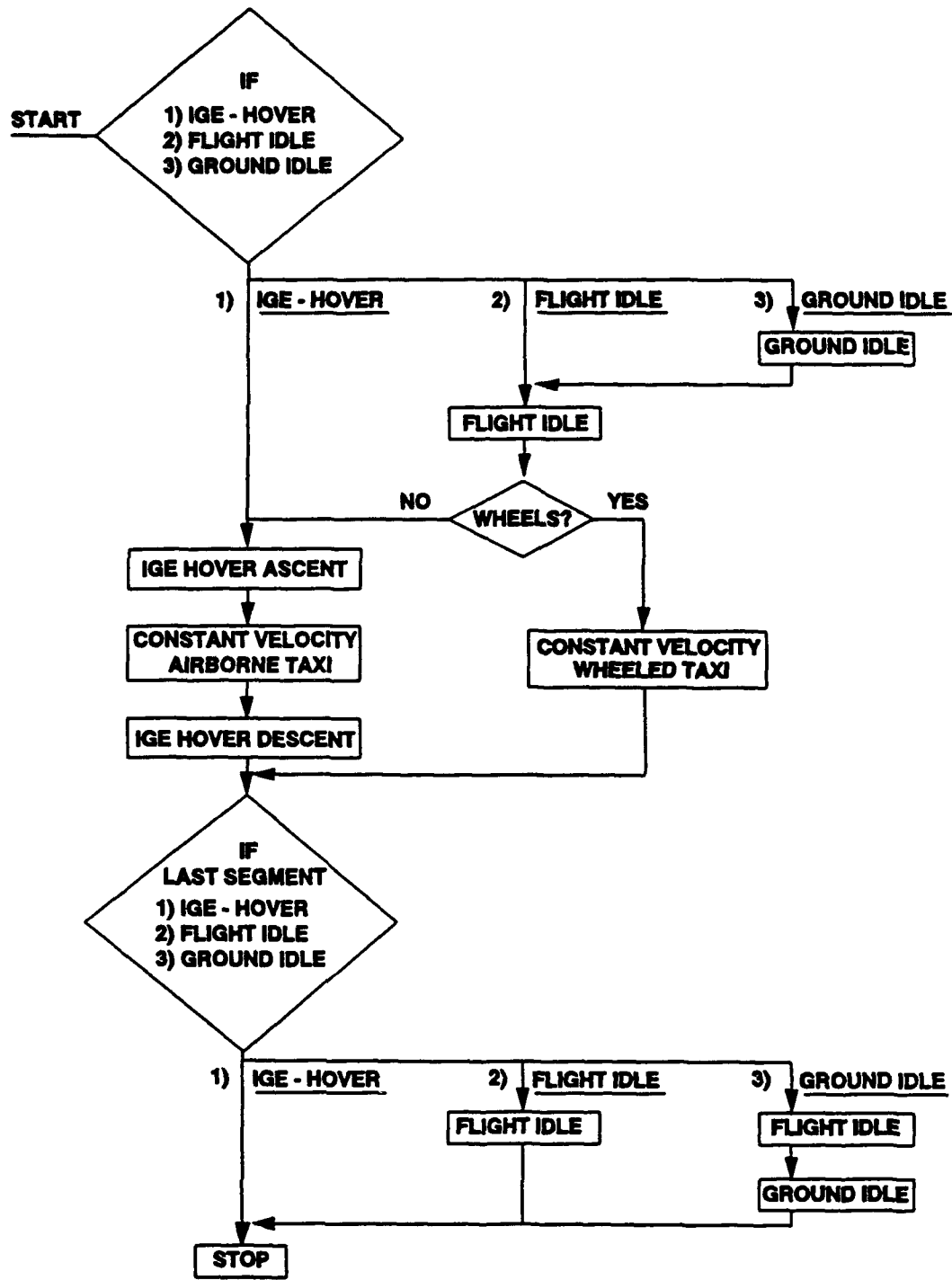
FIGURE 2-6: HNM HELICOPTER TAXI OPERATING MODE INPUT OPTIONS

TABLE 2-7: **PROFILE OF TAXI FROM THE TAKEOFF/LANDING PAD TO THE PARKING PAD FOR "EXAMPLE HELIPORT"***

Description	Distance (ft)	Altitude (ft)	Duration IAS(kt) or SEC	Velocity or Thrust
Takeoff Portion				
1. Ground Idle	0	0	60 (SEC)	GIDLE
2. Vertical Ascent to 3 ft. and Accel.	0	0	30 (SEC)	HIGE
3. Initial Horizontal Taxi Motion	0	3	10 (kt)	HIGE
4. Constant Velocity**	5,280	3	10 (kt)	
Landing Portion				
1. Constant Velocity**	5,280	3	10 (kt)	HIGE
2. Vertical Descent to Ground and Decel.	0	3	10 (SEC)	HIGE
3. Ground Idle	0	0	60 (SEC)	GIDLE
4. Stop	0	0	0	

*   This example is for an operation in which the helicopter: (1) starts from the takeoff/landing pad, moves to the parking pad, sits down and stops; (2) starts from the parking pad and moves to the takeoff/landing pad; or (3) moves from pad to pad.

**   The HNM combines two constant velocity segments into a single taxi segment with a length specified by the operator in the track definition. The "5280" ft is ignored.

For each of the defined points, the distance, altitude, velocity, and thrust are the values at that point. Note that on both the "takeoff" and "landing" portions of the taxi operation no thrust value is necessary for the last point of the profile. For static operations not involving horizontal movement, the duration entered at a point is the duration of the operation initiated at the point. For example, for Point 1 of the takeoff portion, at a distance and altitude of zero ft, 60 seconds is the duration of the operation at GIDLE thrust.

Note that the FIDLE noise thrust curve is used for constant velocity taxi segments if a helicopter has wheels. If the vehicle has no wheels, the HIGE noise curve is used. This distinction is made automatically by the HNM.

2.1.8 Description of Takeoff Tracks and Operations

A takeoff track definition consists of all information needed to model a flight path's projection on the ground, starting at a reference point on a helipad. Each track is associated with a particular helipad and can be used for only one type of operation: takeoff, landing, or taxi. Ordinarily, each helipad will be associated with several tracks for each type of operation. The user is

encouraged to use a unique name for each track in the case study.

A track consists of up to 16 segments which must alternately be straight and curved. The initial and final segments must always be straight. The heading of the initial straight segment must be specified. Subsequent straight segments can be defined simply by their length in user-specified units. A curved segment requires three entries: (1) the turn, to the left or right; (2) the turn angle or a heading; and (3) the radius of the turn.

Takeoff tracks are defined as a departing helicopter flies, with the first segment beginning at the helipad. Figure 2-7 presents a sample takeoff track for TD1 of "Example Heliport".

The user must provide the heading of the helicopter for any static operation at the helipad. This information is used in the computation of the directional characteristics of the static operating modes. Data Base 2 provides for uniform directivity in all directions for the helicopters without directional emission data.

Takeoff operations describe the type, magnitude, and arrangement of takeoff activity at a heliport. The input consists of the average number of daytime and nighttime takeoffs per day on each track. Daytime is the period between 0700 and 2200 hours local time; nighttime is between 2200 and 0700 hours local time. The specification of the time-of-day is an important factor in the computation of Day-Night Average Sound Level, which is the measure of cumulative noise in the HNM. The contribution of each nighttime operation to total noise exposure is ten times the contribution of each daytime operation. The preparation of operations data is based on knowledge of schedule, demand, track utilization, air traffic control procedures, and helipad and track layout.

Takeoff operations are described for the HNM by frequency of operation in daytime and in nighttime. Each takeoff track description must be accompanied by a description of the operations on that track. Each operation description gives the helicopter type-name, and the number of daytime and nighttime takeoffs for that helicopter on that particular track. Table 2-8 contains takeoff operations by frequency for "Example Heliport".

2-16
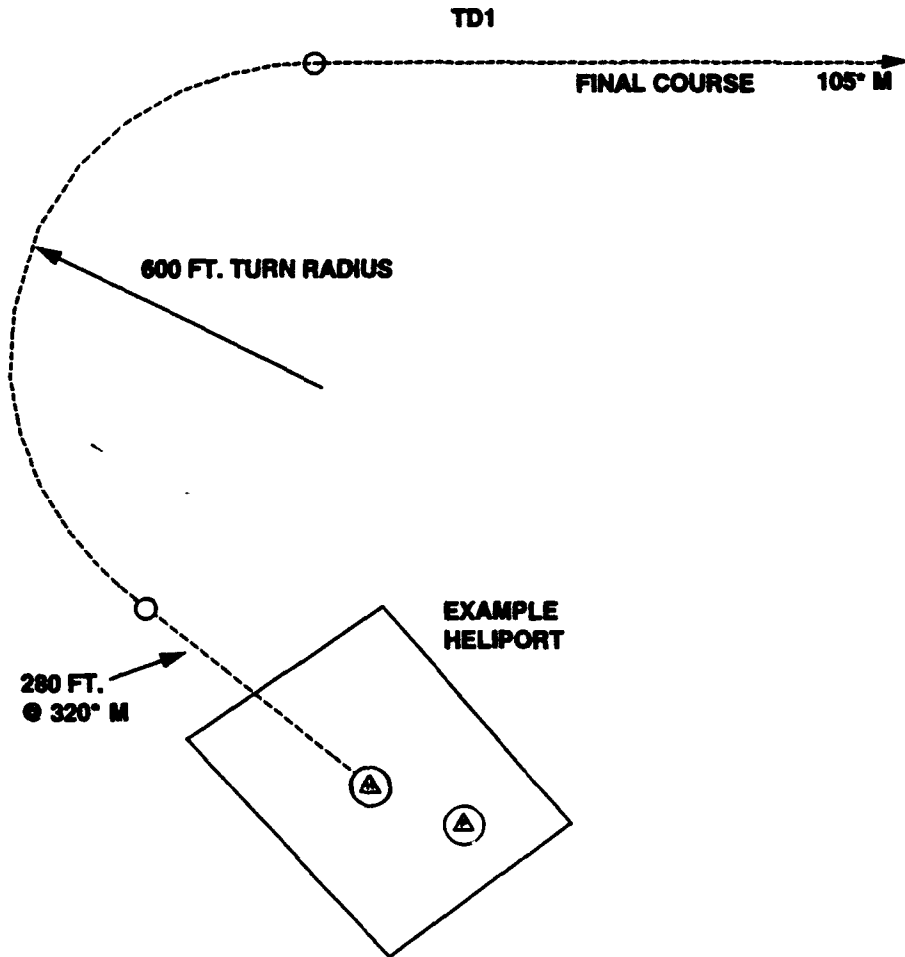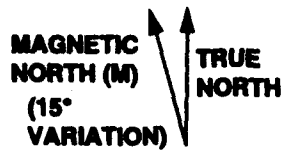
FIGURE 2-7: ILLUSTRATION OF A TAKEOFF TRACK AT "EXAMPLE HELIPORT"

2-17

TABLE 2-8: ANNUAL AVERAGE DAILY TAKEOFF OPERATIONS AT "EXAMPLE HELIPORT"

Helicopter	Track	Profile	Operations		Heading	
			Daytime	Nighttime	Hover	Ground
Augusta A-109	TD1	TA109	2	1	300	300
Augusta A-109	TD2	TA109	1	0	299	299
Augusta A-109	TD3	TA109	1	0	33	33
Augusta A-109	TD4	TA109	1	0	32	32
Sikorsky S-76	TD1	TS76	5	0	300	300
Sikorsky S-76	TD3	TS76	6	0	33	33

2.1.9 Description of Landing Tracks and Operations

A landing track definition consists of all information needed to model a flight path's projection on the ground, up to a reference point on a helipad. Each track is associated with a particular helipad and can be used only for one type of operation: takeoff, landing, or taxi. Ordinarily, each helipad will be associated with several tracks for each type of operation. The user is encouraged to use a unique name for each track in the case study.

A track is made up of up to 16 segments which must alternately be straight and curved. The initial and final segments must always be straight. The heading of the initial straight segment must be specified. Subsequent straight segments can be defined simply by their length in user-specified units. A curved segment requires three entries: (1) the turn, to the left or right; (2) the turn angle or a heading; and (3) the radius of the turn.

Landing tracks are defined as an arriving helicopter flies, with the last segment ending at the helipad. Figure 2-8 presents a sample landing track, TA4, for "Example Heliport".

The user must provide the heading of the helicopter for any static operations at the helipad. This information is used in the computation of the directional characteristics of the static operating modes. Data Base 2 provides for uniform directivity in all directions for the helicopters without directional emission data.

Landing operations describe the type, magnitude, and arrangement of landing activity at a heliport. The input consists of the average number of daytime and nighttime landings per day on each track. The preparation of operations data is based on knowledge of schedule, demand, air traffic control procedures, and the helipad and track layout.

MAGNETIC NORTH (M) (15° VARIATION)

TRUE NORTH

INITIAL COURSE @ 155° M

TA4

600 FT. TURN RADIUS

EXAMPLE HELIPORT

200 FT. @ 230° M
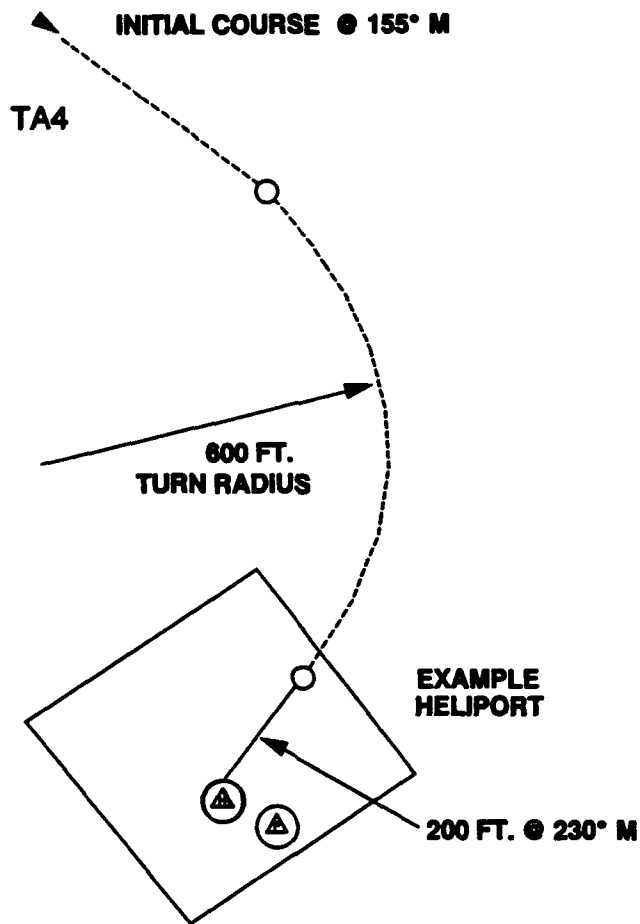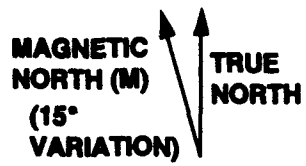
FIGURE 2-8: ILLUSTRATION OF A LANDING TRACK AT "EXAMPLE HELIPORT"

2-19

Landing operations are described for the HNM by frequency of operations in daytime and nighttime. Each landing track description is followed by the operations on that track. Each operation description gives the helicopter type-name and the number of daytime and nighttime landings for that helicopter on that particular track. Table 2-9 contains landing operations by frequency for "Example Heliport".

TABLE 2-9: ANNUAL AVERAGE DAILY LANDING
            OPERATIONS AT "EXAMPLE HELIPORT"

Helicopter	Track	Profile	Operations		Heading	
			Daytime	Nighttime	Hover	Ground
Augusta A-109	TA1	AA109	2	1	125	125
Augusta A-109	TA2	AA109	1	0	126	126
Augusta A-109	TA3	AA109	1	0	215	215
Augusta A-109	TA4	AA109	1	0	215	215
Sikorsky S-76	TA1	AS76	5	0	125	125
Sikorsky S-76	TA3	AS76	6	0	215	215

2.1.10 Description of Taxi Tracks and Operations

Taxi tracks are described with the first segment beginning at a helipad, or parking pad, as appropriate, and the final segment ending at a parking pad or helipad. The track is defined as the taxi would be performed. The user must provide the heading of the initial segment and the X- and Y-coordinates of the taxi track's termination point (i.e., final location). Figure 2-9 presents a sample taxi track, TX1, for "Example Heliport".

The user must provide the heading of the helicopter for any static operations at the helipad or parking pad. This information will be used to compute the directional characteristics of several of the static operating modes. Data Base 2 provides for uniform directivity in all directions for the helicopters without directional emission data.

Taxi operations describe the type, magnitude, and arrangement of taxi activity at a heliport. The input consists of the average number of daytime and nighttime taxi operations per day on each track. The preparation of operations data is based on knowledge of schedule, demand, air traffic control procedures, and the helipad and track layout.

