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ROUTEMAP VERSION 2.0: MILITARY TRAINING ROUTE NOISE MODEL USER'S MANUAL

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13. ABSTRACT *(Maximum 200 words)*

ROUTEMAP 2.0 is a PC-based computer program that calculates the noise levels under Military Training Routes (MTRs). The calculations are based on a United States Air Force (USAF) data of measured aircraft noise levels called ROUTEFILE. The program calculates L_{dn} and L_{dnmr} noise metrics. The L_{dnmr} noise metric was developed specifically to assess the impact of noise generated aircraft flying on a MTR. The metric is based on human response studies examining the annoyance elicited by aircraft overflights. The program permits the user to define the MTR and aircraft flight parameters, calculate the noise levels, and generate plots and tables. The plots and tables can be used for Environmental Impact Statements (EISs) and Environmental Assessments (EAs) of MTRs. This user's manual contains the necessary information to install and operate ROUTEMAP 2.0.

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1.0 INTRODUCTION

1.1 Overview

Low-altitude, high-speed training operations are routinely conducted by all Air Force flight operation commands. These operations occur on specially designated Military Training Routes (MTRs). MTRs are continually changed because of the need for variety, changing requirements of weapons systems and tactics, and encroachment on existing routes. The Air Force environmental policy[1] requires an environmental assessment or impact statement to be filed whenever there is a change in air base operations or air space requirements on MTRs.

A series of studies on MTR noise[2-6] has led to the ROUTEMAP model[7] which is currently used for environmental noise assessment. Additional MTR noise studies[8-12] have refined the algorithms for the computation of lateral attenuation, the statistical distribution of aircraft flight tracks, and L_{dnmr}, the recommended metric for MTR noise analysis. To improve the current model for predicting MTR noise impact, ROUTEMAP has been updated to reflect this new technology.

The ROUTEMAP Version 2.0 noise model provides improved computational features along with an enhanced user interface. Individual program modules allow the user to define MTR inputs, calculate noise impact, and generate reports and graphs, independently. The input module is used to construct operation scenarios for MTRs by specifying the airspace components (segments) and aircraft flight parameters. Aircraft operations data for each MTR are stored in a single file, organized by individual airspace segments. In the calculation module, airspace segments can be processed individually or in a batch mode. Program output includes tables and graphs of the noise metrics used for environmental impact analysis.

This user's manual contains the necessary information to install and operate ROUTEMAP 2.0.

The remainder of Section 1 specifies the computer system requirements to run ROUTEMAP 2.0, software installation procedures, and a description of the files associated with the program. Section 2 describes the various types of MTRs and identifies the airspace parameters that must be defined when using ROUTEMAP 2.0. In addition, the metrics commonly reported for MTR noise assessment are described. Section 3 provides the operating instructions for ROUTEMAP 2.0, including a

sample MTR scenario. Appendix A defines the updated algorithms in use and describes the noise calculation procedure. Appendix B lists the identification codes associated with each aircraft flight configuration in the NOISE database.

1.2 System Requirements

The following table lists the system requirements for ROUTEMAP 2.0 which runs under DOS.

Category	Requirement
Hardware	16-bit x 86-based microprocessor (such as an Intel 80386/33 or higher) VGA or higher resolution video display, and a hard disk with at least 2 megabytes (MB) minimum free space. High-density floppy drive. Mouse or other pointing device (optional).
Memory	4 MB recommended minimum.
Software	DOS Version 5.0 or higher.

1.3 Installation

To install ROUTEMAP 2.0, insert the installation disk into a floppy drive and proceed as follows:

1. Type **A:** or **B:** to make the floppy drive with the installation disk the current drive.
2. Type **INSTALL** from the **A:\>** or **B:\>** DOS prompt.
3. To install ROUTEMAP 2.0 in the recommended program directory (C:\RTMAP2), highlight this choice and press <ENTER>. A user-defined program directory can also be created by selecting the second menu option. This choice requires the user to specify the drive and directory (e.g., C:\MYDIR). After selecting one of the installation procedures, all program files will be copied to the specified drive and directory and a configuration file will be created. To exit the program without performing the installation, select EXIT PROGRAM.

4. When the installation process is complete, a message will appear noting the directory locations of all program files (see Section 1.4). Press the <ENTER> key to leave the installation program.

5. To run ROUTEMAP 2.0 from any directory, add the name of the program directory to the PATH statement in your AUTOEXEC.BAT file and reboot the computer.

6. Refer to Section 3.1 to begin using ROUTEMAP 2.0.

Note: *While ROUTEMAP 2.0 replaces the original version of the program, both share the identical executable file name 'ROUTEMAP'. If the original version had previously been installed, all associated files should be removed from the hard disk to prevent conflicts.*

1.4 Program Files

The installation provides 15 files associated with the ROUTEMAP 2.0 program. All files are located in the program directory specified during the installation. The data files generated by the program will reside in the current user directory.

Note: *All data files created in ROUTEMAP will be stored in the current directory. To keep these files separate from the files in the program directory, ROUTEMAP can be run from other user-defined directories which should be created to hold all files associated with a particular MTR (e.g., C:\RTMAP2\VR1074).*

A description of each program file (underlined) and data file is provided.

INSTALL.EXE

ROUTEMAP 2.0 installation program.

ROUTEMAP.CFG

This configuration file is created during the installation process and contains values used to specify device drivers and communication parameters. Also included are the names of the program directory and the aircraft noise database (NOISE). The official aircraft noise database is subject to change in the future; therefore ROUTEMAP 2.0 has been designed to utilize new versions with the same data format.

Note: *To change the name of the program directory, ROUTEMAP.CFG must be edited to include the new drive and directory name, or the program can be re-installed with a new program directory name provided. To replace the existing version of the aircraft noise database (NOISE) with a new one, which may have a different name, copy the new version to the program directory and change the aircraft database name in the configuration file (provide full name and extension).*

ROUTEMAP.EXE

This is the main program which calls five additional modules (RTINP.EXE, RTCALC.EXE, OMEG108R.EXE, RTPLOT.EXE, and RTPRN.EXE). Operations data are specified in RTINP; noise calculations are performed in RTCALC and OMEG-108R; reports and graphic plots are generated in RTPRN and RTPLOT, respectively. Together these programs are accessed through the main program ROUTEMAP.

Note: *To implement all program features, run the main program ROUTEMAP.*

NOISE

This file contains the official U.S. Air Force aircraft noise database. Aircraft are listed by specific operating conditions along with the one-third octave band noise levels referenced to these conditions. These data are the basis for the noise computations. As mentioned above, this database may be replaced with a new version provided the complete name is specified in the configuration file.

CODE.EXE

This program can be used to create a listing of the aircraft identification codes and the associated flight configurations in the NOISE database (see Appendix B).

IN, OUT, & OMEG108R.OUT

Temporary files used during the noise calculation process.

COURB.FON

Font file used by the graphics plotting routines.

VR-1074.MTR

Sample MTR operations file containing airspace descriptors and aircraft flight operation parameters.

Throughout this manual, MTR VR-1074 is used to develop a hypothetical MTR operations scenario. It should be emphasized that the selection and use of this MTR is for explanation purposes only and does not imply any unique characteristics or other importance in regard to the noise impact, or that the noise impact resulting from the sample analysis is representative of actual conditions.

MTR operations files (***.MTR**) are created in the input module and processed in the calculation module. For each airspace segment, the following output files can be generated: (1) a noise distribution report (***.NDR**) showing the cumulative noise impact of all aircraft operations; (2) a specific points report (***.SPR**) which orders the aircraft operations according to noise level, at user specified locations; and (3) a binary plot file (***.PLT**) used to display a graph of the noise distribution. These files are discussed further in Section 3.0.

2.0 MILITARY TRAINING ROUTE CHARACTERISTICS

2.1 MTR Airspace Description

A Military Training Route (MTR) is a defined volume of airspace designed for use by military aircraft which can be generally described as having an altitude structure below 10,000 feet mean sea level (MSL) and varying width along the different airspace segments (linear sections of the MTR defined by the coordinates of the route centerline and the route width). MTRs are divided into three sub-types: visual routes (VRs), instrument routes (IRs), and slow-speed low-altitude routes (SRs). Operations on ***visual routes*** are conducted only when the weather is at or above Visual Flight Rule minimums of five miles or more visibility and a weather ceiling of 3,000 feet or more. Operations on ***instrument routes*** can be conducted in instrument meteorological conditions. Military aircraft on VRs and IRs have operating speeds in excess of 250 knots indicated airspeed (KIAS). These operations do not meet the terms of FAR 91.117 (Aircraft Speed); however, the FAA has issued a waiver to DOD permitting aircraft operations below 10,000 feet MSL in excess of 250 knots along mutually developed DOD/FAA routes. ***Slow-speed low-altitude routes*** are used for military aircraft operations at or below 1,500 feet at airspeeds of 250 knots or less.

The Department Of Defense publishes a guide entitled "Area Planning – Military Training Routes – North and South America (AP/1B)" which contains the definitions and operating instructions for all MTRs in this region. This document defines each MTR by airspace segment and lists the latitude and longitude of the start and end points, the altitude profile (floor and ceiling), and the route width. Special operating procedures describe avoidance areas (noise-sensitive areas, airports, etc.) and additional terrain-following instructions. The airspace parameters used by ROUTEMAP 2.0 include the MTR segment width and the aircraft altitude. ***The altitude used to model any flight training mission must be consistent with the defined vertical boundaries of the airspace, as specified in AP/1B.***

Figure 2-1 shows an excerpt from AP/1B for MTR VR-1074. Figure 2-2 depicts VR-1074 geographically and lists the pertinent parameters associated with airspace segments A through I. ROUTEMAP 2.0 calculates the noise distribution for

VR ROUTES

VR-1072

ORIGINATING/SCHEDULING ACTIVITY: 14th FTW, Columbus AFB, MS 39701. C601-434-7560 AUTOVON 742-7560/7572.

HOURS OF OPERATION: Normally 0800-2100/cl-use other time not prohibited.

ROUTE DESCRIPTION:

Altitude Data	Pt	Fac/Rad/Dist	Lat/Long
As assigned to	A	JAN 171/27	32°03.0'N 90°08.0'W
15 AGL to	B	JAN 194/31	32°01.0'N 90°22.0'W
05 AGL B 15 AGL to	C	JAN 214/63	31°41.0'N 90°56.0'W
05 AGL B 15 AGL to	D	JAN 214/96	31°15.0'N 91°20.0'W
05 AGL B 15 AGL to	E	JAN 204/99	31°03.0'N 91°06.0'W
05 AGL B 15 AGL to	F	JAN 165/55	31°36.0'N 89°59.0'W
05 AGL B 15 AGL to	G	JAN 125/44	32°02.0'N 89°31.0'W
05 AGL B 15 AGL to	H	MEI 165/25	31°58.0'N 88°43.0'W

TERRAIN FOLLOWING OPERATIONS: Authorized entire route.

ROUTE WIDTH – 5 NM either side of centerline.

Special Operating Procedures:
(1) Not flight checked below 500' AGL.

FSS's Within 100 NM Radius:
BHM, CEW, DRI, GWO, MCB

VR-1074

ORIGINATING ACTIVITY: 4 OSS/OSOSF, Seymour Johnson AFB, NC 27531-5004 AUTOVON 488-6351.

SCHEDULING ACTIVITY: 4 OSS/OSOSF, Seymour Johnson AFB, NC 27531-5004 AUTOVON 488-6565: after duty hrs and weekends schedule with 4 WG/CP-AUTOVON 488-6601/6602.