Taxi operations are described for the HNM by frequency of operation in the daytime and nighttime. Each taxi track description is followed by the operations on that track. Each operation description gives the helicopter type-

2-20

MAGNETIC NORTH (M) (15° VARIATION)

TRUE NORTH

"EXAMPLE HELIPORT"

TOUCH DOWN PAD P01

110 FT. @ 195° M

100 FT. TURN RADIUS

TOUCH DOWN PAD PP1

TX1

110 FT. @ 105° M
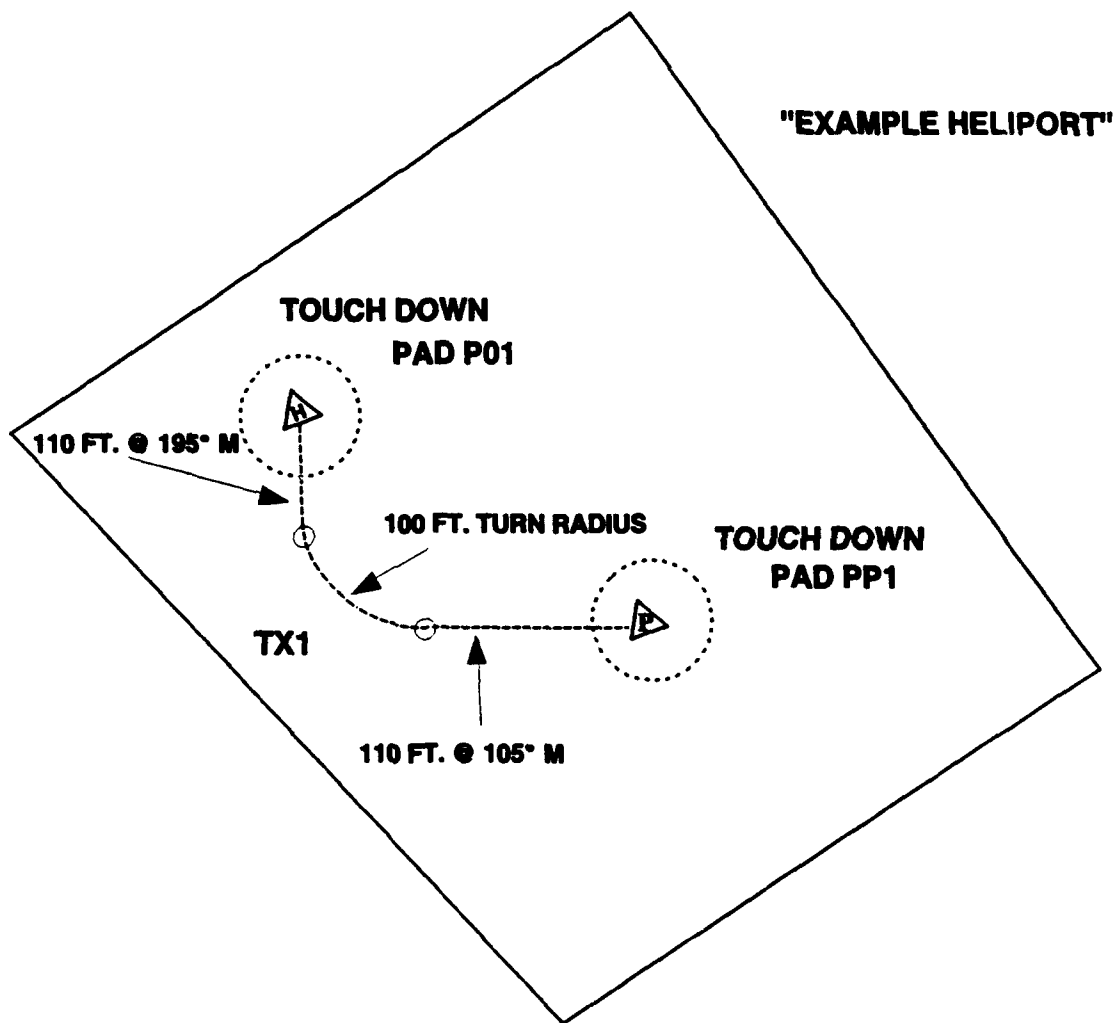
FIGURE 2-9: ILLUSTRATION OF TAXI TRACK AT "EXAMPLE HELIPORT"

2-21

name, and the number of daytime and nighttime taxi operations for that helicopter on that particular track. Table 2-10 contains taxi operations by frequency for "Example Heliport".

TABLE 2-10: ANNUAL AVERAGE DAILY TAXI OPERATIONS AT "EXAMPLE HELIPORT"

Helicopter	Track	Profile	Operations		Takeoff		Landing	
			Daytime	Nighttime	Hover	Ground	Hover	Ground
Sikorsky S-76	TX1	GS76	1	0	180	180	90	90
Sikorsky S-76	TX2	GS76	1	0	270	270	0	0

2.2 Description of "Example Heliport"

A hypothetical heliport, together with its tracks and operations, has been developed to serve as an example for the HNM user. The heliport is named "Example Heliport". It is the basis for the sample input and output data contained in this User's Guide.

Figure 2-10 shows the layout of "Example Heliport". The heliport contains a touchdown helipad that is used by two helicopter types. A parking position is also shown. There are two principal arrival and departure corridors for the heliport.

The following define "Example Heliport" and its operations for an assessment of its potential noise impact.

● Heliport elevation is 0 ft MSL.

● Annual average ambient temperature near the surface is 59°F.

● The touchdown helipad and the parking position shown in Figure 2-10 are utilized at the "Example Heliport".

● There are four takeoff tracks, four landing tracks, and two taxi tracks, as illustrated in Figure 2-11.

● Two helicopter types, a Sikorsky S-76 and an Augusta A-109, operate at the heliport on a regular basis.

● The number of operations of each helicopter on each track are given in Tables 2-8, 2-9, and 2-10.

● The landing, takeoff, and taxi profiles for both helicopters are described in Tables 2-4, 2-6, and 2-7. Note: These profiles are hypothetical and should not be assumed to be applicable to an actual heliport case.

● The ground surface is acoustically soft.

MAGNETIC
NORTH (M)

TRUE
NORTH

(15° W
VARIATION)

PRIMARY APPROACH/DEPARTURE
DEPARTURE TRACK 320° M (305° T)

SECONDARY APPROACH/DEPARTURE
APPROACH TRACK 230° M (215° T)

"EXAMPLE HELIPORT"

TAXI TRACK
210 FT.

TOUCHDOWN
PAD P01

TOUCHDOWN
PAD PP1
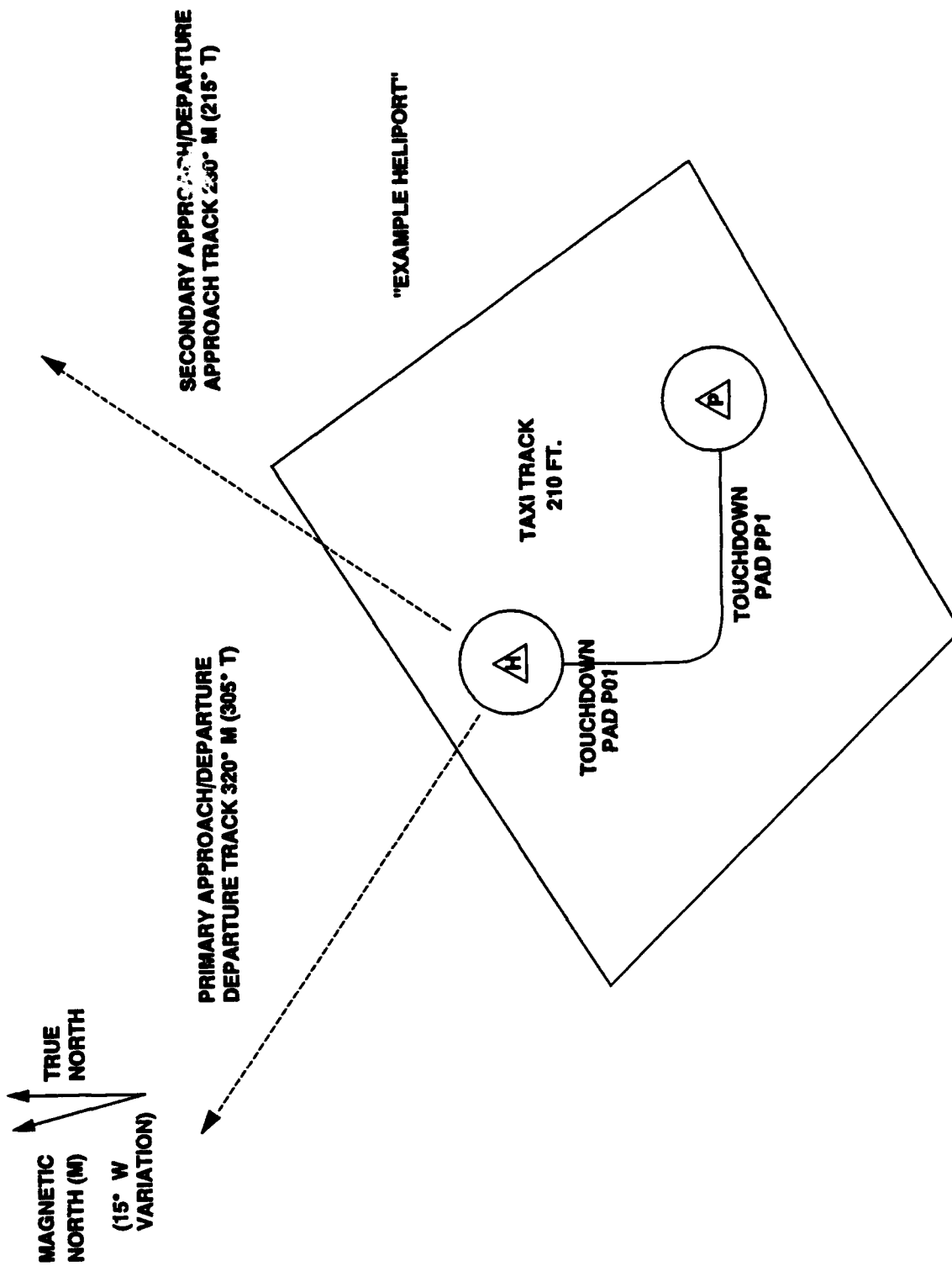
FIGURE 2-10: "EXAMPLE HELIPORT" LAYOUT

MAGNETIC
NORTH (M)
(15°
VARIATION)

TRUE
NORTH

TD4

TD2

TA4

TA2

TA3

TD3

TA1

TD1

"EXAMPLE
HELIPORT"

TX 1,2
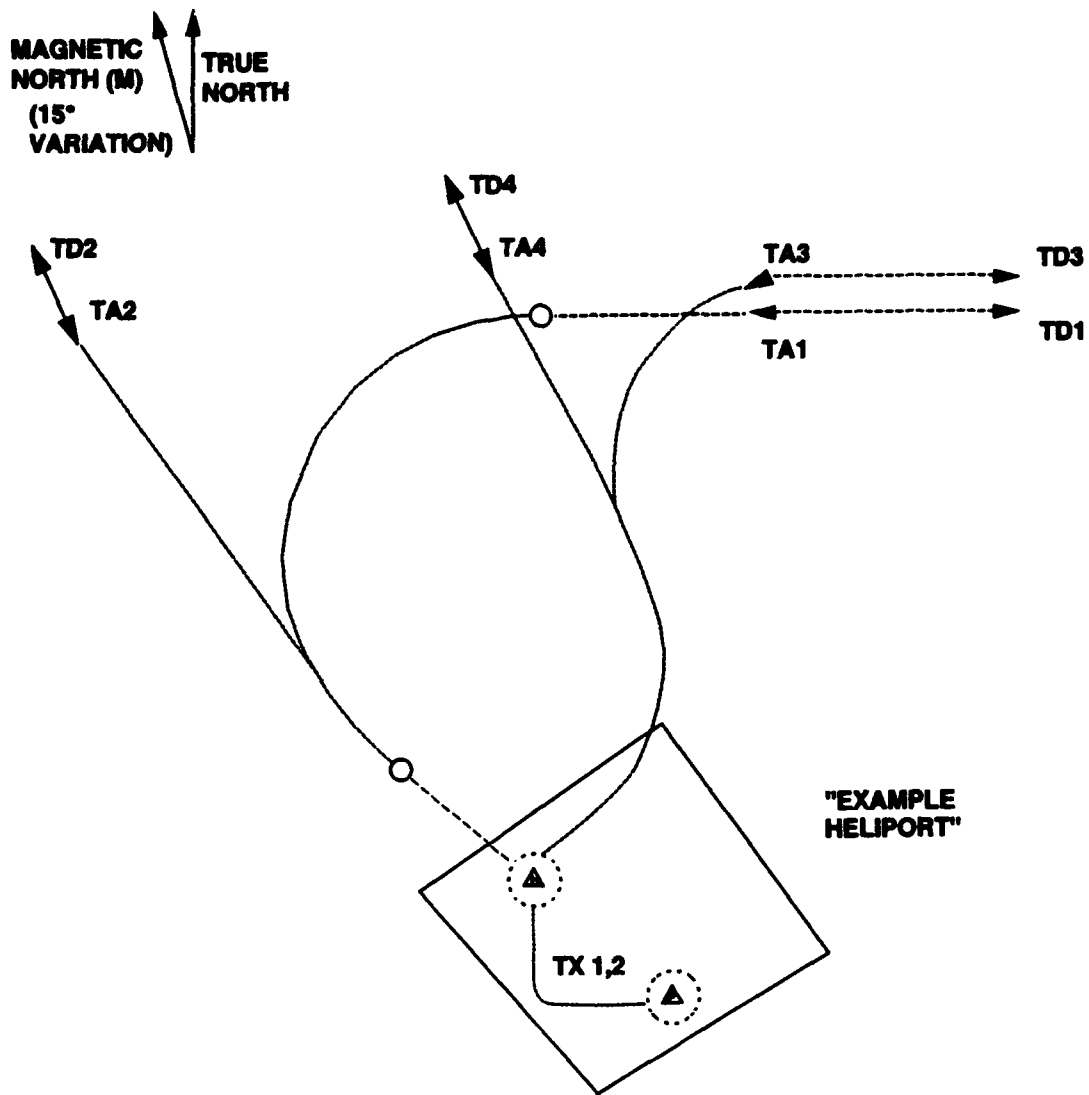
NOTE: TX1 IS FROM PARKING
        PAD (PO1) TO PARKING PLACE

        TX2 IS FROM PARKING
        PLACE (PP1) TO PAD

FIGURE 2-11: TAKEOFF AND LANDING TRACKS AT "EXAMPLE HELIPORT"

3. PROGRAM START-UP AND PREPARING CASE INPUTS

This section describes HNM Version 2.2 start-up and heliport case study preparation. Case preparation is presented in a concise step-by-step fashion and is accompanied by HNM screen examples.

3.1 System Start-Up: The "HNM Main Menu"

The Heliport Noise Model Version 2.2 is executed by typing HNMRUN from within the HNM22 subdirectory.

●   **C:\HNM22\HNMRUN**

Initially the "HNM Title Screen" is displayed. Selecting any key will then bring up the "HNM Main Menu", Figure 3-1. The user may scroll through the available options within this menu and all subsequent menus described herein using the up/down and left/right arrow keys. From within the "HNM Main Menu" and all other menus context-sensitive help is available to the user by selecting "F1".

With the "HNM Main Menu" displayed on the screen the user has the following four options:

> Case Selection: A case must be selected before a user can edit/load a case study. The "Case Selection" option must be chosen and either an existing or a new case study should be selected (see Section 3.2).
>
> Edit/Load Case: Executing the "Edit/Load Case" option allows the user to edit HNM input parameters, (e.g., Setup, Pad/Parking Place, Helicopters, etc.) and to load the edited case for processing (see Section 3.3).
>
> Process Case: The "Process Case" option executes the HNM's INPUT, FLIGHT and COMPUTE modules for a user-specified input case, (i.e., a user-specified case that has been prepared and saved using the "Edit/Load" option) (see Section 3.4).
>
> Plot Case: This menu option executes the HNMPLOT module to plot the noise contour for the processed case (see Section 3.5).

The above options from the "HNM Main Menu" are discussed in further detail in the following sections.

```
┌─────────────────────────────────────────────────────────┐
│  ┌───────────────────────────────────────────────────┐  │
│  │ ▌                        ▐▐                         │  │
│  │              Selected Case :                         │  │
│  │                                                      │  │
│  │                                                      │  │
│  │              ▐ CASE SELECTION ▌                      │  │
│  │                                                      │  │
│  │                EDIT/LOAD CASE                        │  │
│  │                                                      │  │
│  │                PROCESS CASE                          │  │
│  │                                                      │  │
│  │                PLOT CASE                             │  │
│  │                                                      │  │
│  │                                                      │  │
│  │                                                      │  │
│  │                                                      │  │
│  │ F1-Help    Esc-Exit    ◄┘-Select   ↑↓◄►-Menu Movement│  │
│  └───────────────────────────────────────────────────┘  │
└─────────────────────────────────────────────────────────┘
```
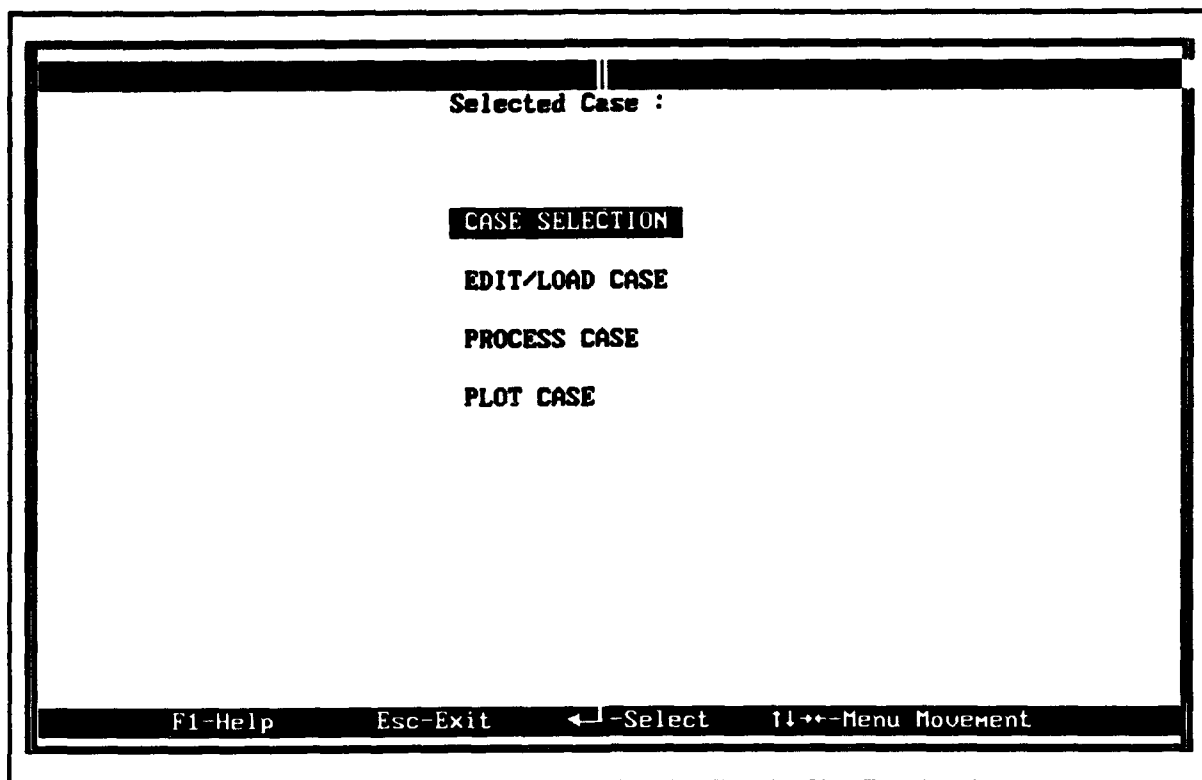
FIGURE 3-1:   HNM MAIN MENU

3.2 Case Selection

Upon selecting this option, the "Case File Selection Menu"
will be displayed on the screen (Figure 3-2). The user has
the option to: (1) select an existing case study; or (2)
create a new study from scratch or use an existing case as a
model.

To select an existing case study, move the cursor to the
desired filename and select "ENTER" and "F10". A small window
will appear on the display to verify the selection. Select
"F10" to continue with the selected case which will be saved
under its displayed name. To create a new case using the
selected case as a model, type a new "Save Case File" name and
select "F10". Upon selecting "F10", the data in the user-
specified file is loaded into memory, and the "HNM Main Menu"
will again be displayed. **Note**: The "Save Case File" name
must be changed if the user does not want to overwrite the
original file.