HOURS OF OPERATION: Continuous.

ROUTE DESCRIPTION:

Altitude Data	Pt	Fac/Rad/Dist	Lat/Long
01 AGL B 15 AGL at	A	ILM 194/30	33°51.0'N 77°57.0'W
01 AGL B 15 AGL to	B	ILM 118/8	34°18.0'N 77°43.0'W
01 AGL B 15 AGL to	C	ILM 011/29	34°50.0'N 77°50.0'W
01 AGL B 15 AGL to	D	GSB 144/21	35°06.0'N 77°38.0'W
01 AGL B 15 AGL to	E	NKT 315/31	35°12.0'N 77°23.0'W
01 AGL B 15 AGL to	F	NKT 005/26	35°20.0'N 76°54.5'W
10 AGL B 15 AGL to	G	NKT 015/37	35°31.0'N 76°48.0'W
10 AGL B 15 AGL to	H	NKT 039/52	35°39.5'N 76°21.0'W
01 AGL B 15 AGL to	I	NKT 043/59	35°43.0'N 76°11.5'W
Alternate Exit from F			
01 AGL B 15 AGL to	F1	NKT 035/32	35°23.0'N 76°35.0'W

TERRAIN FOLLOWING OPERATIONS: Authorized entire route.

ROUTE WIDTH – 2 NM left and 5 NM right of centerline A to B; 5 NM either side of centerline B to I.

Special Operating Procedures:
(1) Aircraft requesting R-5306A shall contact Trojan 362.8 MHz giving call-sign, mission number, area and altitude requested. (Note: Altitude approval into R-5306A does not constitute clearance on the targets). Scheduled aircraft contact Cherry Targets (BT-9 337.0 MHz) (BT-11 324.9 MHz).
(2) Do not enter R-5314 unless scheduled for Dare County Range and cleared by the Range Officer.
(3) Avoid towns and populated areas by 1 NM or overfly 1000' AGL; avoid airports by 3 NM or overfly 1500' AGL. Over sparsely populated areas, aircraft may not be operated closer than 500' to any person, vessel, vehicle or structure.
(4) Avoid Mattamuskeet, Pungo and Swanquarter National Wildlife Refuges by 5 NM.
(5) Contact 4 OSS/OSOSF, AUTOVON 488-6565/6561, for scheduling and route briefing of additional noise sensitive areas.
(6) Tie-in FSS: New Bern (EWN) 255.4.
(7) Alternate Entry Points: B, D and E.
(8) Alternate Exit Points: D, F, F1 and H.
(9) CAUTION:
(A) A-B, Light aircraft along coast. Entire beach is considered noise sensitive. Maintain 1000' minimum when flying within 1 NM of coastal area.
(B) B-C maintain 1000' minimum until 4 NM past highway U.S. 17. Congressional noise sensitive area at 34°22.0'N 77°42.9'W avoid by 1000' or 2 NM.
(C) C-D, VR-1046 crosses from right at D. Avoid Maxwell Wildlife Refuge by 1.5 NM, located at 35°02'N 77°41'W. Avoid Pink Hill Airport by 1500' or 3 NM located at 35°03'N 77°44'W.
(D) D-E, avoid sawmill at E. Avoid town of Cove City.
(E) E-F, avoid overflight of Streets Ferry Plant located at 35°12.0'N 77°07.5'W by 1500' or 1.5 NM. Possible helicopter traffic entire leg. 200' tower at 35°20.0'N 77°05.0'W. CAUTION: Anderson's Airport (Private) 35°19.0'N 77°10.5'W. Congressionally noise sensitive area at 35°14.5'N 77°12.5'W, avoid by 1000' and 1 NM.
(F) F-G, Overfly coastal areas 1000' minimum. Avoid overflight of the town of Bath, located 4 NM south of G, by 1.5 NM. 200' tower at 35°25.7'N 76°44.8'W.
(G) G-H, minimum altitude during this leg is 1000' AGL. Exercise caution for VFR intensive student training area around Donald's Airpark. Stay south of the town of Pantego and you will be clear. Two 300' Gray unlighted towers at 35°35.5'N 76°29.0'W 200' tower at 35°30.8'N 76°48.0'W.
(H) H-I avoid town of Gumneck by 1500' or 1.5 NM. 300' Gray, unlighted tower at 35°43'N 76°09'W.
(I) F-F1, overfly coastal areas at 1000' AGL minimum. Mining operations 2 NM north of Aurora with 250' mining booms located at 35°20.0'N 76°47.0'W.
(J) Bird activity all legs.
(K) Extensive helicopter activity at and below 500' between Aurora and Phelps Lake; Seasonal spraying and crop dusting could be in progress. Horizontally: (37°07.5'N 77°35.5'W) (35°42.7'N 76°13.8'W)
(L) Mission permitting, on segment B-C remain on centerline or to left of centerline to avoid environmentally sensitive areas (Multiple Woodpecker Concentrations); if flight is necessary right of centerline, aircrews should remain at/above 500' AGL mission permitting.
(M) Mission permitting, avoid the following environmentally sensitive areas (Woodpecker Nests) by 500' vertically or 1000' horizontally: (37°07.5'N 77°35.5'W), (35°42.7'N 76°13.8'W).
(10) Users must make the 10 minute entry block times or reschedule.

FSS's Within 100 NM Radius:
CHS, EWN, FLO, PHF, RDU, RWI

Figure 2-1. AP/1B Excerpt for MTR VR-1074.

each airspace segment about a reference line called the centerline. In Figure 2-2, the dotted line connecting points A through I represents the centerline defined in AP/1B. The solid lines on either side of the centerline represent the lateral boundaries specified by the airspace segment width. Aircraft flight track dispersion and offset are specified with respect to the centerline which is not always located at the geometric center of the airspace. An example of this asymmetry is shown for airspace segment A–B.

2.2 Noise Metrics

The noise environment under MTRs is unique in several respects. Aircraft overflight events are highly sporadic, ranging from 20 to 30 per day to 10 or less per week. This differs from civilian airport noise exposure scenarios where events from commercial aircraft traffic tend to be continuous or somewhat regular. Individual noise events from military aircraft training in military airspace are also different from typical commercial aircraft noise sources because the frequent combination of low altitude and high speed can result in very rapid onset of noise.

The primary noise metric used in this model is the ***onset rate-adjusted monthly day-night average A-weighted sound level, L_{dnmr}***. This cumulative noise metric is based on an integration period equal to one calendar month and uses the month with the highest number of operations. L_{dnmr} was developed from studies which found that an overflight's annoyance rating is dependent on the event's onset rate, as well as its sound exposure level.[4] The current version, incorporated in ROUTEMAP 2.0, has been validated and refined based on a series of laboratory and field studies.[10,11,12]

ROUTEMAP 2.0 will additionally generate the ***equivalent continuous sound level, L_{eq}*** and ***day-night average sound level, L_{dn}***. The L_{eq} is the level of a constant sound which, in a stated period and at a stated location, has the same A-weighted sound energy as a time-varying sound. L_{dn} is the equivalent continuous sound level, in decibels, for a 24-hour period from midnight to midnight, obtained after the addition of 10 dB to sound levels from 10:00 p.m. to 7:00 a.m.

MTR	Segment	Floor_ft_AGL	Ceiling_ft_AGL	Width_RE_cl
VR-1074	A-B	100	1500	2NM left and 5NM right
VR-1074	B-C	100	1500	5NM either side
VR-1074	C-D	100	1500	5NM either side
VR-1074	D-E	100	1500	5NM either side
VR-1074	E-F	100	1500	5NM either side
VR-1074	F-G	1000	1500	5NM either side
VR-1074	G-H	1000	1500	5NM either side
VR-1074	H-I	100	1500	5NM either side

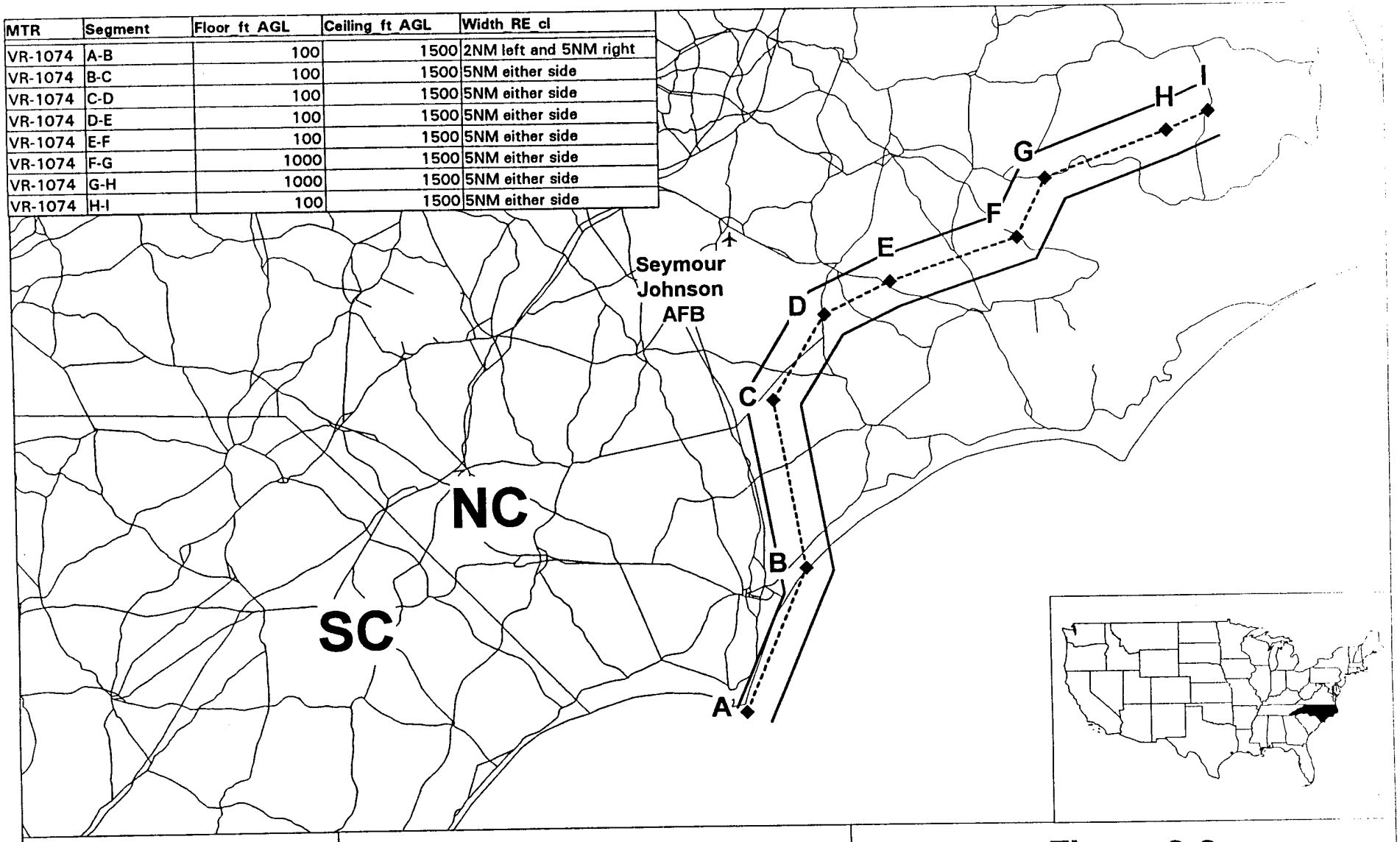

Figure 2-2.