To create a new case study from scratch select "F10" with the
"Case File Selection Menu" displayed. A small window appears
and the "Load Case File" name and "Save Case File" name
entries will be blank. Enter a filename for the "Save Case
File" and select "F10". Any valid DOS filename (up to eight
characters, optionally followed by a one-to-three character
extension) can be used. A new case study is created using
default values under the selected "Save Case File" name.

```
┌──────────────────────────────────────────────────────────┐
│  ████████████████████████████████████████████████████    │
│  ██                 Case File Selection              ██    │
│  ████████████████████████████████████████████████████    │
│                                                            │
│   Load Case                       Save Case                │
│   Name      Date        Time      Name      Date     Time  │
│  ┌──────────────────────────────────────────────────────┐ │
│  │ ▓TESTCASE▓ 11/30/93    10:42:04                        │ │
│  │                                                        │ │
│  │                                                        │ │
│  │                                                        │ │
│  │                                                        │ │
│  │                                                        │ │
│  │                                                        │ │
│  │                                                        │ │
│  │                                                        │ │
│  └──────────────────────────────────────────────────────┘ │
│  F1-Help  F4-Delete File  F10-Continue  Esc-Exit  ◄┘-Select  ↑↓→←-Menu Move │
└──────────────────────────────────────────────────────────┘
```

FIGURE 3-2:   CASE FILE SELECTION MENU

3.3   Edit/Load Case

Upon selecting this option, the "Data Entry Menu" will be
displayed on the screen (Figure 3-3). All data entry steps
begin and end with this menu. These steps are shown in two
categories: (1) "Keyboard Entries" on the left; and (2)
"Tablet Entries" on the right. As mentioned earlier in
Section 1, the "Tablet Entry" option has been disabled. To
make a selection from the "Data Entry Menu", highlight the
desired function and select "ENTER". In general, data entry
should proceed in the order in which the steps are shown in
the menu. Upon completion select "F10" to save the input file
with a .INP filename extension and the case file with a .ENT
extension.

The user has the following data entry options:

> Setup: The "Setup Menu" (Figure 3-4) allows the user to
> change heliport parameters and units definition. This
> menu is used to enter information identifying the case
> and the heliport under study, including: (1) Title - any
> descriptive name up to 67 characters; (2) Heliport Name -
> any descriptive name up to 35 characters; (3) Altitude
> Above Mean Sea Level (MSL); (4) Temperature in Centigrade
> (C), Fahrenheit (F), or Rankine (R) degrees; (5) Surface
> Type (i.e., hard or soft - currently soft is the only

```
                        Data Entry Menu
                    Selected Case: TESTCASE

  ┌──────────────────────────┐        ┌──────────────────────────┐
  │                          │        │                          │
  │  Keyboard Entries        │        │  Tablet Entries          │
  │  ─────────────────       │        │  ─────────────────       │
  │                          │        │                          │
  │  ▌Setup▐                 │        │  Map                     │
  │                          │        │                          │
  │  Pad/Parking Place       │        │  Pad/Parking Place       │
  │                          │        │                          │
  │  Helicopters             │        │  Takeoff Tracks          │
  │                          │        │                          │
  │  Takeoff                 │        │  Approach Tracks         │
  │                          │        │                          │
  │  Approaches              │        │  Taxi Tracks             │
  │                          │        │                          │
  │  Taxi                    │        │                          │
  │                          │        │                          │
  │  Processes               │        │                          │
  │                          │        │                          │
  │  Echo Reports            │        │                          │
  └──────────────────────────┘        └──────────────────────────┘
  F1-Help   F10-Save Data/Load Case   Esc-Exit   ←┘-Select   ↑↓→←-Menu Move
```
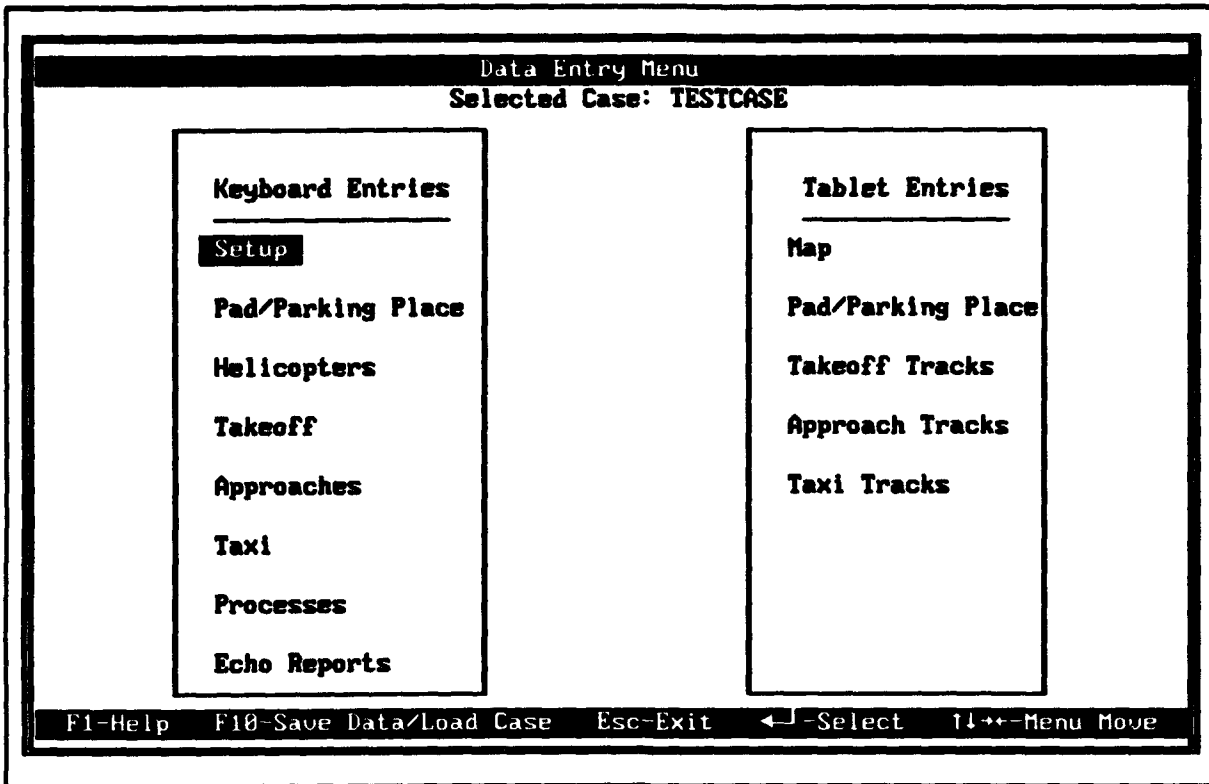
FIGURE 3-3:   DATA ENTRY MENU

```
                              Setup
                      Selected Case:TESTCASE

                              Title
  ▌Example test case HNM Version 2.2                                    ▐

                          Heliport Name
  Example Heliport

              Altitude (Ft) 0
              Temperature 59    Scale Fahrenheit
              Surface Type Soft

                        Units Definition

      F Pads            F Takeoff Profiles      F Takeoff Tracks
      F Grid            F Approach Profiles      F Approach Tracks
      F Contour         F Taxi Profiles          F Taxi Tracks
          Select Units Definitions for ground distances
          F - Feet  M - Meters  I - International Nautical Miles
    Space Toggles Selection (Units, Surface Types and Temperature Scale)
  Note: All units converted to feet when graphic tablet input is selected.
    F1 - Help    F10 - Continue   Esc - Exit    ↑↓→←←┘ - Field Movement
```

FIGURE 3-4:   SETUP MENU

valid selection); and (6) Units definition in ft, m or nm.

Upon completion, enter "F10" to save or "ESC" to exit without saving.

Pad/Parking Place: The "Helipad Definition Menu" (Figure 3-5) allows the user to define Pad/Parking identification names and X-,Y-coordinates of the pads in feet.

Helipad and parking locations are defined by first entering an identifier, up to three letters/characters in combination, e.g., PO1 and PP1, for each helipad and parking location. The X- and Y-coordinates should then be entered. Normally the helipad (or main helipad, if there is more than one at the heliport) is assigned the coordinates (0,0); the other helipads are assigned coordinates relative to that point.

Upon completion, enter "F10" to save or "ESC" to exit without saving.

Helicopters: The "Helicopter Selection Menu" (Figure 3-6) allows the user to identify specific helicopters for processing. With this menu displayed, the "Space Bar" is used to select/deselect any number of helicopters from the list. A helicopter is selected when it is highlighted in yellow. Nominal rotor RPM values are also displayed for each helicopter. They may be modified as appropriate. If a helicopter is deselected, all other entries relating to that helicopter will be erased.

Note: At least one helicopter must be selected for HNM computations to be performed. The following helicopters, although listed as available choices, do not have acoustic data in the Data Base and cannot be selected for processing: S64, B47, BK117, H300C, and R22HP.

Takeoff: The "Takeoff Flight Menu" (Figure 3-7) has three sub-menus which allow for the editing of takeoff tracks, profiles, and operations. Selection of these items from the menu is described further in Section 3.3.1 below.

Approach: The "Approach Flight Menu" is identical to takeoffs (see Figure 3-7 and Section 3.3.1 below).

Taxi: With one exception, the "Taxi Flight Menu" is identical to takeoffs (see Figure 3-7 and Section 3.3.1 below). The exception is as follows: For proper processing of taxi tracks, the geometric sum of the straight and curved sections must equal the "Final Location". The "F3" option facilitates the adjustment of segment definition to match the "Final Location" by

```
                          Helipad Definition
                         Selected Case: TESTCASE

                              Coordinates (Feet)
        Pad/Parking Id.           X                Y

              Po1                 0.0              0.0
              Pp1               210.0           -210.0
                                  0.0              0.0
                                  0.0              0.0
                                  0.0              0.0
                                  0.0              0.0
                                  0.0              0.0
                                  0.0              0.0
                                  0.0              0.0
                                  0.0              0.0
                                  0.0              0.0
                                  0.0              0.0
                                  0.0              0.0


     F1-Help        F10-Continue          Esc-Exit        ↑↓→←↵-Field Movement
```

FIGURE 3-5:   HELIPAD DEFINITION MENU

```
                           Helicopter Selection
                          Selected Case: TESTCASE
              Helicopter             Rotor            Helicopter            Rotor
      Name    Description            RPM       Name   Description           RPM

      B212    BELL 212 (UH-1N)       324       S61    SIKORSKY S-61(CH-3A)   203
      S64     SIKORSKY S-64(CH54B)   186       CH47D  BOEING VERTOL CH-47D   225
      H500D   HUGHES 500D            492       BO105  BOELKOW BO-105         424
      B47G    BELL 47G               370       SA330J AEROSPATIALE SA-330J   265
      B206L   BELL 206L              394       A109   AGUSTA A-109           385
      SA341G  AEROSPATIALE SA-341G   378       H300C  HUGHES 300C            471
      S65     SIKORSKY S-65(CH-53)     0       S70    SIKORSKY S-70(UH60A)   285
      S76     SIKORSKY S-76          293       SA365N AEROSPATIALE SA-365N   365
      SA355F  AEROSPATIALE SA-355F   394       SA350D AEROSPATIALE SA-350D   386
      B222    BELL 222               348       R22HP  ROBINSON R22HP         530
      BK117   BOELKOW BK-117         391




               Select Helicopters to be used for this Case.
               Selected Helicopters are displayed in Yellow
     F1-Help  F10-Continue  Esc-Exit  ↑↓→←↵-Field Movement  Space-Select
```

FIGURE 3-6:   HELICOPTER SELECTION MENU

```
┌─────────────────────────────────────────────────────────┐
│ ┌─────────────────────────────────────────────────────┐ │
│ │ ███████████████ Takeoff Flight Menu ███████████████ │ │
│ │              Selected Case:TESTCASE                 │ │
│ │                                                     │ │
│ │                                                     │ │
│ │                                                     │ │
│ │                                                     │ │
│ │                ████████████████                     │ │
│ │                █ Tracks       █                     │ │
│ │                ████████████████                     │ │
│ │                                                     │ │
│ │                  Profiles                           │ │
│ │                                                     │ │
│ │                                                     │ │
│ │                  Operations                         │ │
│ │                                                     │ │
│ │                                                     │ │
│ │                                                     │ │
│ │ F1 - Help   F10 - Continue   Esc - Exit  ◄┘Select  ↑↓→←-Menu Movement │ │
│ └─────────────────────────────────────────────────────┘ │
└─────────────────────────────────────────────────────────┘
```
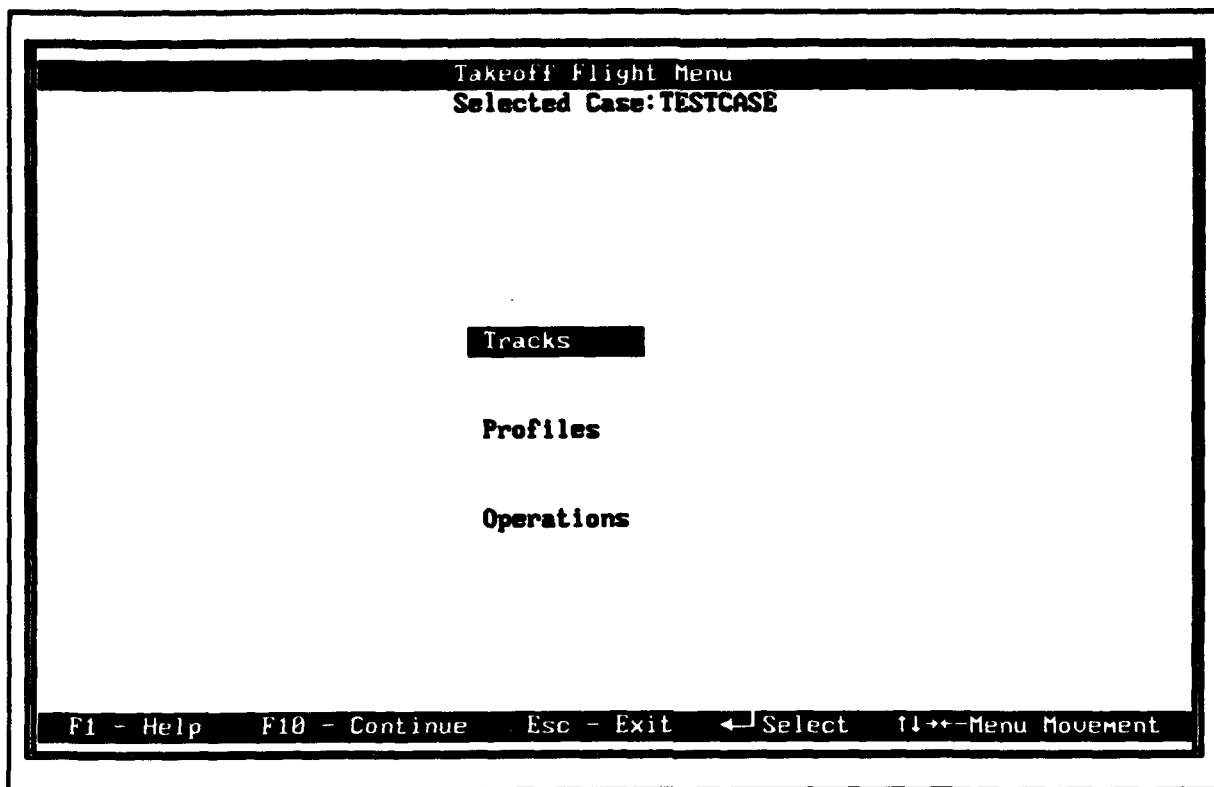
FIGURE 3-7: TAKEOFF FLIGHT MENU

computing the geometric sum of the given straight and
curved sections.

Processes: The "Process Menu" (Figure 3-8) has two sub-
menus, the "Grid Definition Menu" (Figure 3-9) and the
"Contour Definition Menu" (Figure 3-10).   From the
"Process Menu", selecting "Grid Reports" allows the user
to define specific grid points, i.e., receiver locations,
for noise computations. Selecting "Contour Definition"
allows the user to define specific contour level(s) and
plot window limits.

Grid Reports: A grid analysis determines the noise
levels for the L_{dn} noise metric at specified points
on a grid, i.e., receiver locations, around the
heliport area. The actual grid is defined by three
entries in the "Grid Definition Menu":

(1) The offset coordinates represent the first
     point of a grid of point(s) beginning in the
     lower left-hand corner of the grid.

(2) The increment is the distance between points
     in the X- and Y-direction.

(3) Values are the number of points making up the
     grid in the X- and Y-directions. The actual

```
                        Process Menu
                  Selected Case:TESTCASE




                  ┌─────────────────┐
                  │  Grid Reports   │
                  └─────────────────┘
                    Contour Definition










  F1 - Help      F10 - Continue     Esc - Exit     ↑↓→←◄┘  - Menu Movement
```

FIGURE 3-8:   PROCESS   MENU

```
                        Grid Definition
                     Selected Case:TESTCASE
   Grid  X-Offset   Y-Offset  X-Increment  Y-Increment  X-Values Y-Values Detail
    01   -1200.0   -1200.0      200.0        200.0         11       11     N
    02    200.0     200.0        0.0          0.0          1        1      N
    03     0.0       0.0         0.0          0.0          1        1      N
    04                                                                    N
    05                                                                    N
    06                                                                    N
    07                                                                    N
    08                                                                    N
    09                                                                    N
    10                                                                    N
    11                                                                    N
    12                                                                    N
    13                                                                    N
    14                                                                    N
    15                                                                    N
    16                                                                    N
    17                                                                    N
    18                                                                    N
    19                                                                    N
  F1 - Help F4 - Delete F10 - Continue  Esc - Exit    ↑↓→←◄┘ - Menu Movement
```

FIGURE 3-9:   GRID DEFINITION MENU

3-8

```
                        Contour Definition
                     Selected Case: TESTCASE
         Contour Name:  NEW001
                     Contour Levels (dB):
            60.0    65.0    70.0     0.0     0.0
             0.0     0.0     0.0     0.0     0.0

    Tolerance:              1.0      Number of Refinements:   4

                 Window Coordinates  (Feet):
         Lower Left - X   -2000.0 - Y   -2000.0
         Upper Right- X    2000.0 - Y    2000.0

      Print Report   Y                Contour Plot   Y

           Contour Plot Information  (Feet):

      Paper Size ( X -:     8.5  Y -     11.0
      Plot Scale     1000.0
      Plot Origin  X -      0.0  Y -      0.0
      (0.0 , 0.0 places the origin at the center.)

   F1-Help  F10-Continue    Esc-Exit    ↑↓→←↲-Field Movement  Space-Toggle
```

FIGURE 3-10: CONTOUR DEFINITION MENU

number of points in the grid is the product of
the number of X-values and the number of Y-
values. The user should enter 1 for both the
X- and Y-values to define a grid with a single
point.

The normal output from the grid analysis is a
"Standard Grid Analysis Report" (See Section 5).
In addition to this report, the user may elect to
receive a "Detailed Grid Analysis Report," of up to
20 points, i.e., receiver locations. Any number of
grid analyses may be requested in one execution.

Contour Definition: A contour analysis determines
a recursively subdivided grid of points from which
contours of selected values of L_{dn} may be extracted
in the area around the heliport. For example, if
the user defines a contour value of 75 dB, the area
enclosed by the contour will have an L_{dn} at or above
75 dB. The user must specify at least one level.
Contour files are saved with a filename extension
of .F33 added to the case name and may be retrieved
during subsequent use of the HNM.

The user may also specify a contour value
"Tolerance", i.e., the measure of smoothness of the
contour line(s). Tolerance in dB indicates the

section of the heliport noise surface which will require more detailed computations. The default tolerance is ± 1 dB, and the user may change this to any desired value. If, for example, the minimum requested contour value is 65.0 and the points being checked have values of 63.1 and 66.2, then the area around this point will be subdivided further to produce more points at which to compute noise levels. Smaller tolerances result in additional computations and may greatly increase the HNM's run-time.

"Number of Refinements" determines the distance between receiver locations based on the measurement window selected. A higher refinement means closer spacing and yields smoother, more precise contours. Higher refinement levels also increase computation time. Refinement can be set from three to seven.

The user can also specify the rectangular area, i.e., "Window Coordinates", within which the contour computations are to be restricted. The window is defined by the X- and Y-coordinates of its lower left and upper right-hand corners. All four window coordinates must be specified if this user option is selected. A window with 4,000 ft sides centered around the origin is recommended.

The user may select one or two types of reports from the "Contour Definition Menu". The "Print Report" option generates a tabulation of the points which define the contours. The "Contour Plot" option generates a graphic plot of the contours.

The "Contour Plot Information" option allows additional user input. The user may specify the paper X-axis and Y-axis lengths, the plot scale, and plot origin point. The X-axis length is the size of the paper along the X-axis. Similarly, the Y-axis length is the size of the paper along the Y-axis; the default size is 8.5 by 11 in. The plot scale is in ft per inch, and defaults to 1000 ft per inch. The plot origin position (X,Y) in inches relative to the lower left-hand corner of the paper is entered. If no origin is specified, the center of the paper is selected as the origin.

Echo Reports: The "Echo Reports" option allows the user to reproduce specific input information so that correctness can be verified. With the "Echo Reports Menu" displayed, the "Space Bar" is used to select/deselect specific reports.

3.3.1 Takeoff/Approach/Taxi Flight Menu

The HNM requires information about helicopter takeoff, approach, and/or taxi activities at the heliport. In each case, it is necessary to define ground tracks and flight profiles, and to enter information on the number of operations associated with each track and profile for the helicopters selected. This is a relatively involved process for a busy heliport, but the HNM allows the information to be entered in a straightforward and systematic way. The entry of data on takeoff activities is described in this section. The entry of data on approach and taxi activities is essentially identical; the one exception for taxi is noted in Section 3.3 above.

Tracks: The "Takeoff Track Selection Menu" (Figure 3-11) allows the user to define helicopter takeoff tracks or select existing tracks for editing. To define a new track the user must first select "F3" to add a track; similarly, the user may delete an existing track by selecting "F4". Note: If a track to be deleted is already specified in the "Operations Menu", the operations must first be deleted from the track.

To edit a new or previously existing track the track should be highlighted and "ENTER" should be selected. Once the track is selected the "Takeoff Track Segment Definition Menu" is displayed (Figure 3-12). When entering segment information, certain rules are enforced before the data can be saved:

(1)　The track must start and end with a straight segment having a length greater than zero.

(2)　The heading of the initial straight segment must be specified.

(3)　If a curve segment is specified, the change in heading/angle between segments must be greater than zero.

A takeoff ground track must start at a designated helipad with a straight segment and an initial heading. User-specified curved and straight segments can then follow. Straight segments are defined simply by their length in user-specified units. A curved segment requires three entries: (1) the turn, to the left or right; (2) the turn angle or a heading; and (3) the radius of the turn.

Upon completion, enter "F10" to save or "ESC" to exit without saving.

```
┌─────────────────────────────────────────────────────┐
│              Takeoff Track Selection Menu             │
│                 Selected Case: TESTCASE               │
│                                                       │
│                                                       │
│      td1          td2          td3          td4       │
│                                                       │
│                                                       │
│                                                       │
│                                                       │
│                                                       │
│                                                       │
│                                                       │
│ F1-Help  F3-Add  F4-Delete  F10-Save/Continue  Esc-Exit ←Select ↑↓→←-Move │
└─────────────────────────────────────────────────────┘
```
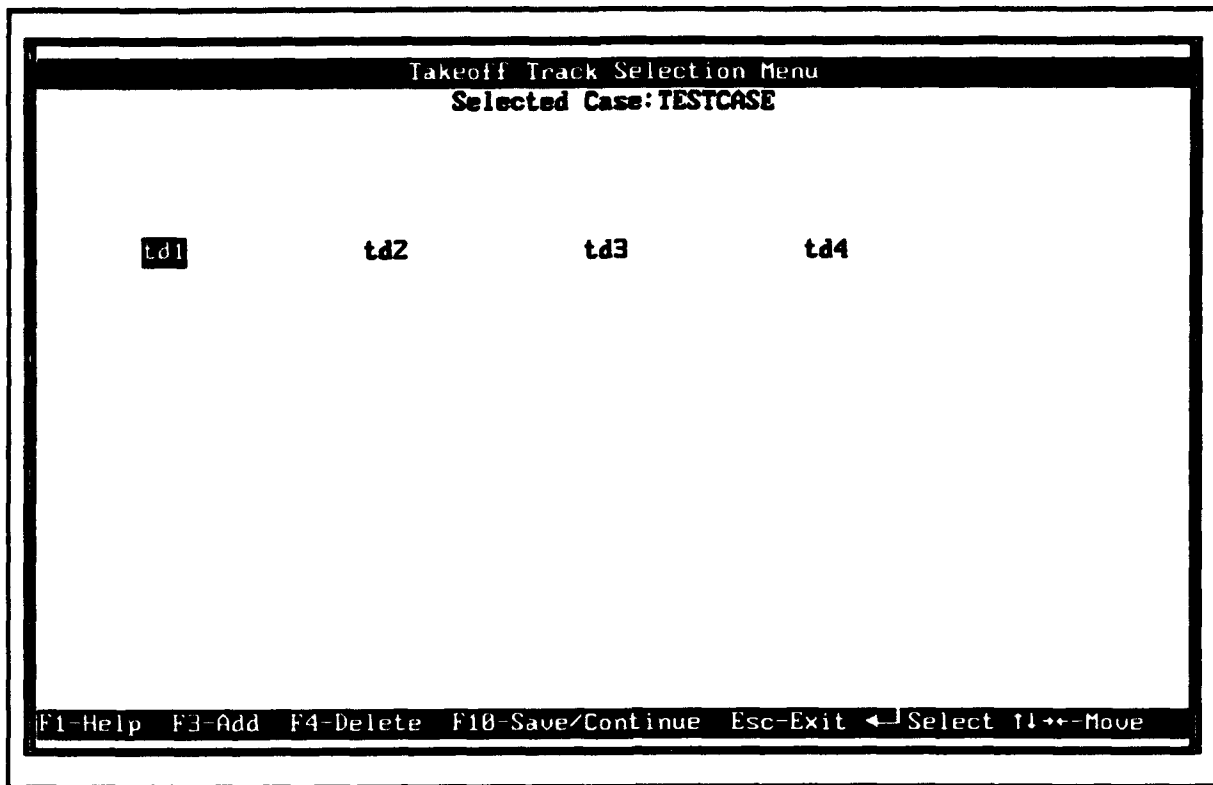
FIGURE 3-11: TAKEOFF TRACK SELECTION MENU

```
┌─────────────────────────────────────────────────────┐
│             Takeoff Track Segment Definition          │
│                 Selected Case: TESTCASE               │
│                                                       │
│       Track: td1  Pad: Po1 Initial Heading 305 (Deg.) │
│                                                       │
│ Straight:280     (Ft.)                                │
│ Curved:Right          90 (Deg.)  Heading Radius:600  (Ft.) │
│ Straight:9999    (Ft.)                                │
│ Curved:                0 (Deg.)          Radius:0    (Ft.) │
│ Straight:0       (Ft.)                                │
│ Curved:                0 (Deg.)          Radius:0    (Ft.) │
│ Straight:0       (Ft.)                                │
│ Curved:                0 (Deg.)          Radius:0    (Ft.) │
│ Straight:0       (Ft.)                                │
│ Curved:                0 (Deg.)          Radius:0    (Ft.) │
│ Straight:0       (Ft.)                                │
│ Curved:                0 (Deg.)          Radius:0    (Ft.) │
│ Straight:0       (Ft.)                                │
│ Curved:                0 (Deg.)          Radius:0    (Ft.) │
│ Straight:0       (Ft.)                                │
│                                                       │
│ F1-Help   F10-Save/Continue   Esc-Exit  ↑↓→←←┘-Field Move   Space-Toggle │
└─────────────────────────────────────────────────────┘
```

FIGURE 3-12: TAKEOFF TRACK SEGMENT DEFINITION MENU

Profiles: After selecting "Profiles" from the "Takeoff Flight Menu", the "Takeoff Profile Helicopter Selection Menu" is displayed (Figure 3-13). The user should highlight the desired helicopter and select "ENTER". The "Takeoff Profile Selection Menu" is displayed (Figure 3-14) and a list of applicable profiles is given for the helicopter. To add a new profile the user must first select "F3"; similarly, the user may delete an existing profile by selecting "F4". Note: If a profile to be deleted is already specified in the "Operations Menu", the operations must first be deleted.

To edit a new or previously existing profile it should be highlighted and "ENTER" should be selected. Once the profile is selected, the "Takeoff Profile Definition Menu" is displayed (Figure 3-15). When entering profile information, certain rules are enforced before the data can be saved:

(1) BLANKS and VOID are not valid for "Mode".

(2) "Duration/Speed" must be greater than zero.

(3a) Takeoff: At least three segments must be specified; and distances and altitudes must be in ascending order.

(3b) Approach: At least three segments must be specified; and distances and altitudes must be in descending order.

(3c) Taxi: At least three takeoff and three approach segments must be specified; and they must be connected by a common 5280 ft segment.

For each segment of a helicopter profile, the user will be required to provide the following four items: (1) operating mode (thrust name); (2) ground distance of the point from start of the operation in user specified units (ft, m or nm); (3) altitude in ft above the heliport; and (4) the velocity in knots (kt) at the point or, for static operations, duration in seconds of the operation at the point.

Upon completion, enter "F10" to save or "ESC" to exit without saving.

Operations: After selecting operations, the "Takeoff Operations Definition Menu" is displayed (Figure 3-16). An operation is defined by selecting a "Helicopter", "Track", "Profile", and the number of "Operations" during either the day (0700 to 2200 hours local time) or night (2200 to 0700 hours local time). When the cursor is on

```
 ┌────────────────────────────────────────────────────────────┐
 │        Takeoff Profile Helicopter Selection                │
 │               Selected Case: TESTCASE                       │
 │                                                            │
 │   ▐A109    AGUSTA A-109▌                                    │
 │    S76     SIKORSKY S-76                                    │
 │                                                            │
 │                                                            │
 │                                                            │
 │                                                            │
 │                                                            │
 │                                                            │
 │                                                            │
 │                                                            │
 │                                                            │
 │                                                            │
 │ F1 - Help    F10 - Continue    Esc - Exit   ←┘-Select  ↑↓→←- Menu Move │
 └────────────────────────────────────────────────────────────┘
```
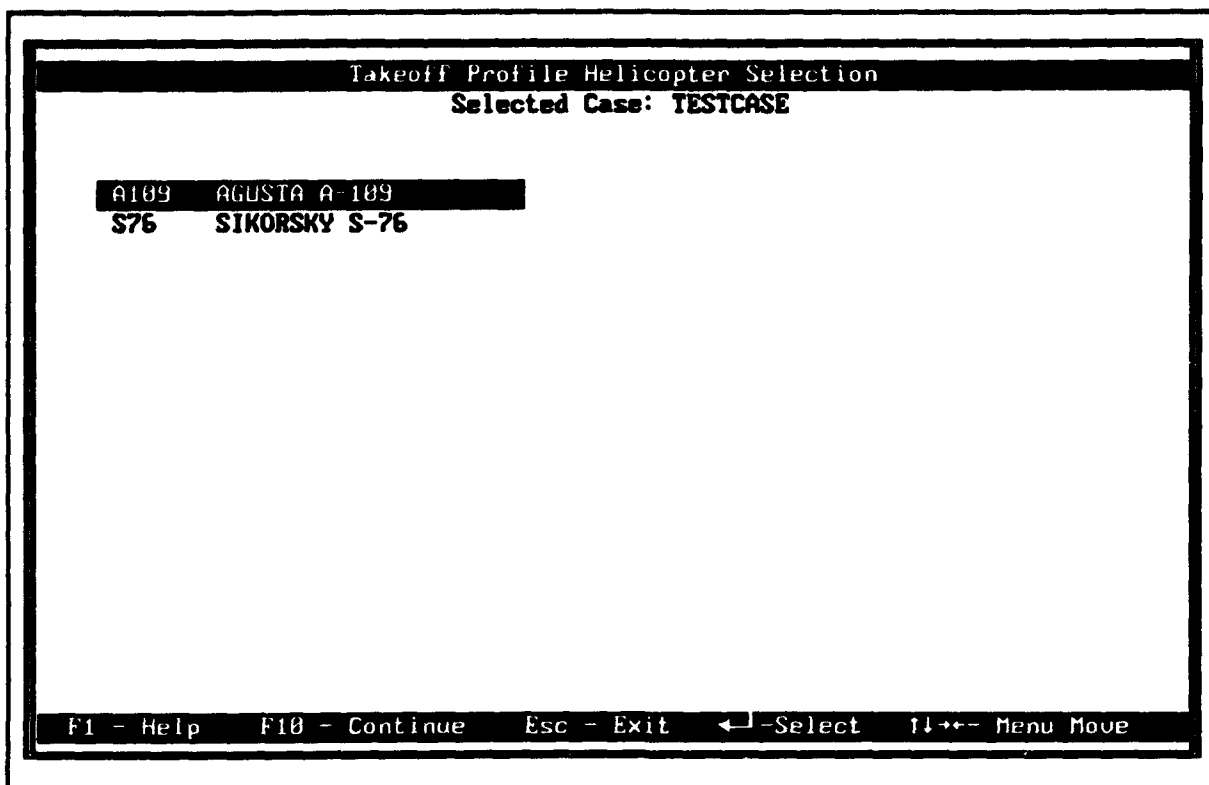
FIGURE 3-13:   TAKEOFF PROFILE HELICOPTER SELECTION MENU

```
 ┌────────────────────────────────────────────────────────────┐
 │              Takeoff Profile Selection                     │
 │               Selected Case: TESTCASE                       │
 │                                                            │
 │  Helicopter : A109   - AGUSTA A-109                         │
 │                                                            │
 │                         ▐TA109▌                             │
 │                                                            │
 │                                                            │
 │                                                            │
 │                                                            │
 │                                                            │
 │                                                            │
 │                                                            │
 │ F1-Help  F3-Add  F4-Delete  F10-Continue  Esc-Exit  ↑↓→←←┘-Menu Movement │
 └────────────────────────────────────────────────────────────┘
```
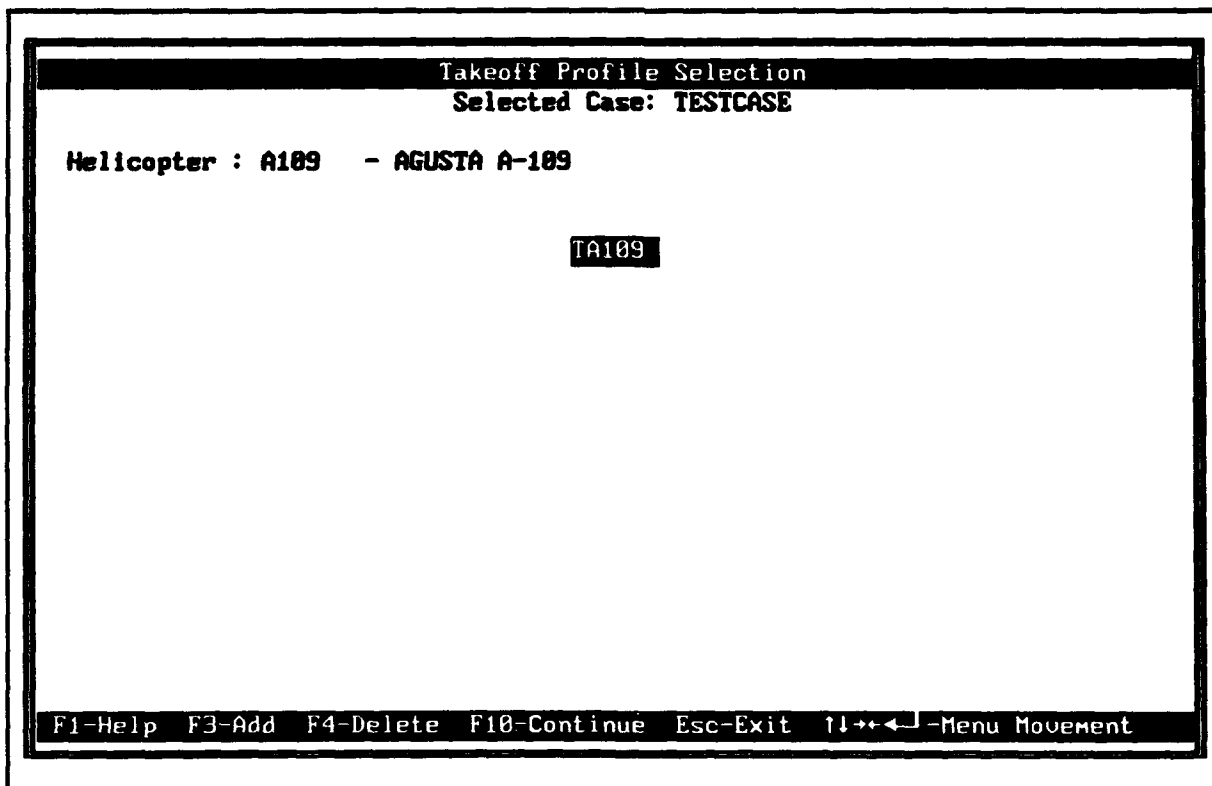
FIGURE 3-14:   TAKEOFF PROFILE SELECTION MENU

```
                    Takeoff Profile Definition
                     Selected Case:TESTCASE
    Helicopter:A109   AGUSTA A-109              Profile: TA109


    Mode          Distance          Altitude        Duration/Speed

    HIGE            0.00              0.00            30.00 (Sec.)
    HIGE            0.00              0.00            30.00 (Sec.)
    VASC            0.00              0.00             3.00 (Sec.)
    ACLH            0.00             15.00            16.00 (Kts.)
    ACLC          100.00             15.00            30.00 (Kts.)
     TO           562.00             30.00            60.00 (Kts.)
     TO          4032.00           1000.00            60.00 (Kts.)
    LFLO         6786.00           1000.00           100.00 (Kts.)
                99999.00           1000.00           100.00 (Kts.)
                    0.00              0.00             0.00 (Kts.)
                    0.00              0.00             0.00 (Kts.)
                    0.00              0.00             0.00 (Kts.)
                    0.00              0.00             0.00 (Kts.)
                    0.00              0.00             0.00 (Kts.)

F1-Help F4-Delete F10-Save/Continue  Esc-Exit ↑↓→←↲-Field Move  Space-Toggle
```

FIGURE 3-15:   TAKEOFF PROFILE DEFINITION MENU

```
                    Takeoff Operations Definition
                     Selected Case: TESTCASE
    Helicopter           Track   Profile    Operations        Heading
                                            Day     Night   Hover   Ground
    AGUSTA A-109          td1     TA109      2.0     1.0     300     300
    AGUSTA A-109          td2     TA109      1.0     0.0     299     299
    AGUSTA A-109          td3     TA109      1.0     0.0      33      33
    AGUSTA A-109          td4     TA109      1.0     0.0      32      32
    SIKORSKY S-76         td1     TS76       5.0     0.0     300     300
    SIKORSKY S-76         td3     TS76       6.0     0.0      33      33
                                            0.0     0.0       0       0
                                            0.0     0.0       0       0
                                            0.0     0.0       0       0
                                            0.0     0.0       0       0
                                            0.0     0.0       0       0
                                            0.0     0.0       0       0
                                            0.0     0.0       0       0
                                            0.0     0.0       0       0
                                            0.0     0.0       0       0
                                            0.0     0.0       0       0

F1-Help F4-Delete F10-Save/Continue  Esc-Exit ↑↓→←↲-Field Move  Space-Toggle
```

FIGURE 3-16:   TAKEOFF OPERATIONS DEFINITION MENU

the "Helicopter", "Track", or "Profile" field, a selection is made by using the "Space Bar" to toggle through the available choices. Certain rules are enforced before an operation can be saved:

(1) A track and profile must be specified or the entry must be deleted with the "F4" key.
(2) Total operations must be greater than zero.