MTR VR-1074
Airspace Segments A-I

3.0 USING ROUTEMAP VERSION 2.0

This chapter provides instructions for using ROUTEMAP Version 2.0, hereafter referred to as ROUTEMAP. Section 3.1 details the operating instructions for each program module. Section 3.2 describes a sample MTR scenario.

3.1 Operating Instructions

To start the program, type 'ROUTEMAP' at the DOS prompt and press the <ENTER> key. After reading the opening banner and pressing the <ENTER> key to continue, the MAIN MENU appears with the following options:

- Aircraft Operations Menu
- Noise Calculation Menu
- Report Menu
- Graphics Menu
- Decibel Addition
- End Program

Throughout the program, menu selections are made using the keyboard or mouse (optional). Arrow keys are used to highlight an option which is then selected by pressing the <ENTER> key. Selections can also be made by double-clicking the left mouse button, first to highlight the menu option and a second time to select it. A number of menus permit multiple selections where the <SPACE> key is used to tag more than one option. While most of the user inputs are menu driven, some require typed values. Unless noted otherwise, the <ESCAPE> key is used to back out of the current menu and return to the previous one. ***A help window at the bottom of the screen will note the user inputs required to navigate through each menu.***

Selection of any main menu option will transfer control to the associated program module which is identified in the upper-right corner of the screen.

The following sections describe the operating procedures for each ROUTEMAP program module.

3.1.1 Input Module

Select **AIRCRAFT OPERATIONS MENU** to enter the input module.

To model MTR noise environments, the airspace boundaries and aircraft flight conditions must be specified. The input module is used to build a single file for each MTR, containing the aircraft flight operations for each defined airspace segment. This is done through the AIRCRAFT OPERATIONS MENU, which has the following options:

- Define MTR Operations
- View/Modify MTR File
- Return To Main Menu

Select Define Aircraft Operations to use the menu system to build each MTR operations file. The '***MTR Description***' screen is used to specify the flight rules, MTR number, and the airspace segment name and width. All of these values can be obtained for each MTR in the AP/1B document. The MTR number and the airspace segment name can be up to five and three characters, respectively, and will automatically be entered in uppercase format. The width of the specified segment must be defined within the range of 2 to 30 nautical miles. Figure 3-1 displays a sample description for MTR VR-1074 segment A-B. To terminate entry of these descriptors and return to the AIRCRAFT OPERATIONS MENU press the <ESCAPE> key.

MTR Description	
Flight Rules:	VR
MTR Number :	1074
Segment Name:	A-B
Width in nm :	7.0

Figure 3-1. MTR Description.

Note: *The flight rules, MTR number, and segment name are used to form the names of the files containing the associated data. The name of each MTR file includes the flight rules and the MTR number (i.e., VR-1074.MTR). An airspace segment defined for this MTR can be named 'A-B' as specified in AP/1B. Since ROUTE-MAP calculates noise distributions and specific points analyses for individual airspace segments, the resulting data will be stored in files named according to the MTR and segment names (i.e., 1074A-B.NDR and 1074A-B.SPR).*

The next screen specifies three '***Case Parameters***' associated with the MTR operating conditions. These are the temperature, relative humidity, and the number of days in the busiest month, which is used in the L_{dnmr} noise metric calculation. Accept the default values or make modifications as necessary.

The following screen, entitled '***Available Aircraft From ROUTEFILE***' and shown in Figure 3-2, displays the aircraft listed in the current database. This screen lists up to 50 aircraft at a time; however, if there are more than 50 aircraft, the remainder can be displayed by pressing the <ESCAPE> key. In this case, the <ESCAPE> key can be used to toggle between two screens, each containing the names of up to 50 aircraft. Select one aircraft type to model.

Note: *If the current version of the database has data for more than 50 aircraft, a message will be posted in the HELP window at the bottom of the screen and the <ESCAPE> key can be used to view additional aircraft.*

Available Aircraft From ROUTEFILE				
1 A-4C	11 B-52B&D&E	21 C-130A&D	31 F-5E	41 F-111F
2 A-5C	12 B-52G	22 C-130E	32 F-14A	42 F-117A
3 A-6A	13 B-52H	23 C-130H&N&P	33 F-15A	43 OV-10A
4 A-7E	14 FB-111A	24 C-131B	34 F-16A	44 P-3A
5 AV-8A	15 C-5A	25 C-135A	35 F-16(G100)	45 S-3A
6 AV-8B	16 C-7A	26 C-135B	36 F-18	46 T-2C
7 A-10A	17 C-9A	27 KC-135R	37 F-105D	47 T-33A
8 A-37	18 C-17	28 C-141A	38 F-106	48 T-37B
9 B-1B	19 C-18A	29 F-4C	39 F-111A&E	49 T-38A
10 B-2A	20 C-21A	30 F-5A&B	40 F-111D	50 T-39A

(a) Screen 1: Aircraft 1-50.

Available Aircraft From ROUTEFILE			
51 T-43A	61 CH-47D	71 SA330J	81 TH55
52 A109	62 CH-53E	72 SA341G	82 UH-13
53 AH-1G	63 CH-54B	73 SA350D	83 UH-1N
54 AH64	64 CH47B	74 SA3555F	
55 BL212	65 CH47D	75 SA365N	
56 BL222	66 HH-53	76 SK61	
57 BOKW150	67 HU500D	77 SK65	
58 CH-3C	68 OH-6A	78 SK70	
59 CH-46E	69 OH58	79 SK76	
60 CH-47C	70 OH58D	80 TH-55A	

(b) Screen 2: Aircraft 51-83.

Figure 3-2. Available Aircraft From ROUTEFILE.