Upon completion, enter "F10" to save or "ESC" to exit without saving.

3.4 Process Case

After selecting "Process Case" from the "HNM Main Menu" a case study can be selected for processing by moving the cursor over the desired filename and selecting "ENTER" and "F10". All case studies that appear in this menu have been previously loaded/edited and saved (having a filename with a .INP extension) using the F10 key under "Edit/Load Case". As the case study begins running, the processing status of INPUT.EXE, FLIGHT.EXE, and COMPUTE.EXE is displayed. When the current run is complete, a small window is displayed and various output options are available to the user, including the viewing and printing of the "Echo Reports". When processing is completed a plot file is created with a filename containing a .F33 extension.

Note: All input file data are automatically verified by the HNM, and all warning messages are displayed and execution will proceed as requested from the "Process Case" option. The HNM does not have the "NO VERIFY", "NO EXECUTE", and "NO WARN" options of the INM.

3.5 Plot Case

After selecting "Plot Case" from the "HNM Main Menu" a case study is selected for plotting by moving the cursor over the desired filename and selecting "ENTER" and "F10". All case studies that appear in this menu have been previously created with the "F10" key under "Process Case" and have a filename with a .INP extension. After the plotting routine starts, the "HNM Plot Menu" is displayed. Selecting F1 displays a "Help Menu" that describes the functions available with the plotting package. Note that the HNM plotting package is essentially identical to the one used by the INM. Consequently, HNM users seeking additional information on the contour plotting program are referred to the User's Manual for the INM contour plotting program.[5]

3.6 Help

Context-sensitive help menus are provided for all screen displays by selecting "F1". The help menus are self-explanatory.

4. PROCESSING THE CASE

This section describes the HNM's processing of a user-selected input case, prepared as described in Section 3 above. The menu-driven, graphical user interface facilitates the preparation of an input text file (HFOR02.DAT) similar to that required by the INM (FOR02.DAT). The input file for "Example Heliport", shown in Figure 4-1, is processed by the HNM in the following three steps:

- Input Formatting
- Flight Compilation
- Noise Level Computations

The above steps are performed automatically on a user-selected input file, i.e., case study, by selecting: (1) PROCESS CASE in the "HNM Main Menu"; (2) a specific input file, one which carries a filename with a .INP extension; and (3) the F10 key. To execute the above three program steps separately, perform the following procedures exclusive of the HNM menu-environment: (1) rename the subject input text file to HFOR02.DAT; (2) execute INPUT.EXE, FLIGHT.EXE, and COMPUTE.EXE; and (3) execute HNMPLOT.EXE to view the computed contour.

4.1 The Input File

The majority of the errors which can occur in creating an input file using a text editor, as with the INM, are eliminated using the HNM's menu-driven entry process. However, some errors of omission can still occur.

Each input file, i.e., case study, must contain the following data sections:

(1) SETUP: contains heliport descriptions and helipad data.
(2) AIRCRAFT: selects or defines the helicopter types.
(3) TAKEOFFS: describes takeoff tracks, and defines takeoff operations by frequency.
(4) LANDINGS: describes landing tracks, and defines landing operations by frequency.
(5) TAXI: describes taxi tracks, and defines taxi operations by frequency.
(6) PROCESS: describes the analysis processes to be performed on the input case.

An exception to the above requirement is the situation where only one or two types of operations are included in the scenario. In this case, the user may omit any two of following three sections: TAKEOFFS, LANDINGS, or TAXIS. However, the input data must include at least one of these sections; and for each section that is included, at least one operation.

```
BEGIN.                                                           COMMENTS:
NOECHO.
SETUP:
  TITLE <Example test case HNM Version 2.2>
  AIRPORT <Example Heliport                 >
  ALTITUDE      0. TEMPERATURE  59.00 F SURFACE S        Note:   If  a  heliport  altitude  and
NOECHO.                                                  temperature  are  not  specified,  default
FT.                                                      values of 0 ft MSL and 59°F, respectively,
  RUNWAYS                                                will  be  assumed.  In  addition,  "S"oft
    RW Po1       0.       0. TO      0.     1.   HEADING=360   surface type is the only valid selection.
    RW Pp1     210.    -210. TO    210.  -209.   HEADING=360
NOECHO.
AIRCRAFT:
  TYPES
  AC A109   ROTOR   385 CURVE A109   CATEGORY HCOM
        STAGE 1=TA109
        STAGE 2=GA109
  AC S76    ROTOR   293 CURVE S76    CATEGORY HCOM
        STAGE 1=TS76
        STAGE 2=GS76
NOECHO.
FT.
  PROFILES APPROACH
  PP AA109   SEGMENTS= 7                                 Note:   From  3  to  14  approach  profile
        DISTANCES 99998. 10535.  4819.  3062.    0.    0.    0.   segments are allowed.
        ALTITUDES  1000.  1000.  1000.   500.    3.    0.    0.
          SPEEDS  100.00 100.00  60.00  60.00  3.00 60.00  0.00
        THRUSTS   LFLO   DCLH   APPR   DCLD   HIGE   HIGE
  PP AS76    SEGMENTS= 7
        DISTANCES 99998. 10535.  4819.  3062.    0.    0.    0.
        ALTITUDES  1000.  1000.  1000.   500.    3.    0.    0.
          SPEEDS  100.00 100.00  60.00  60.00  3.00 60.00  0.00
        THRUSTS   LFLO   DCLH   APPR   DCLD   HIGE   HIGE
  PP GS76    SEGMENTS= 5                                 Note: This entry is an example of the final
        DISTANCES  5280.     0.     0.     0.     0.    profile phase for a taxi operation.
        ALTITUDES     3.     3.     0.     0.     0.
          SPEEDS  10.00  10.00  10.00  60.00  0.00
        THRUSTS   HIGE   HIGE   HIGE   GIDLE
NOECHO.
FT.
  PROFILES TAKEOFF
  PP TA109   SEGMENTS= 9 WEIGHT= 5632 ENGINES= 1         Note: From 3 to 14 takeoff profile segments
        DISTANCES     0.     0.     0.     0.   100.   562.  4032.   are allowed.
                   6786. 99999.
        ALTITUDES     0.     0.     0.    15.    15.    30.  1000.
                   1000.  1000.
          SPEEDS  30.00  30.00   3.00  16.00  30.00  60.00  60.00
                 100.00 100.00
        THRUSTS   HIGE   HIGE   VASC   ACLH   ACLC   TO     TO
                  LFLO
  PP TS76    SEGMENTS= 9 WEIGHT= 9984 ENGINES= 1
        DISTANCES     0.     0.     0.     0.   100.   562.  4032.
                   6786. 99999.
        ALTITUDES     0.     0.     0.    15.    15.    30.  1000.
                   1000.  1000.
          SPEEDS  60.00  30.00   3.00  16.00  30.00  60.00  60.00
                 100.00 100.00
        THRUSTS   GIDLE  HIGE   VASC   ACLH   ACLC   TO     TO
                  LFLO
  PP GS76    SEGMENTS= 4 WEIGHT= 9984 ENGINES= 1         Note:   This  entry  is  an  example  of  the
        DISTANCES     0.     0.     0.  5280.              initial profile phase for a taxi operation.
        ALTITUDES     0.     0.     3.     3.
          SPEEDS  60.00  30.00  10.00  10.00
        THRUSTS   GIDLE  HIGE   HIGE
NOECHO.
FT.

TAKEOFFS BY FREQUENCY:
  TRACK td1  RWY Po1 HEADING 305
          STRAIGHT  280.00
          RIGHT  90 H   600.00
          STRAIGHT 9999.00
    OPER A109   STAGE 1 D     2.00 N     1.00 GHDT 300 HHDT 300
    OPER S76    STAGE 1 D     5.00 GHDT 300 HHDT 300
  TRACK td2  RWY Po1 HEADING 305
          STRAIGHT  280.00
          RIGHT 320 H   600.00
          STRAIGHT 9999.00
    OPER A109   STAGE 1 D     1.00 GHDT 299 HHDT 299
  TRACK td3  RWY Po1 HEADING  35
          STRAIGHT  200.00
          LEFT  350 H   600.00
          STRAIGHT  200.00
          RIGHT  90 H   600.00
          STRAIGHT 9999.00
    OPER A109   STAGE 1 D     1.00 GHDT  33 HHDT  33
    OPER S76    STAGE 1 D     6.00 GHDT  33 HHDT  33
```

FIGURE 4-1: INPUT TEXT FILE FOR "EXAMPLE HELIPORT" CASE STUDY

```
    TRACK td4  RWY Po1 HEADING  35                              COMMENTS:
            STRAIGHT  200.00
            LEFT   320 H   600.00
            STRAIGHT 9999.00
      OPER A109   STAGE 1 D     1.00 GHDT  32 HHDT  32
NOECHO.
FT.
LANDINGS BY FREQUENCY:
   TRACK ta1  RWY Po1 HEADING 270
            STRAIGHT 9999.00
            LEFT   125 H   600.00
            STRAIGHT  280.00
      OPER A109   PROF=AA109  D     2.00 N    1.00 GHDA 125 HHDA 125
      OPER S76    PROF=AS76   D     5.00 GHDA 125 HHDA 125
   TRACK ta2  RWY Po1 HEADING 140
            STRAIGHT 9999.00
            LEFT   125 H   600.00
            STRAIGHT  280.00
      OPER A109   PROF=AA109  D     1.00 GHDA 126 HHDA 126
   TRACK ta3  RWY Po1 HEADING 270
            STRAIGHT 9999.00
            LEFT   170 H   600.00
            STRAIGHT  200.00
            RIGHT  215 H   600.00
            STRAIGHT  200.00
      OPER A109   PROF=AA109  D     1.00 GHDA 215 HHDA 215
      OPER S76    PROF=AS76   D     6.00 GHDA 215 HHDA 215
   TRACK ta4  RWY Po1 HEADING 140
            STRAIGHT 9999.00
            RIGHT  215 H   600.00
            STRAIGHT  200.00
      OPER A109   PROF=AA109  D     1.00 GHDA 215 HHDA 215
NOECHO.
FT.
TAXIS BY FREQUENCY:
   TRACK tx1  RWY Po1    210.0   -210.0 HEADING 180
            STRAIGHT  110.00
            LEFT    90 H   100.00
            STRAIGHT  110.00
      OPER S76    STAGE 2 PROF=GS76  D     1.00
                        GHDT 180 HHDT 180 GHDA  90 HHDA  90
   TRACK tx2  RWY Pp1     0.0      0.0 HEADING 270
            STRAIGHT  110.00
            RIGHT    0 H   100.00
            STRAIGHT  110.00
      OPER S76    STAGE 2 PROF=GS76  D     1.00
                        GHDT 270 HHDT 270 GHDA   0 HHDA   0
PROCESS:
FT.
   GRID LDN   START=  -1200.   -1200. STEP=    200.     200.
              SIZE=   11 BY    11
   GRID LDN   START=    200.     200. STEP=     0.      0.
              SIZE=    1 BY     1
   GRID LDN   START=     0.      0. STEP=     0.      0.
              SIZE=    1 BY     1
FT.
   CONTOUR LDN  AT  60.0  65.0  70.0                     Note:  If an LDN contour is not specified,
            WITH NAME=NEW001 TOLERANCE=1.00              default values of 65 and 75 dB will be
            XSTART=  -2000. YSTART=  -2000. XSTOP=  2000. YSTOP=  2000.  assumed. In addition, if a refinement level
            REFINE= 4                                    or window size is not specified, default
            REPORT                                       values of 6 (no units) and 4000 ft per side
            PLOT SIZE=     8.5    11.0 SCALE=   1000.     are assumed.
                 ORIGIN=     0.0     0.0
END.
```

FIGURE 4-1 (CONTINUED): INPUT TEXT FILE FOR "EXAMPLE HELIPORT" CASE STUDY

4.2 Run-time Files

The HNM creates several files during execution. Most of the files can be erased from the hard disk after running a case. However, if future processing or analysis of a subject case is anticipated, the following two files should be renamed:

HFOR02.DAT: the Input File, i.e., case study, created for processing by HNM Version 2.2; and

FOR33.DAT: the Contour Points File created by the compute module for input into the HNMPLOT Program.

Note: During execution these files are automatically renamed by the HNM to HFOR02.INP and FOR33.F33, respectively.

4.3 Error Messages

The HNM Input Formatting Module can produce a number of warning and fatal error messages. The output reports should be checked for these messages and the input case should be corrected to be error free. To aid the user, as the Input Formatting Module begins to process a major section of input, it prints out a processing location message. For example, the message "***PROCESSING SETUP SECTION" is printed prior to the processing of the section of the input text file which follows the keyword "SETUP:". If a fatal error is detected by the Input Formatting Module, execution of the HNM terminates immediately. If warning errors are detected by the Input Formatting Module, no analyses will be performed on the data and execution of the HNM terminates after execution of the module.

The Input Formatting Module can also print out the input data in the form of "Echo Reports", if that option is selected from the "Data Entry Menu". It is recommended that the user verify that the information processed by the program is correct.

If the input case is acceptable to the Input Formatting Module, execution of the process commands will begin. However, all modules can produce warning and fatal error messages. The execution printout should be checked for these messages. Section 4.4 and Appendix C describe these messages and instruct the user as to the action to be taken when the messages are encountered. A fatal error within any one of these modules, except the Flight Compilation Module, terminates execution of that module only and not termination of the execution of the HNM. Any fatal error during Flight Compilation will terminate the HNM. All fatal errors must be eliminated for proper execution. In addition, measures should be taken to eliminate all warning messages, if possible. The HNM does not contain the "NOWARN" option which exists in the INM. Finally, the user should study the output reports and plots produced by the various modules, verify that the desired analyses were performed, and verify that the input data produced reasonable results.

4.4 Error Analysis and Correction

Each module of the HNM produces its own error messages. All are listed in Appendix C. These messages take the following form:

Axx*FATAL: ....
    or
Axx*WARNING: ....

where,   A is a one/two-letter prefix to indicate which module produced the message; the prefixes are as follows:

C	-	COMPUTATION
CN	-	CONTOUR
F	-	FLIGHT OVERLAY
I	-	INPUT
P	-	PLOT
RG	-	REPORT GENERATOR

and xx is a unique number identifier for the error.

A fatal message within the Input Formatting or Flight Compilation Modules causes termination of HNM execution. A fatal message within any other module causes control to be returned to the Executive Module, which will attempt to continue the processing of modules, as directed by the processing template.

4.5 Data Base Reports

File FOR17.DAT is a user-accessible ASCII version of the Data Base. With the DOS prompt displayed on the computer display, the user may obtain a hardcopy of the Data Base by printing the FOR17.DAT file.

4.6 Plots

The plot option from the "HNM Main Menu" allows the plotting of previously computed noise exposure contours. When this option is selected, the "HNM Plot Menu" is displayed. By selecting from this menu, the user may plot contours on the screen or a plotter. The user can change the plot window, plot scale, or the centering of the origin of the plot. With the "HNM Plot Menu" displayed, selecting F1 initiates the online "Help" facility which describes the functions available with the plotting package. Note that the HNM plotting package is essentially identical to the one used by the INM.

5. INTERPRETING THE OUTPUT

The output of the HNM consists of printed reports and contour plots. Specifically, the Input Formatting Module produces "Echo Reports" of the input data file; a "Grid Analysis" produces a printed report of noise exposure at specific receiver locations on the ground; and a "Contour Analysis" produces a report of receiver locations with equal noise exposure and a plot of these contours. Section 3 describes how to obtain a copy of these reports. The following sections describe their contents.

5.1 Echo Reports

The Input Formatting module can produce up to nine Echo Reports to provide the user with a quick means of detecting errors in the input data. Figures 5-1 through 5-9 are examples of these nine reports for "Example Heliport". The reports, which are formatted with headers, are self-explanatory.

5.2 Grid Analysis

A grid analysis produces a standard tabular report, and an optional detailed tabular report. Figure 5-10 is a sample "Standard Grid Analysis Report" for "Example Heliport". Following the report title, the case title and heliport name, as input by the user, is displayed. A table of noise values for the specified grid points, i.e., receiver locations, follows. The grid point locations are listed under the headings "X" and "Y" for X-coordinate and Y-coordinate, respectively. Under the L_{dn} heading are the computed noise values for the particular grid point(s).

A maximum of 20 grid points may be specified in the "Detailed Grid Analysis Report". A separate page is printed for each point. Figure 5-11 presents two pages from the detailed report for "Example Heliport". The boxed area identifies the X- and Y-coordinates of the grid point, and the total noise value at the point. The next section of the report gives the individual contributions made by the 20 flights making the most significant contribution to the total noise. A flight is defined as a unique combination of a helicopter's track, type, and profile. A line of information is printed for each flight, giving the following:

(1) Helicopter Name
(2) Takeoff Profile Name for Takeoffs, or Approach Profile Name for Landings
(3) Noise Curve Name
(4) "Stage", an Identification Number Assigned to the Type of Profile (e.g., for "Example Heliport" Stage 1 and 2 in the input file (Figure 4-1) refer to Takeoff and Taxi, Respectively; Stage 0 in Figure 5-11 refers to Approach)
(5) Taxi Approach Profile Name

TITLE   Example test case HNM Version 2.2

AIRPORT   Example Heliport

ALTITUDE   0. FT.
TEMPERATURE   518.7 R   59.0 F   15.0 C

SOFT SURFACE

NOISE METRICS

DAY-NIGHT AVERAGE SOUND LEVEL (LDN) - BASED ON LEQ, WITH NIGHTTIME OPERATIONS WEIGHTED BY A 10 DECIBEL PENALTY.

FIGURE 5-1:   SAMPLE ECHO REPORT: SETUP

NAME	HEADING	UNITS		STARTING COORDINATES		RUNWAY LENGTH
----	-------	-----		X	Y	
				---------	----------	----------
Po1		360	FT	0.	0.	1.
			M	0.	0.	0.
			NMI	.000	.000	.000
Pp1		360	FT	210.	-210.	1.
			M	64.	-64.	0.
			NMI	.035	-.035	.000

FIGURE 5-2:   SAMPLE ECHO REPORT: HELIPADS

NAME	CATEGORY	NOISE CURVE NAME	ROTOR SPEED	TAKEOFF PROFILE NAMES						
				STAGE1	STAGE2	STAGE3	STAGE4	STAGE5	STAGE6	STAGE7
A109	HCON	A109	385	TA109	GA109					
S76	HCON	S76	293	TS76	GS76					

FIGURE 5-3: SAMPLE ECHO REPORT: HELICOPTERS

A P P R O A C H   P R O F I L E S
------------------- ----------------

| NAME | SEGMENT | DISTANCE FROM RUNWAY END | | | ALTITUDE (FT) | SPEED (KNTS) | THRUST |
		FT	M	NMI			
AA109	1	0.	0.	.00	.00	.00	HIGH
	2	0.	0.	.00	.00	60.00	HIGH
	3	0.	0.	.00	3.00	3.00	DCLD
	4	3062.	933.	.50	500.00	60.00	APPR
	5	4819.	1469.	.79	1000.00	60.00	DCLH
	6	10535.	3211.	1.73	1000.00	100.00	LFLO
	7	99998.	30479.	16.46	1000.00	100.00	LFLO
AS76	1	0.	0.	.00	.00	.00	HIGH
	2	0.	0.	.00	.00	60.00	HIGH
	3	0.	0.	.00	3.00	3.00	DCLD
	4	3062.	933.	.50	500.00	60.00	APPR
	5	4819.	1469.	.79	1000.00	60.00	DCLH
	6	10535.	3211.	1.73	1000.00	100.00	LFLO
	7	99998.	30479.	16.46	1000.00	100.00	LFLO
GS76	1	0.	0.	.00	.00	.00	GIDLE
	2	0.	0.	.00	.00	60.00	HIGH
	3	0.	0.	.00	.00	10.00	HIGH
	4	0.	0.	.00	3.00	10.00	HIGH
	5	5280.	1609.	.87	3.00	10.00	HIGH

FIGURE 5-4: SAMPLE ECHO REPORT: APPROACH PROFILES

TAKEOFF PROFILES

NAME	ENGINES	WEIGHT	SEGMENT	DISTANCE FROM RUNWAY END			ALTITUDE(FT)	SPEED(KTS)	THRUST
				FT	M	NMI			
TA109	1	5632.	1	0.	0.	.00	.00	30.00	HIGE
			2	0.	0.	.00	.00	30.00	HIGE
			3	0.	0.	.00	.00	3.00	VASC
			4	0.	0.	.00	15.00	16.00	ACLH
			5	100.	30.	.02	15.00	30.00	ACLC
			6	562.	171.	.09	30.00	60.00	TO
			7	4032.	1229.	.66	1000.00	60.00	TO
			8	6786.	2068.	1.12	1000.00	100.00	LFLO
			9	99999.	30480.	16.46	1000.00	100.00	LFLO
TS76	1	9984.	1	0.	0.	.00	.00	60.00	GIDLE
			2	0.	0.	.00	.00	30.00	HIGE
			3	0.	0.	.00	.00	3.00	VASC
			4	0.	0.	.00	15.00	16.00	ACLH
			5	100.	30.	.02	15.00	30.00	ACLC
			6	562.	171.	.09	30.00	60.00	TO
			7	4032.	1229.	.66	1000.00	60.00	TO
			8	6786.	2068.	1.12	1000.00	100.00	LFLO
			9	99999.	30480.	16.46	1000.00	100.00	LFLO
GS76	1	9984.	1	0.	0.	.00	.00	60.00	GIDLE
			2	0.	0.	.00	.00	30.00	HIGE
			3	0.	0.	.00	3.00	10.00	HIGE
			4	5280.	1609.	.87	3.00	10.00	HIGE

FIGURE 5-5: SAMPLE ECHO REPORT: TAKEOFF PROFILES

T A K E O F F - T R A C K S

		INITIAL			LENGTH	TURN ANGLE	RESULTANT	TURN RADIUS
td1	Po1	305	1	STRAIGHT	.05		305	
			2	RIGHT		145	90	.10
			3	STRAIGHT	1.65		90	
td2	Po1	305	1	STRAIGHT	.05		305	
			2	RIGHT		15	320	.10
			3	STRAIGHT	1.65		320	
td3	Po1	35	1	STRAIGHT	.03		35	
			2	LEFT		45	350	.10
			3	STRAIGHT	.03		350	
			4	RIGHT		100	90	.10
			5	STRAIGHT	1.65		90	
td4	Po1	35	1	STRAIGHT	.03		35	
			2	LEFT		75	320	.10
			3	STRAIGHT	1.65		320	

T A K E O F F - O P E R A T I O N S

							OPERATIONS		
TRACK	RUNWAY	AIRCRAFT	CLASS	STAGE	PROFILE	---	DAY	EVENING	NIGHT
-----	------	--------	-----	-----	-------		------	-------	-----
td1	Po1	A109	COM	1	TA109		2.00	.00	1.00
		S76	COM	1	TS76		5.00	.00	.00
td2	Po1	A109	COM	1	TA109		1.00	.00	.00
td3	Po1	A109	COM	1	TA109		1.00	.00	.00
		S76	COM	1	TS76		6.00	.00	.00
td4	Po1	A109	COM	1	TA109		1.00	.00	.00

T A K E O F F - D I S T R I B U T I O N

		O P E R A T I O N S		
		DAY	EVENING	NIGHT
COMMERCIAL	-	16.0	.0	1.0
GENERAL AVIATION	-	.0	.0	.0
MILITARY	-	.0	.0	.0

P R O P O R T I O N S

		COMMERCIAL			GENERAL AVIATION			MILITARY		
TRACK	RUNWAY	DAY	EVENING	NIGHT	DAY	EVENING	NIGHT	DAY	EVENING	NIGHT
-----	------	-----	-------	-----	-----	-------	-----	-----	-------	-----
td1	Po1	.44	.00	1.00	.00	.00	.00	.00	.00	.00
td2	Po1	.06	.00	.00	.00	.00	.00	.00	.00	.00
td3	Po1	.44	.00	.00	.00	.00	.00	.00	.00	.00
td4	Po1	.06	.00	.00	.00	.00	.00	.00	.00	.00
	TOTAL	1.00	.00	1.00	.00	.00	.00	.00	.00	.00

FIGURE 5-6: SAMPLE ECHO REPORT: TAKEOFF TRACKS AND OPERATIONS

LANDING - TRACKS   REPORT 7 - PART A
--------------   ----------

		INITIAL			LENGTH	TURN ANGLE	RESULTANT	TURN RADIUS
ta1	Pol	305	1	STRAIGHT	.05		305	
			2	RIGHT		145	90	.10
			3	STRAIGHT	1.65		90	
ta2	Pol	305	1	STRAIGHT	.05		305	
			2	RIGHT		15	320	.10
			3	STRAIGHT	1.65		320	
ta3	Pol	35	1	STRAIGHT	.03		35	
			2	LEFT	.	45	350	.10
			3	STRAIGHT	.03		350	
			4	RIGHT		100	90	.10
			5	STRAIGHT	1.65		90	
ta4	Pol	35	1	STRAIGHT	.03		35	
			2	LEFT		75	320	.10
			3	STRAIGHT	1.65		320	

LANDING - OPERATIONS   REPORT 7 - PART B
--------------   ----------------

| | | | | | OPERATIONS | | |
TRACK	RUNWAY	AIRCRAFT	CLASS	PROFILE	DAY	EVENING	NIGHT
ta1	Pol	A109	COM	AA109	2.00	.00	1.00
		S76	COM	AS76	5.00	.00	.00
ta2	Pol	A109	COM	AA109	1.00	.00	.00
ta3	Pol	A109	COM	AA109	1.00	.00	.00
		S76	COM	AS76	6.00	.00	.00
ta4	Pol	A109	COM	AA109	1.00	.00	.00

LANDING - DISTRIBUTION   REPORT 7 - PART C
--------------   ------------------------

| | | OPERATIONS | | |
		DAY	EVENING	NIGHT
COMMERCIAL	-	16.0	.0	1.0
GENERAL AVIATION	-	.0	.0	.0
MILITARY	-	.0	.0	.0

| | | PROPORTIONS | | | | | | | | |
| | | COMMERCIAL | | | GENERAL AVIATION | | | MILITARY | | |
TRACK	RUNWAY	DAY	EVENING	NIGHT	DAY	EVENING	NIGHT	DAY	EVENING	NIGHT
ta1	Pol	.44	.00	1.00	.00	.00	.00	.00	.00	.00
ta2	Pol	.06	.00	.00	.00	.00	.00	.00	.00	.00
ta3	Pol	.44	.00	.00	.00	.00	.00	.00	.00	.00
ta4	Pol	.06	.00	.00	.00	.00	.00	.00	.00	.00
	TOTAL	1.00	.00	1.00	.00	.00	.00	.00	.00	.00

FIGURE 5-7:   SAMPLE ECHO REPORT: LANDING TRACKS AND OPERATIONS

T A X I - T R A C K S   REPORT 8 - PART A

		INITIAL				LENGTH	TURN ANGLE		RESULTANT	TURN RADIUS
tx1	Po1	180	1	STRAIGHT		.02			180	
			2	LEFT			90		90	.02
			3	STRAIGHT		.02			90	
tx2	Pp1	270	1	STRAIGHT		.02			270	
			2	RIGHT			90		360	.02
			3	STRAIGHT		.02			360	

T A X I - O P E R A T I O N S   REPORT 8 - PART B

					TAXI		OPERATIONS		
TRACK	RUNWAY	AIRCRAFT	CLASS	STAGE	PROFILE	PROFILE	DAY	EVENING	NIGHT
tx1	Po1		S76	COM	2	GS76	GS76	1.00	.00	.00
tx2	Pp1		S76	COM	2	GS76	GS76	1.00	.00	.00

T A X I - D I S T R I B U T I O N   REPORT 8 - PART C

		OPERATIONS		
		DAY	EVENING	NIGHT
COMMERCIAL	-	2.0	.0	.0
GENERAL AVIATION	-	.0	.0	.0
MILITARY	-	.0	.0	.0

			PROPORTIONS							
			COMMERCIAL		GENERAL AVIATION			MILITARY		
TRACK	RUNWAY	DAY	EVENING	NIGHT	DAY	EVENING	NIGHT	DAY	EVENING	NIGHT
tx1	Po1	.50	.00	.00	.00	.00	.00	.00	.00	.00
tx2	Pp1	.50	.00	.00	.00	.00	.00	.00	.00	.00
	TOTAL	1.00	.00	.00	.00	.00	.00	.00	.00	.00

FIGURE 5-8: SAMPLE ECHO REPORT: TAXI TRACKS AND OPERATIONS

P R O C E S S E S

VERIFY

EXECUTE
    METRIC = LDN
    STARTING POINT =   -1200. -1200.
    STEP =   200.   200.
    SIZE =   11   11
    RREPORT
    DETAIL
    METRIC = LDN
    STARTING POINT =   200.   200.
    STEP =   0.   0.
    SIZE =   1   1
    RREPORT
    DETAIL

CONTOUR
    LEVELS = 60.00 65.00 70.00
    METRIC LDN
    TOLERANCE = 1.00
    REFINEMENT = 4
    WINDOW =   -2000. -2000.   2000.   2000.
    SAVED AS NEW001
    RREPORT
    PLOT
       X AXIS   8.5
       Y AXIS   11.0
       SCALE   1000.0
       USER DEFINED CENTERING   ORIGIN (.0,   .0)
          1 file(s) copied
          1 file(s) copied
          1 file(s) copied
 *** CALCULATING GRID LOCATIONS

    ----
        0 WARNING MESSAGES WERE PRODUCED BY THE COMPUTATION MODULE

FIGURE 5-9: SAMPLE ECHO REPORT: PROCESS

Example test case HNM Version 2.2

HELIPORT - Example Heliport

X	Y	LDN		X	Y	LDN
-1200.	-1200.	52.5		-1000.	-1200.	53.1
-800.	-1200.	53.7		-600.	-1200.	54.4
-400.	-1200.	54.9		-200.	-1200.	55.5
0.	-1200.	56.1		200.	-1200.	56.2
400.	-1200.	55.5		600.	-1200.	54.5
800.	-1200.	53.3		-1200.	-1000.	53.5
-1000.	-1000.	54.3		-800.	-1000.	55.1
-600.	-1000.	55.8		-400.	-1000.	56.6
-200.	-1000.	57.3		0.	-1000.	58.0
200.	-1000.	58.0		400.	-1000.	57.0
600.	-1000.	55.6		800.	-1000.	54.2
-1200.	-800.	54.6		-1000.	-800.	55.6
-800.	-800.	56.6		-600.	-800.	57.6
-400.	-800.	58.3		-200.	-800.	59.1
0.	-800.	60.0		200.	-800.	59.8
400.	-800.	58.5		600.	-800.	56.7
800.	-800.	55.0		-1200.	-600.	55.7
-1000.	-600.	56.9		-800.	-600.	58.2
-600.	-600.	59.3		-400.	-600.	60.3
-200.	-600.	61.4		0.	-600.	62.6
200.	-600.	62.1		400.	-600.	59.8
600.	-600.	57.6		800.	-600.	56.0
-1200.	-400.	56.7		-1000.	-400.	58.2
-800.	-400.	59.7		-600.	-400.	61.2
-400.	-400.	62.9		-200.	-400.	64.9
0.	-400.	67.0		200.	-400.	65.3
400.	-400.	61.2		600.	-400.	58.6
800.	-400.	57.0		-1200.	-200.	57.5
-1000.	-200.	59.2		-800.	-200.	61.0
-600.	-200.	63.2		-400.	-200.	66.3
-200.	-200.	69.6		0.	-200.	73.3
200.	-200.	74.6		400.	-200.	63.4
600.	-200.	60.5		800.	-200.	58.7
-1200.	0.	57.7		-1000.	0.	59.5
-800.	0.	61.5		-600.	0.	64.0
-400.	0.	68.1		-200.	0.	74.2
0.	0.	134.6		200.	0.	73.6
400.	0.	67.2		600.	0.	63.0
800.	0.	60.5		-1200.	200.	57.5
-1000.	200.	59.2		-800.	200.	61.1

Example test case HNM Version 2.2

HELIPORT - Example Heliport

X	Y	LDN		X	Y	LDN
-600.	200.	63.5		-400.	200.	67.1
-200.	200.	71.3		0.	200.	73.5
200.	200.	70.3		400.	200.	66.5
600.	200.	63.2		800.	200.	61.0
-1200.	400.	57.2		-1000.	400.	59.0
-800.	400.	61.1		-600.	400.	63.9
-400.	400.	67.4		-200.	400.	68.0
0.	400.	67.9		200.	400.	67.5
400.	400.	64.1		600.	400.	62.0
800.	400.	60.4		-1200.	600.	57.3
-1000.	600.	59.2		-800.	600.	61.4
-600.	600.	64.1		-400.	600.	66.7
-200.	600.	65.3		0.	600.	65.0
200.	600.	65.2		400.	600.	62.5
600.	600.	60.9		800.	600.	59.8
-1200.	800.	57.3		-1000.	800.	59.2
-800.	800.	61.7		-600.	800.	64.5
-400.	800.	65.3		-200.	800.	64.1
0.	800.	63.9		200.	800.	63.8
400.	800.	61.7		600.	800.	60.4
800.	800.	59.5				

FIGURE 5-10:   SAMPLE STANDARD GRID ANALYSIS REPORT

```
I                               I
I X =  -1200.    Y =   -1200. I
I                               I
I METRIC LDN      TOTAL =  52.5 I
I                               I
```

AIRCRAFT	PROFILE	NOISE CURVE	STAGE	TAXI APPROACH	FLIGHT TYPE	TRACK	HELIPAD	SEL	OPERATIONS DAY	EVENING	NIGHT	CONTRIBUTION
A109	TA109	A109	1		T	td1	Po1	87.3	2.0	.0	1.0	.48651E+02
A109	AA109	A109	0		A	ta1	Po1	84.9	2.0	.0	1.0	.46289E+02
S76	AS76	S76	0		A	ta1	Po1	83.3	5.0	.0	.0	.40907E+02
S76	TS76	S76	1		T	td3	Po1	81.1	6.0	.0	.0	.39528E+02
S76	AS76	S76	0		A	ta3	Po1	80.1	6.0	.0	.0	.38490E+02
A109	TA109	A109	1		T	td2	Po1	87.5	1.0	.0	.0	.38136E+02
S76	TS76	S76	1		T	td1	Po1	79.8	5.0	.0	.0	.37384E+02
A109	AA109	A109	0		A	ta2	Po1	85.8	1.0	.0	.0	.36398E+02
A109	AA109	A109	0		A	ta4	Po1	85.5	1.0	.0	.0	.36143E+02
S76	GS76	S76	2	GS76	G	tx1	Po1	85.0	1.0	.0	.0	.35625E+02
A109	AA109	A109	0		A	ta3	Po1	84.8	1.0	.0	.0	.35364E+02
A109	TA109	A109	1		T	td4	Po1	82.6	1.0	.0	.0	.33210E+02
A109	TA109	A109	1		T	td3	Po1	82.0	1.0	.0	.0	.32610E+02
S76	GS76	S76	2	GS76	G	tx2	Pp1	80.2	1.0	.0	.0	.30837E+02