The operating conditions available for each aircraft are specified in the screen entitled '***Available Power Conditions From ROUTEFILE***', shown in Figure 3-3. Several flight configurations are available for each aircraft, corresponding to a specific data set. One of the available configurations must be selected; however, the aircraft engine power and speed may be adjusted within certain limitations in an upcoming menu.

The '***Flight Track Dispersion***' can be specified for each aircraft operation. The dispersion is specified by entering the standard deviation of the flight tracks about the MTR airspace segment centerline.

- ***Centerline Flight Tracks*** should be chosen to specify a tight distribution of flight tracks with a standard deviation of 0.43 nautical mile. This is appropriate for long-range bombers using electronic navigation.[2]
- Select ***Dispersed Flight Tracks*** to specify the standard deviation based on the width of the airspace segment. This option provides a flight track dispersion that increases linearly with route width (see Appendix B for a description of this calculation), and is applicable to tactical aircraft using visual navigation.[9]
- Select ***Specify Track Dispersion*** to enter a user-defined flight track standard deviation between 0.34 and 5.1 nautical miles. This is appropriate when specific dispersion data are available for the airspace segment being analyzed.

The remaining flight parameters for the chosen aircraft are specified in the '***Aircraft Operation Parameters***' screen, shown in Figure 3-4. At the top of this screen the aircraft type and operation index are listed. The operation index keeps track of the various individual operations defined for the current airspace segment. The power and airspeed values previously selected are entered as the default values. These can be modified according to the guidelines specified in the window above. In general, airspeed is limited to 449 knots with the exception of some high-speed configurations. The engine power settings are expressed in various units of measure. Additional operation parameters include the altitude in feet, centerline track offset (if applicable) in nautical miles, and the number of sorties occurring in the busiest month during the daytime and nighttime hours. A centerline track offset

Available Power Conditions From ROUTEFILE For Aircraft: F-15A

SEQUENCE CODE	POWER DESCRIPTION	POWER		DRAG CONFIGURATION	AIR SPEED
1	AFTERBURNER POWER	91	% NC	NO DRAG	350
2	TAKEOFF POWER	90	% NC	NO DRAG	300
3	CRUISE POWER	73.5	% NC	NO DRAG	280
4	APPROACH POWER	75	% NC	LANDING CONFIGURATION	170
5	MID SPD TRAINING RT	81	% NC		520
6	HIGH SPD TRAINING RT	88	% NC		570
7	TRAINING ROUTE	82	% NC		550
8	LOW SPD TRAINING RT	77	% NC		450

Figure 3-3. Available Power Conditions From ROUTEFILE.

Aircraft Operation Parameters

Aircraft Type: F-15A Operation: 1

No Power or Airspeed Modifications Permitted

Power (82 % NC) : 82.0
Airspeed (550 knots) : 550.
Altitude Above Ground Level (feet) : 500.
Centerline Track Offset (nm.) : .000
Number Of Daytime Monthly Sorties : 50.0
Number of Nighttime Monthly Sorties : 5.00

Figure 3-4. Aircraft Operation Parameters.

can be entered if dispersed flight tracks have been specified. As data is entered in this screen, the cursor will move through all entry positions and then relocate to the initial position to allow modifications. To accept the entered values press the <ESCAPE> key.

After entering all the pertinent operations data for the chosen aircraft on the current MTR airspace segment, the user may: (1) define additional aircraft operations for the current airspace segment; (2) define a new airspace segment for the current MTR; (3) save the current MTR operations data to file; or (4) return to the AIRCRAFT OPERATIONS MENU without saving the current operations data. Data will be saved in the MTR operations file if option 2 or 3 is selected.

Note: *Up to 20 aircraft operations can be defined for each airspace segment and up to 20 airspace segments can be defined for any MTR.*

To view or edit a prebuilt MTR operations file, select View/Modify MTR File. A list box appears with the names of these files in the current directory. Once a file is selected, the contents are loaded into the MS-DOS editor. To use this editor, please consult your MS-DOS user's manual for instructions and be sure the EDIT.COM program is located in the C:\DOS directory. Any editor invoked by "edit filename" will also work. MTR files can also be edited outside of the ROUTEMAP program using any ASCII file editor. ***If a MTR file is modified, new data entries must comply with the file format described in Section 3.2 or the program will report an error while reading the file.***

After defining the aircraft flight operations parameters for a MTR, the user is returned to the AIRCRAFT OPERATIONS MENU. Additional MTR scenarios can be constructed or the user can select Return To Main Menu to exit the input module.

3.1.2 Calculation Module

To enter the calculation module and compute noise levels for any previously defined MTR operations, select **NOISE CALCULATION MENU**. The aircraft operations data and resultant noise levels can be tabulated in a screen display or printable report for each airspace segment. A plot file can also be generated to graphically display the noise distribution. With the specific points analysis feature, the user can examine the noise impact at specified locations, lateral to the MTR centerline. The options available in the NOISE CALCULATION MENU are as follows:

- Select MTR File
- Specific Points Analysis
- Data Output Format
- Calculate Noise Levels
- Return To Main Menu

Choose Select MTR File to specify the MTR and airspace segments to analyze. Provided that MTR operations files are located in the current directory, a *single* file should be chosen from the list box entitled 'MTR Files'. A second list box entitled 'Segments' will appear showing all the airspace segments that were previously defined for the chosen MTR. Select one or more airspace segments, using the <SPACE> key to tag multiple segments.