PEAK LEVEL = 87.5

		DECIBELS BELOW 88									
		0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10
NUMBER OF FLIGHTS	-	2	0	3	2	1	2	1	2	1	0
NUMBER	DAY -	3	0	3	3	5	2	6	7	5	0
OF	EVENING -	0	0	0	0	0	0	0	0	0	0
OPERATIONS	NIGHT -	1	0	0	1	0	0	0	0	0	0

```
I                               I
I X =  -1000.    Y =   -1200. I
I                               I
I METRIC LDN      TOTAL =  53.1 I
I                               I
```

AIRCRAFT	PROFILE	NOISE CURVE	STAGE	TAXI APPROACH	FLIGHT TYPE	TRACK	HELIPAD	SEL	OPERATIONS DAY	EVENING	NIGHT	CONTRIBUTION
A109	TA109	A109	1		T	td1	Po1	88.0	2.0	.0	1.0	.49414E+02
A109	AA109	A109	0		A	ta1	Po1	85.4	2.0	.0	1.0	.46790E+02
S76	AS76	S76	0		A	ta1	Po1	83.8	5.0	.0	.0	.41348E+02
S76	TS76	S76	1		T	td3	Po1	82.2	6.0	.0	.0	.40538E+02
S76	AS76	S76	0		A	ta3	Po1	80.7	6.0	.0	.0	.39131E+02
A109	TA109	A109	1		T	td2	Po1	88.3	1.0	.0	.0	.38853E+02
S76	TS76	S76	1		T	td1	Po1	80.3	5.0	.0	.0	.37851E+02
A109	AA109	A109	0		A	ta2	Po1	86.1	1.0	.0	.0	.36746E+02
S76	GS76	S76	2	GS76	G	tx1	Po1	85.9	1.0	.0	.0	.36523E+02
A109	AA109	A109	0		A	ta4	Po1	85.8	1.0	.0	.0	.36404E+02
A109	AA109	A109	0		A	ta3	Po1	85.1	1.0	.0	.0	.35702E+02
A109	TA109	A109	1		T	td4	Po1	83.5	1.0	.0	.0	.34077E+02
A109	TA109	A109	1		T	td3	Po1	83.0	1.0	.0	.0	.33622E+02
S76	GS76	S76	2	GS76	G	tx2	Pp1	81.6	1.0	.0	.0	.32208E+02

PEAK LEVEL = 88.3

		DECIBELS BELOW 89									
		0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10
NUMBER OF FLIGHTS	-	2	0	1	4	0	3	1	1	2	0
NUMBER	DAY -	3	0	1	5	0	7	6	1	11	0
OF	EVENING -	0	0	0	0	0	0	0	0	0	0
OPERATIONS	NIGHT -	1	0	0	1	0	0	0	0	0	0

FIGURE 5-11: SAMPLE DETAILED GRID ANALYSIS REPORT

(6) Flight Type, "T" for Takeoff, "A" for Approach, and "G" for Taxi
(7) Track Name
(8) Helipad Designation
(9) Individual SEL at the Grid Point
(10) Number of Daytime and Nighttime Operations (Evening operations are not accessible in the HNM)
(11) Individual Contribution to the Total Noise Exposure

Printed below this table is the highest noise level (peak level) for all flights over the receiver location, i.e., grid point. A table showing the number of flights having noise levels within approximately 10 dB of the peak level then follows. The table shows the distribution of these flights by 1 dB increments from the first whole number level which equals or exceeds the peak level. The number of daytime and nighttime operations for these flights is also given.

5.3 Contour Analysis

Two types of output can be produced from a contour analysis: a tabular "Contour Analysis Report" and a "Contour Plot". Their contents are discussed in the following sections.

5.3.1 Contour Analysis Report

The "Contour Analysis Report" provides a list of the points which define the contours of equal noise values within the user-specified or default contour window. Separate reports are given for each level requested. Figure 5-12 presents two pages from the "Contour Analysis Report" for "Example Heliport".

Following the report title, the contour name, case title, and heliport name are shown. Next is the noise level for which the contour was created, the total area in square miles encompassed by the contour, and the noise metric, L_{dn}. This information is followed by a table of points defining the contour. A contour may be comprised of several distinct and separate areas, called "islands". Within the table, these islands are identified by sequential indexes under the header "ISLAND". Then, for each island, the table prints out a point identifier and the X- and Y-coordinates of the point for each point on the contour island. To conserve space, the points are printed three to a line. The island indicator is printed only once, just before the first point of the island.

If, for a given level, there is no contour within the contour window, the table of points will not be printed. In addition, the area value will be 0.00.

C O N T O U R - NEM001
-------------- ------

Example test case HNM Version 2.2
HELIPORT - Example Heliport
LEVEL = 60.0 DB   AREA =   .13   METRIC = LDN

ISLAND	PNT	X	Y		PNT	X	Y		PNT	X	Y	
1	1	0.	1632.		2	-108.	1608.		3	-250.	1565.	
	4	-376.	1500.		5	-459.	1459.		6	-500.	1429.	
	7	-689.	1250.		8	-724.	1224.		9	-750.	1196.	
	10	-899.	1000.		11	-926.	926.		12	-940.	750.	
	13	-925.	575.		14	-911.	500.		15	-900.	400.	
	16	-910.	250.		17	-941.	59.		18	-951.	0.	
	19	-928.	-72.		20	-887.	-250.		21	-834.	-334.	
	22	-750.	-407.		23	-636.	-500.		24	-558.	-558.	
	25	-500.	-584.		26	-355.	-645.		27	-284.	-681.	
	28	-250.	-701.		29	-232.	-713.		30	-220.	-720.	
	31	-195.	-723.		32	-115.	-750.		33	0.	-797.	
	34	53.	-803.		35	125.	-810.		36	235.	-765.	
	37	250.	-760.		38	256.	-756.		39	261.	-750.	
	40	321.	-679.		41	369.	-625.		42	372.	-622.	
	43	375.	-615.		44	434.	-500.		45	459.	-459.	
	46	493.	-375.		47	500.	-362.		48	605.	-250.	
	49	669.	-210.		50	694.	-194.		51	750.	-107.	
	52	861.	0.		53	880.	120.		54	916.	250.	
	55	892.	392.		56	816.	500.		57	750.	649.	
	58	723.	723.		59	713.	731.		60	702.	750.	
	61	694.	778.		62	699.	801.		63	733.	1000.	
	64	750.	1024.		65	866.	1134.		66	993.	1250.	
	67	965.	1465.		68	951.	1500.		69	750.	1603.	
	70	658.	1658.		71	500.	1674.		72	341.	1659.	
	73	250.	1668.		74	156.	1656.		75	0.	1632.	

C O N T O U R - NEM001
-------------- ------

Example test case HNM Version 2.2
HELIPORT - Example Heliport
LEVEL = 65.0 DB   AREA =   .03   METRIC = LDN

ISLAND	PNT	X	Y		PNT	X	Y		PNT	X	Y	
1	1	-500.	847.		2	-544.	750.		3	-567.	658.	
	4	-553.	553.		5	-546.	500.		6	-542.	458.	
	7	-514.	368.		8	-511.	250.		9	-519.	135.	
	10	-550.	50.		11	-556.	0.		12	-546.	-46.	
	13	-527.	-138.		14	-500.	-163.		15	-468.	-218.	
	16	-430.	-250.		17	-375.	-295.		18	-330.	-330.	
	19	-250.	-367.		20	-234.	-375.		21	-165.	-415.	
	22	-125.	-431.		23	-36.	-464.		24	0.	-481.	
	25	22.	-478.		26	125.	-474.		27	189.	-439.	
	28	234.	-375.		29	250.	-360.		30	306.	-306.	
	31	322.	-250.		32	375.	-140.		33	383.	-133.	
	34	389.	-125.		35	453.	-47.		36	493.	0.	
	37	494.	6.		38	500.	51.		39	515.	133.	
	40	500.	154.		41	474.	224.		42	450.	250.	
	43	375.	348.		44	364.	364.		45	357.	375.	
	46	340.	410.		47	296.	500.		48	285.	535.	
	49	250.	581.		50	151.	599.		51	125.	598.	
	52	105.	605.		53	0.	610.		54	-121.	621.	
	55	-125.	621.		56	-128.	622.		57	-161.	625.	
	58	-250.	645.		59	-270.	711.		60	-314.	750.	
	61	-375.	818.		62	-429.	821.		63	-500.	847.	

FIGURE 5-12: SAMPLE CONTOUR ANALYSIS REPORT

5.3.2 Contour Plot

The "Contour Plot" option produces a plot of user-selected L_{dn} contours around a heliport. Figure 5-13 is a sample Contour Plot for "Example Heliport". The outer border of the plot is drawn to a user-specified height and width. As the default, the plot width is 8.5 inches and the plot height is 11 inches. An inner border is drawn to define the actual plotting area. This border serves as a window against which the heliport noise contours and coordinate system axes are drawn. Contours or portions of contours that lie outside of this window will not be shown.

The heliport origin, used in the helipad definitions, is automatically centered within the plotting area. This default may be overridden if the user inputs non-zero plot origin values. Tic marks are drawn along the X- and Y-axes of the airport coordinate system every 1,000 ft regardless of scale. Each contour is drawn and annotated with its noise level.

The case title and heliport name as input by the user are shown below the inner border. The scale of the contour plot is shown graphically in the lower right corner of the plot. A graphical representation of the scale is shown so that magnified or reduced reproductions will automatically display correct scale factor information. The scale unit of distance is also shown.

(2956,2299)　(2956,-1642)

(-2956,2299)　(-2956,-1642)

657 ft

60

65

Example test case HNM Version 2 2
Example Heliport
METRIC = LDN　60 0 65 0 70 0
AREA(SQ MI) =　1　0　0
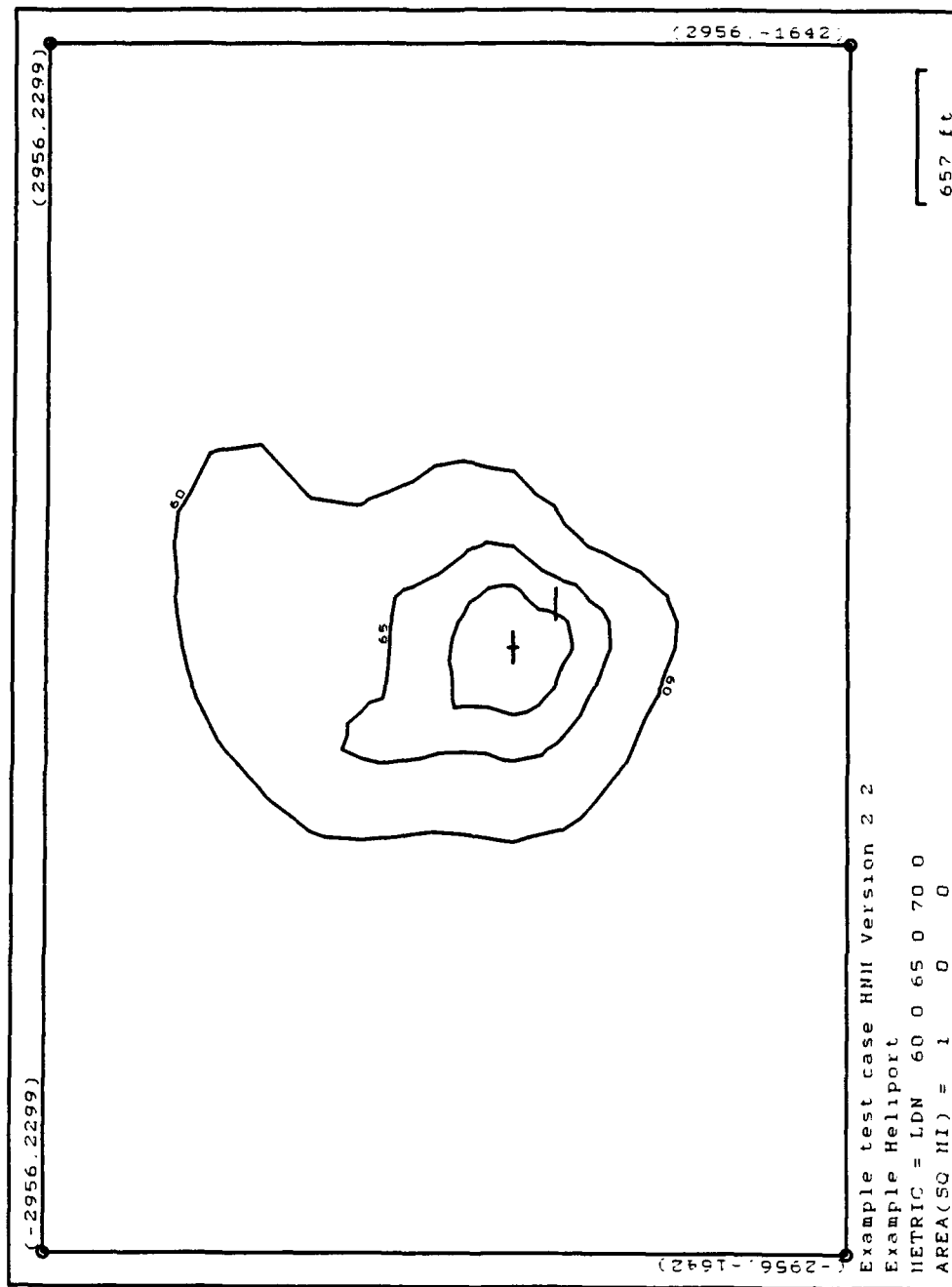
FIGURE 5-13:　SAMPLE CONTOUR PLOT

6.0 REFERENCES

1   Flythe, M.C., INM, Integrated Noise Model Version 3, User's Guide - Revision 1, Report No. FAA-EE-92-02, Arlington, VA: CACI, Inc. - Federal, June, 1992.

2   Fleming, G.G., Rickley, E.J., Burstein, J., D'Aprile, J.R., INM, Integrated Noise Model Version 4.11, User's Guide - Supplement, Report No. FAA-EE-93-03, Cambridge, MA: Volpe National Transportation Systems Center, December, 1993.

3   Keast, D., Eldred, K., Purdum, J., HNM, Heliport Noise Model Version 1, User's Guide, Report No. FAA-EE-88-2, Concord, MA: HMM Associates, Inc., February, 1988.

4   Federal Register Vol. 53, No. 8722, Expansion of Applicability of Part 150 to Heliports, Washington, D.C.: U.S. Department of Transportation, Federal Aviation Administration, March 16, 1988.

5   INM, Integrated Noise Model, Contour Plotting Program, User's Manual, Cambridge, MA: Unisys Corporation, November, 1989.

APPENDIX A

REVISIONS TO HNM ALGORITHMS

This Appendix discusses, in general terms, revisions to several algorithms and subroutines included in HNM Version 2.2. It also discusses the rationale for these revisions. The associated computer source code is not included. All revisions discussed below are transparent to the user in that they do not affect user-operation of the HNM. However, these revisions will result in more accurate HNM noise predictions and an increase in HNM computational efficiency as compared to HNM Version 1. They include: (1) revisions to the flight significance testing within the HNM; (2) revisions to the dipole directivity pattern within the HNM; and (3) reformatting of the track file (FOR13.DAT).

A.1 Flight Significance Testing

The methodology employed for determining flight noise significance during grid computations has been streamlined in HNM Version 2.2. Rather than looping through each of the first four refinement levels individually and constructing the noise grid on a level-by-level basis, HNM Version 2.2 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.

The restructuring of the flight significance methodology was originally performed during the development of INM Version 4.11 (see the INM Version 4.11 User's Guide Supplement[1]). 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. Similar improvements in run-time can be expected for HNM Version 2.2 as compared with Version 1.

A.2 Dipole Directivity Pattern

For helicopters without measured directivity data, a 90° dipole directivity pattern was originally instituted within the HNM as a means of approximating the directivity characteristics of a helicopter in flight. This assumption stems from INM Version 3 where a dipole directivity pattern, a reasonable approximation for an airplane, is utilized (**Note**: In INM Version 4.11, the 90° dipole directivity pattern has been modified). A dipole approximation is not appropriate for a helicopter. Consequently, for HNM Version 2.2, the original dipole directivity directly in front of and behind the airplane has been suppressed, resulting in a monopole pattern (i.e., no directivity). The monopole pattern is applied for all helicopters without measured directivity data, regardless of the mode of operation.

A.3 Track File (FOR13.DAT)

To increase the precision of the distance computations within the HNM, the format of the track information stored in the FOR13.DAT file has been changed to include an increased number of significant figures. This change will improve the accuracy of computations regardless of the distance units specified by the user.

A.4 References

[1] Fleming, G.G., Rickley, E.J., Burstein, J., D'Aprile, J.R., _INM, Integrated Noise Model Version 4.11, User's Guide - Supplement_, Report No. FAA-EE-93-03, Cambridge, MA: Volpe National Transportation Systems Center, December, 1993.

APPENDIX B

HELICOPTER NOISE DATA BASE

The HNM Version 2.2 Data Base contains partial data on 18 helicopters. All of these data have been developed in a consistent manner and are intended to provide information regarding directional characteristics.

In-flight directionality in terms of elevation angle is accounted for by three sets of sound exposure level (SEL) data, i.e., left, center, and right. The left and right data are corrected to elevation angles of 45 degrees. The center data are for an elevation angle of 90 degrees. All of these data were processed from the measured sound-level time-history recordings to sound exposure levels, adjusting for propagation through the Society of Automotive Engineer's (SAE) reference atmosphere[1]. The computations were made with either the integrated or simplified procedure, described in the Federal Aviation Regulations, Part 36[2], with a value of 10.0 used as a multiplier to account for distance duration effects in the Delta-2 adjustment factor.

The approach noise-versus-distance data are for six-degree descent angles using International Civil Aviation Organization (ICAO) procedures, where data were reported for more than one velocity. The takeoff data also used the ICAO procedure, where data were reported for more than one velocity. The overflight data were based on level flights at a nominal altitude of 500 ft. The tabulated data represent the median speed measured. Data at other velocities are computed by adding a delta dB correction to the tabulated noise data. The delta dB is computed using the constants from a polynomial regression of the existing data, using the formula:

$$\text{Delta dB} = B_0 + B_1 (M_t - M_{tref}) + B_2 (M_t - M_{tref})^2,$$

where B_0, B_1 and B_2 are constants computed from the data and stored in the Data Base;

M_t is the tip speed for the advancing main rotor blade; and

M_{tref} is the tip speed for the main rotor when the helicopter velocity is zero at the flight RPM.

Static directivity in terms of azimuth angle measured clockwise from the helicopter's nose is accounted for by the coefficients of an eight-degree of freedom sine/cosine series which was derived from measurements at 45-degree intervals over both hard and soft surfaces. All of these coefficients were derived by Southwest Research Institute using the original raw data[3].

Table B-1 summarizes the data available in the HNM Version 2.2 Data Base. Table B-2 reproduces the directivity data from Reference 3. File FOR17.DAT is a user-accessible ASCII version of the Data Base. With the DOS prompt displayed on the computer display, the user may obtain a hardcopy of the Data Base by printing the FOR17.DAT file.

B.1 Data Base Number 2

Data Base Number 2 of the HNM has been created through the addition of existing helicopter noise data from the archives at the Volpe Center's Acoustics Facility. Additions to the Data Base Include: (1) takeoff, approach, and level flyover data for the B206L helicopter; (2) ground idle (GIDLE) data for the CH47D, H500D, B206L, S76, SA365N, SA355F, SA350D, and B222 helicopters; and (3) hover in-ground (HIGE) data for the B212, S61, BO105, SA330J, A109, SA341G, S65, and S70 helicopters. With the exception of the HIGE data, all data were processed consistent with the procedures described previously in this Appendix.

The HIGE data were conservatively estimated from the existing measured takeoff data for their respective helicopters. Specifically, the HIGE data were estimated at a slant range of 200 ft using the takeoff/HIGE noise relationship for similar (i.e., based upon weight) helicopters with existing measured data. The HIGE data at subsequent slant ranges were then computed using the noise level drop-off rates of similar helicopters.

B.2 References

[1] Transportation Systems Center (TSC), "Series of Letter Reports, SEL/L_{eq} vs. distance data for helicopters - Unpublished Data," June-December, 1986.

[2] Federal Aviation Regulations, Part 36, Noise Standards: Aircraft Type and Airworthiness Certification, Washington, D.C.: Federal Aviation Administration, December, 1988.

[3] Unruh, J. F., Evaluation of Helicopter Directivity Hover in Ground Effect Data, for TSC under Contract No. DTRS-57-80-C-00086, San Antonio, TX: Southwest Research Institute, September, 1986.

TABLE B-1: STATUS SUMMARY OF HELICOPTER NOISE DATA FOR DATA BASE NUMBER 2

Order of Storage	Helicopter	Data Base Quantities[1]						
		Takeoff	Approach	Level Cruise	HOGE[3]	HIGE[3,4]	FIDLE	GIDLE
1	B212 (UH-1N)	X	X	(1 vel)[2]		S		
2	S61 (CH-3A)	X	X	(1 vel)		S		
3	S64 (CH-54B)							
4	CH47D (BV 234)	X	X	X	S	D,S		X
5	H500D	X	X	X		D,S		X
6	B0105	X	X	(1 vel)		S		
7	B47G							
8	SA330J	X	X	(1 vel)		S		
9	B206L	X	X	X		S		X
10	A109	X	X	X		D,S		
11	SA341G	X	X	(1 vel)		S		
12	H300C							
13	S65 (CH-53)	X	X	(1 vel)		S		
14	S70 (UH-60A)	X	X	X		S		
15	S76	X	X	X		D,S		X
16	SA365N	X	X	X	S	D,S		X
17	SA355F	X	X	X	S	D,S		X
18	SA350D	X	X	X		D,S		X
19	B222	X	X	X	S	D,S		X
20	R22HP					D		
21	BK117					D		

[1] X indicates data from TSC.

[2] (1 vel) indicates data available at only one velocity for left, center and right.

[3] S indicates L_A vs. Slant Distance available from TSC over soft ground.

[4] D indicates directivity constants available from SWRI for both hard and soft ground.

TABLE B-2 HELICOPTER DIRECTIVITY PATTERN COEFFICIENTS

Helicopter	Path	Coefficients							
		-Cosine terms					-Sine terms		
		a0	a1	a2	a3	a4	b1	b2	b3
B222	Hard	-0.59237	-1.14299	-0.17480	0.94277	-.200000	-1.60432	0.77495	-1.75457
	Soft	-0.28927	-0.32619	-0.02495	-0.57387	-0.49992	-0.24125	-1.22508	-1.49111
SA365N	Hard	-0.51802	-2.08223	0.17497	-0.66764	-0.41251	-0.10988	0.60010	2.09008
	Soft	-0.70137	-2.10033	0.64005	-1.44973	0.97506	-0.33335	1.00994	0.03671
H500D	Hard	-2.12589	-5.61492	-0.14977	1.31477	0.72498	-2.35532	0.60002	-0.75586
	Soft	-2.56115	-5.73704	0.77528	-0.36318	-1.03748	-0.42319	2.09986	-1.27355
SA355F	Hard	-1.90408	-4.89956	0.70010	-0.55044	-0.28749	-2.77874	0.97506	1.47104
	Soft	-0.74464	-3.28579	-0.19996	-1.16419	0.42496	-0.51265	0.90008	0.93731
SA350D	Hard	-1.41909	-4.11177	-0.13475	0.78845	0.41755	-0.30721	2.19995	-1.17742
	Soft	-0.53827	-2.61368	0.99996	-0.38626	-0.06249	-0.07613	-0.62508	0.32383
S76	Hard	-1.52630	-4.66072	-1.02507	-2.53935	-0.16230	-0.84154	-1.29996	-1.49132
	Soft	-1.55469	-4.23485	0.07482	-1.26503	-0.91239	1.05798	-2.45005	-0.49191
CH47D	Hard	-1.20323	0.73770	1.02505	-0.28766	-1.87506	2.18797	1.72490	0.88796
	Soft	-2.16113	0.49999	3.32500	-0.94996	-2.97504	3.52078	1.22459	0.12090
R22HP	Hard	-0.42677	-1.47011	-1.47506	-0.47983	-0.96245	-1.09134	-0.54978	0.80869
	Soft	-1.22094	-3.72551	2.10003	0.37548	0.42499	-0.25517	-0.85026	0.80538
BK117	Hard	-6.03468	-8.29072	-1.49959	-0.75959	-1.83743	-4.39023	3.27523	-0.24072
	Soft	-2.11642	-2.58532	-1.99998	2.43556	-1.92514	1.31973	0.10033	2.56920
A109	Hard	-0.54193	-0.97634	-1.32480	2.27624	0.53742	0.03165	0.80009	-0.81431
	Soft	-0.85536	0.41072	-1.10018	-0.26048	-1.71252	-0.56129	-0.72472	2.78881

APPENDIX C

ERROR MESSAGES AND PROBLEMS

This Appendix presents the error messages produced by HNM Version 2.2. Error messages have the same numbers as in the INM to maintain compatibility. Some messages, however, have been altered to reflect changes between the HNM and INM. In addition, error messages concerning INM approach-parameter sets and INM takeoff-modification sets do not exist in the HNM.

C.1 Input Module Error Messages

The following errors can occur while executing the Input module. The errors will appear in reverse video on the last line of the display screen, starting at the first column. **Note**: INM Errors I1-I11, I14, I17-I19, I21, I23, I24, I26-I28, I30-I38, I40, I41-I46, I48-I59, I61-I65, I67-I69, I71, I72, I74-I84, I86, I88-I102 will not occur when using the HNM data entry module; and INM Errors I30, I32, I33, I34, I35, I37, I42, I43, I51, I55, I69, I94, I98, and I99 do not exist in the HNM.

I12*FATAL: ABOVE KEYWORD ENDS SETUP SECTION AND NO PADS HAVE BEEN DEFINED.

Cause:	No valid helipad definitions were processed.
Correction:	Check that keyword "RUNWAYS" was present and recognized. Check that there is at least one helipad defined and that all definitions area valid.

I13*WARNING: ABOVE KEYWORD HAS OCCURRED MORE THAN ONCE AND MAY ALTER INPUT.

Cause:	Since data is entered by keyword, if a keyword is repeated, the new data replaces the previous data.
Correction:	If the keyword is a duplicate, delete the duplicate keyword and associated data.

I15*WARNING: THESE CHARACTERS NOT PROCESSED. THEY ARE NOT OF TYPE EXPECTED.

Cause:	If characters are numeric, alpha characters were expected. If characters are alpha, numeric characters
Correction:	Remove any extraneous characters. If characters are not extraneous, check that preceding data has been processed properly. This error may occur when data is expected to follow a keyword or another keyword is expected to follow some data.

I16*WARNING: INVALID HELIPAD NAME.

Cause:	Helipad name not found.
Correction:	Correct helipad name.

I20*FATAL: TOTAL ERRORS EXCEED 50 OR NUMBER OF ERRORS ON ABOVE CARD EXCEEDS 20.

Cause: Too many errors have been detected in the input data.

Correction: Correct all the preceding errors and re-submit the job.

I22*FATAL: INPUT MODULE PRODUCED WARNING MESSAGES. PROGRAM TERMINATED.

Cause: At least one input error was detected by the INPUT module. Since this error invalidates the user input, no further processing is allowed.

Correction: Correct all of the preceding errors.

I25*FATAL: ABOVE KEYWORD ENDS AIRCRAFT SECTION AND NO AIRCRAFT WERE DEFINED.

Cause: No valid helicopter definitions were processed.

Correction: Check for a TYPE subsection within the AIRCRAFT section. Make certain that this subsection contains at least one helicopter definition and that all definitions are valid.

I29*Warning: ABOVE NAME IS TOO LONG. IT HAS BEEN TRUNCATED TO 4 CHARACTERS.

Cause: A maximum of 4 characters are allowed for the names of aircraft categories and tracks, and a maximum of 3 for helipads. The input name or a reference to a helipad exceeds 4 characters.

Correction: Use a unique 3- or 4-character name as required.

I39*WARNING: DISTANCE IN Ft CANNOT BE STORED ON DEFINITION FILE. SET TO 0.

Cause: After conversion to ft, this distance was too large for the format in which it must be stored on the definition file. Therefore, a value of 0.0 was used for the distance.

Correction: Enter a distance within the proper range.

I47*WARNING: PROFILE DESCRIP. NOT READ. VALUE OF SEGMENTS NOT BETWEEN 3 AND 14.

Cause: Within the taxi profile definition, the number of segments must be from 3 through 14 for both the approach and takeoff portions of the profile. The takeoff segments are determined from the beginning of the taxi to moving HIGE mode. Approach segments are the moving HIGE mode to the end of the taxi. Since an invalid value was entered for the number of segments, the data for the distances, altitudes, speeds, and thrusts could not be processed. If this error occurs for an approach profile, any mode name will be read as a keyword and the program will go back to a level 1 search on keywords.

Correction: Make certain that the profile has between 3 and 14 segments and that the value following the keyword "SEGMENTS" is that number of segments.

I60*WARNING: ABOVE KEYWORDS ENDS TRACK DEFINITION BUT NO SEGMENTS WERE DEFINED.

Cause: Within a track definition, there must be at least one segment. None were found for this track.

Correction: Enter at least one segment description for the track.

I66*WARNING: ABOVE HELIPAD NAME NOT FOUND IN XREF. ID SET TO 0.

Cause: Within a track definition, a helipad was referenced but was not found in the cross reference table.

Correction: Verify that the name is spelled correctly and was defined in the SETUP section. This message will also appear if the cross reference table was filled before this helipad was defined.

I70*WARNING: NO VALID OPERATIONS DEFINED IN LAST OPERATIONS SECTION.

Cause: Within a TAKEOFFS, LANDINGS, or TAXIS section, at least one valid operation must be defined. None was defined for the section preceding this keyword.

Correction: Correct any invalid operations within the section and add operations if none were present.

I73*WARNING: ABOVE KEYWORD ENDS OPERATION DEFINITION BUT NO D, E, N VALUES GIVEN.

Cause: Within TAKEOFFS, LANDINGS, and TAXIS, operations must include the number of flights by day ("D") and night ("N") with at least one of these being explicitly defined. In this operation, no flights were specified.

Correction: Check for missing or misspelled keywords (at least one of the keywords "D" or "N") and for a valid number of flights for that period of time. At least one time period must have a non-zero number of flights.

I85*WARNING: ABOVE NAME IS DUPLICATE CONTOUR NAME OR 20 CONTOURS ALREADY SAVED.

Cause: Within the PROCESS section, contours are saved and referenced by their names. A duplicate name has been encountered or more than 20 contours were specified to be saved.

Correction: Make the saved contour names unique and limit the total to 20 contours.

I87*WARNING: RETRIEVE COMMAND BEFORE ABOVE KEYWORD REQUESTED NO REPORTS.

Cause: A RETRIEVE command must call for some type of report. For this RETRIEVE, the user has suppressed the default REPORT option with a NOREPORT command but did not select a PLOT report.

Correction: Add requests for the types of reports desired.

C.2 Flight Module Error Messages

The following errors can occur while executing the Flight module. The errors will appear in reverse video on the last line of the display screen, starting at the first column. Note: INM Errors F2, F3, F5, F6, F8, and F9 will not occur when using the HNM data entry modules; and INM Errors F3, F8, and F9 do not exist in the HNM.

F1*FATAL: PAD XXXX TRACK: YYYY PROFILE: ZZZZZZ TOO MANY SEGMENTS. ARRAY BOUNDS EXCEEDED.

Cause:	The number of flight path segments generated for this flight exceeds 200.
Correction:	Verify the helipad, track, and profile definitions for this flight. If all are correct, then simplify the flight path definition.

F4*FATAL: PAD XXX TRACK: YYYY PROFILE: ZZZZZZ TRACK SEGMENT OUT OF RANGE.

Cause:	The actual number of track segments does not equal the track segment counter.
Correction:	Correct the track in error.

F7*FATAL: PAD XXXX TRACK: YYYY PROFILE: ZZZZZZ CHANGE IN HEIGHT GREATER THAN SEGMENT LENGTH.

Cause:	A flight path segment has been generated where the aircraft's change in altitude is greater than the actual length of the flight segment.
Correction:	Verify the track and profile definitions for this flight.

C.3 Computation Module Error Messages

The following errors can occur while executing the HNM Computation module. The errors will appear in reverse video on the last line of the display screen, starting at the first column. INM Errors C1 and C2 will not occur when using the HNM data entry modules.

C3*FATAL: NO CONTOUR LEVEL SELECTED

Cause:	No contour level values were found on the processing template.
Correction:	Supply the missing noise contour level(s).

C4*FATAL: TOLERANCE CANNOT BE ZERO

Cause:	The user has incorrectly defined the recursively subdivided grid window.
Correction:	Correct the window coordinates.

C.4 Report Generator Module Error Messages

The following errors can occur while executing the HNM Report Generator Module. The errors will appear in reverse video on the last line of the display screen, starting at the first column.

RG1*FATAL: NO DETAILED GRID REPORT PRODUCED. ERROR IN COMPUTATION MODULE.

Cause: The COMPUTATION module did not run successfully and consequently did not produce the CONTRIBUTIONS file from which the Detailed Grid Analysis Report is produced.

Correction: Correct the error previously reported by the COMPUTATION module.

RG2*FATAL: NO STANDARD GRID REPORT PRODUCED. ERROR IN COMPUTATION MODULE.

Cause: The COMPUTATION module did not run successfully and consequently did not produce the regular GRID file from which the Standard Grid Analysis Report is produced.

Correction: Correct the error previously reported by the COMPUTATION module.

RG3*FATAL: NO CONTOUR REPORT PRODUCED. ERROR IN COMPUTATION MODULE.

Cause: The COMPUTATION module did not run successfully and consequently did not produce the recursively subdivided GRID file from which supplies data for the Contour Analysis Report.

Correction: Correct the error previously reported by the COMPUTATION module.

C.5 Contour Module Error Messages

The following errors can occur while executing the HNM Contour Module. The errors will appear in reverse video on the last line of the display screen, starting at the first column.

CN1*FATAL: CONTOUR NAME XXXXXX DOES NOT EXIST

Cause: The Grid File does not contain the contour definition name.

Correction: Case 1 -- If this message occurs when a RETRIEVE command is being processed, then an invalid CONTOUR name was used to retrieve from the given old Grid File. Correct the name or select the appropriate old Grid File.

                        Case 2 -- If this message occurs when a CONTOUR command is being processed, there was a previous error in the COMPUTATION module and no Grid File was created for this contour name. Correct the error reported by the COMPUTATION module.

CN2*WARNING: XXXX YY.YY CONTOUR AND AREA MAY BE INCOMPLETE

Cause: The contour with metric name = XXXX and level = YY.YY was determined to not be within the range of levels input to the COMPUTATION module. Therefore, the contour may not be accurate.

Correction: If an accurate contour for this level is desired, then
                   resubmit the job to invoke the COMPUTATION module.

CN3*WARNING: XXXX YYY.YY CONTOUR DOES NOT EXIST

Cause: All noise values computed by the COMPUTATION module for
                   metric XXXX are less than contour level = YY.YY.

Correction: No action is required as long as the user has input a
                   reasonable contour level.

C.6 Plot Module Error Messages

The following errors can occur while executing the HNM Plot Module.
The errors will appear in reverse video on the last line of the
display screen, starting at the first column.

P1*FATAL: NO PLOT TAPE CREATED DUE TO CONTOUR MODULE ERROR

Cause: It is not possible to plot the requested contours due to
                   a previously encountered error in the CONTOUR module.

Correction: Correct the CONTOUR module processing error.

P2*WARNING: NO PLOT FOR CONTOUR LEVEL NUMBER = XX

Cause: No contour for this noise level exists.

Correction: As long as the contour value input to the COMPUTATION
                   module was correct, no action is required.

APPENDIX D

HNM REQUEST FORM

This Appendix contains a copy of the request form for HNM Version 2.2.

REQUEST FORM
HELIPORT NOISE MODEL (HNM)
VERSION 2.2

_____
DATE

_____   _____
LAST NAME   FIRST NAME

_____
COMPANY

_____
DIVISION

_____
STREET ADDRESS

U.S ONLY:

_____ _____ _____
CITY   STATE   ZIP CODE + 4

FOREIGN ONLY:

_____
POSTAL CODES & CITY

_____
COUNTRY

U.S. & FOREIGN:

_____   _____
PHONE   FAX

HNM VERSION 2.2, disk size (choose one): ☐ 5-1/4"   ☐ 3-1/2"

To receive HNM Version 2.2, mail this form and your check or money order for $50 payable to "U.S. Treasury" to:

> Donna G. Warren
> Federal Aviation Administration
> AEE-120
> 800 Independence Ave., SW
> Washington, DC   20591

*****IMPORTANT*****

Due to the expected demand for this HNM release, all orders will be handled by regular mail. FAA will not accept phone orders, FAX orders, nor process special or express deliveries of any kind.

AEE BULLETIN BOARD (BBS)

The Office of Environment and Energy (AEE) has available an electronic bulletin board. This bulletin board is available to all registered HNM users. To become a registered BBS user, check the box below. By checking the box you will receive the BBS phone number and User's Manual. To connect to this board users must have a modem and a communications software package setup as follows: ANSI Terminal Emulation, 8 Data Bits, No Parity, 1 stop Bit, and 1200, 2400, or 9600 BAUD.

> ☐   Yes, I would like to become a registered AEE BBS user.