A Specific Points Analysis can be performed on each of the selected airspace segments. This computation orders the aircraft by noise contribution at locations measured from the airspace segment centerline in a direction normal to aircraft flight operations. Upon selecting Specific Points Analysis, a data entry screen will appear prompting the user to enter up to three analysis points for each airspace segment as shown in Figure 3-5. Numerical values for the location with respect to the segment centerline can be input at any of the entry positions. ***Only values between ±15.00 nautical miles are permitted.*** Navigation through the data entry screen is accomplished by pressing the <ENTER> key after typing in a value. Entry positions may be skipped by pressing the <ENTER> key without previously typing a point value. The cursor will move through all data entry positions and then relocate to the initial position to allow modifications. To accept the entered values press the <ESCAPE> key. The user may reenter the specific points analysis screen to enter or modify values at any time before the noise calculations are performed. ***While the Specific Points Analysis is optional, it must be implemented after selecting a MTR operations file and one or more airspace segments.***

MTR Specific Points Analysis for: VR-1074

Segment	Pt.1	Pt.2	Pt.3	Segment	Pt.1	Pt.2	Pt.3
A-B	.00	.50	1.00				
B-C	.00	.50	1.00				

Figure 3-5. Specific Points Analysis.

Select Data Output Format to show the results of the noise computations in any of the following formats: (1) screen display; (2) noise distribution report; (3) specific points report; and (4) plot file. These choices are provided in a list box and can be selected in any combination to provide the desired output(s) for the MTR airspace segments selected for analysis. If ***screen display*** is selected, the aircraft flight parameters and resulting noise distribution will be listed in separate windows on the screen. If a specific point analysis is performed, this data will also be displayed in an additional window. A ***noise distribution report*** is a file containing the aircraft flight parameters and resulting noise distribution for an airspace segment. A ***specific points report*** is a file containing the results of a specific points analysis. Both of these files have a report format and can be printed. Select ***plot file*** to create a file which can be used to plot the noise distribution graphically. ***The Data Output Format(s) must be specified prior to calculating the noise levels for any MTR airspace segment.***

Note: *Selection of the data output formats determines the program mode of operation. The screen display is interactive, requiring the user to type several keystrokes, while the other types of program output will occur automatically. If multiple airspace segments have been selected for analysis, the user may run the calculations in a* ***batch*** *mode by selecting data output formats other than the screen display.*

After selecting the MTR airspace segment(s), specific points analysis (optional), and data output format(s), the user may now select Calculate Noise Levels to compute the noise levels for each airspace segment under analysis. This calculation process is summarized in Appendix A. If the screen display feature is active, the user must navigate through the series of display windows for each airspace segment before calculations begin on the remaining segments. If the screen display is not active, the program will automatically perform the calculation for each airspace segment and create the specified reports and plot files.

Figures 3-6 to 3-8 show the program output associated with each window in the screen display. The first window lists the operations data defined for the current airspace segment including: aircraft type; engine power; airspeed in knots; altitude in feet; offset from the MTR centerline in nautical miles; number of monthly daytime

Operations Data: MTR: VR-1074 Segment: A-B

Temp = 59 Humidity = 70 Days/Month = 30

Aircraft	Power	Airspeed	Alt.	Offset	#(Day)	#(Night)	σ(nm.)
F-15A	82.00	550	500	.00	50.0	5.0	1.19
F-16A	84.00	500	500	.00	50.0	5.0	1.19

Figure 3-6. Operations Data Screen Display.

MTR Noise Levels: MTR: VR-1074 Segment: A-B

Distances Are From MTR Centerline.

Dist(nm.)	Ldnmr(dB)	Ldn(dB)	Leq(dB)
-1.50	61.0	57.3	54.7
-1.00	62.9	59.2	56.6
-.50	64.1	60.3	57.7
.00	64.5	60.7	58.1
.50	64.1	60.3	57.7
1.00	62.9	59.2	56.6
1.50	61.0	57.3	54.7

Figure 3-7. MTR Noise Levels Screen Display.

Specific Points Analysis: MTR: VR-1074 Segment: A-B

Distances are from MTR Centerline.

Dist(nm.)	Ops. #	Aircraft	Ldnmr(dB)	% Highly Annoyed
.00	1	F-15A	64.3	11.32
	2	F-16A	48.4	1.34
.50	1	F-15A	64.0	10.80
	2	F-16A	48.1	1.27
1.00	1	F-15A	62.8	9.34

Figure 3-8. Specific Points Analysis Screen Display.

and nighttime operations; and the flight track standard deviation in nautical miles. Pressing the <ESCAPE> key brings up a second window which shows the resulting noise levels across the width of the airspace segment. L_{dnmr}, L_{dn}, and L_{eq} are provided at each half-nautical-mile increment over a range spanning from ±15 nautical miles from the airspace segment centerline. Pressing the <ESCAPE> key again brings up a third window if a specific points analysis was performed. This display provides a list of the major aircraft contributors, ordered by noise impact, at up to three user-specified locations. The following data is reported: distance of the point from the airspace segment centerline (in nautical miles); operation index; aircraft type; L_{dnmr}; and the percent highly annoyed. The operation index identifies the specific aircraft operation according to the sequential list of operations defined for that particular segment in the MTR operations file (i.e., operation index 2 corresponds to the second aircraft operation defined for that airspace segment). While the aircraft name is provided, this additional identification is necessary if the same type of aircraft is used in different operations occurring on the same airspace segment. ***Each of the three windows in the screen display will scroll the listed data, and can be exited by pressing the <ESCAPE> key.***

Noise distribution reports contain the same information displayed on the first two screen displays. Specific points reports contain the same data shown on the third screen display. Binary Plot files contain the values of L_{dnmr}, L_{dn}, and L_{eq} for points located every 1,500 feet across the airspace segment. These program outputs will be discussed in Section 3.2 in association with the sample MTR scenario.

Note: *To calculate the noise impacts for any airspace segment(s), the order of instructions listed in this section must be followed, or warning messages will be displayed in the HELP window at the bottom of the screen.*

3.1.3 Print Module

Reports of the noise distribution and specific points analysis for each MTR airspace segment can be printed after being generated in the calculation module. The contents of each report is described in Section 3.2. *To print these reports, the associated files (*.NDR and *.SPR) must be located in the current user directory.* Select **REPORT MENU** to enter the print module which has the following options:

- Print Noise Distribution Report(s)
- Print Specific Points Reports(s)

- Configure Printer Port
- Save Configuration To File
- Return To Main Menu

Select Configure Printer Port to set the communications port (LPT1 or LPT2) for printing. The default communications port is specified in the ROUTEMAP.CFG configuration file and will be used automatically unless changed. If the communication port is changed, the new value can then be saved in the configuration file by selecting Save Configuration To File.

To print a tabulated report of the cumulative noise levels across the airspace segment, select Print Noise Distribution Report(s). A single report can be printed by selecting the file of interest from the list box. Multiple reports can be printed by selecting files that have been tagged using the <SPACE> key.

Specific points reports can be printed by selecting Print Specific Points Report(s) and following the same operations outlined in the paragraph above.

Note: *If an error occurs while attempting to print reports, check the communications port setting and the printer status.*

After the select files have been printed, control returns to the PRINT MENU where the user can print additional files or return to the MAIN MENU.

3.1.4 Plot Module

Select **GRAPHICS MENU** to enter the plot module. L_{dnmr}, L_{dn}, L_{eq}, and the Percent Highly Annoyed can be plotted versus distance across an airspace segment. *To generate graphic displays, plot files (*.PLT) must be located in the current user directory.* When a plot is displayed on the screen, it can be edited using a zoom feature to obtain several views of the noise level distribution. Any of these views can be directed to a printing device to obtain a hardcopy. The PLOT MENU has the following options:

- Plot Noise Metrics
- Device Configuration
- Return To Main Menu

To generate a hardcopy of the graphic plots, the Device Configuration must be set to the printing device specifications. Select ***printer driver*** to view the list of

printing and plotting devices supported by ROUTEMAP (the HPLJIIIp 300 dpi resolution driver is recommended for high-quality plots). Select ***device/port*** to specify the data communications port (COM1, COM2, LPT1, or LPT2 – which may be different from the printer port defined in Section 3.1.3). The device configuration menu also includes a ***plot orientation*** parameter which can be used to orient the plot in a portrait or landscape mode. To change any of these parameters temporarily, make the selection(s) and press the <ESCAPE> key to return to the PLOT MENU. By selecting ***save configuration***, the current parameters will be permanently stored in the ROUTEMAP.CFG configuration file. ***The plotting parameters described above are included in the configuration file and will be used by the program automatically, unless changed in this menu.***

To view a plot of the noise level distribution for a single MTR segment, select Plot Noise Metrics. A list box appears containing the names of the plot files that are located in the current directory. The user can select a *single* file to plot. Once selected, the plot title and noise metrics are specified in the '***Plot Parameters***' menu screen. Enter a plot title by typing up to 40 characters and press the <ENTER> key. To bypass the plot title, press the <ENTER> key without typing any characters. The noise metric(s) can now be selected according to the following guidelines:

- To display the plot of a single noise metric on the screen, select the desired option (L_{dnmr}, L_{dn}, L_{eq}, or Percent Highly Annoyed).
- Multiple noise metrics can be plotted individually and displayed in succession by tagging each desired metric using the <SPACE> key and then pressing the <ENTER> key.
- Any combination of the first three noise metrics (L_{dnmr}, L_{dn}, or L_{eq}) can be plotted together on the same graph by using the <SPACE> key to tag the desired metrics along with the option to collapse the noise curves. The Percent Highly Annoyed option can also be tagged; however, this plot will be displayed individually after the multiple curve plot is displayed. After selecting any combination of noise metrics, the first plot is immediately displayed.

All noise metrics are plotted with the decibel level (referenced to 20 μPa) on the vertical axis and the distance from the airspace segment centerline on the horizontal axis. ***If the maximum level of the selected noise metric is less than 40 dB, the data will not be displayed in the plot window and a warning message will appear.*** When a plot is displayed on the screen, the user can implement the zoom feature to expand or contract the view for more detailed study, obtain a printout of the current view, or advance to the next plot – finally returning to the PLOT MENU. To utilize the zoom feature, the UP and DOWN ARROW keys (↑ and ↓) are used to expand or contract the analysis region, respectively. A printout of any view of the noise distribution can be generated by simultaneously pressing the CTRL-P key sequence. The length of time required to produce each plot will vary, up to two minutes, depending on the resolution of the printer driver in use. After a plot has been generated, the program will display any remaining plot(s) on the screen, one at a time, permitting the user to edit the view and obtain a printout, or return to the PLOT MENU. ***A help window located at the bottom of the plot screen notes the available options.***

Note: *If an error occurs while attempting to generate a graphics plot, check the printer-driver, communications port setting, and the printer status.*

To exit the plot module and return to the MAIN MENU, select Return To Main Menu.

3.1.5 Decibel Addition

Two noise levels can be summed together using the **DECIBEL ADDITION** feature of the program. *This calculation can be useful to determine the overall noise level at a point where two or more airspace segments overlap.* To calculate the summation, two noise levels must be entered. The summation of more than two noise levels can be performed by entering the sum of the first two noise levels followed by an additional noise level, and so on. The <ESCAPE> key returns the user to the MAIN MENU.

To exit ROUTEMAP, select **END PROGRAM**.

3.2 Sample MTR Scenario

To facilitate understanding of the ROUTEMAP program, a sample operations scenario is provided for MTR VR-1074. The MTR operations file, VR-1074.MTR, specifies hypothetical F-15A and F-16A aircraft operations on airspace segments A–B and B–C. This MTR operations file is included in the program installation and can be used to generate the associated reports and graphs for each airspace segment as shown below.

Figure 3-9 shows the structure of the MTR operations file VR-1074.MTR, which is organized by airspace segment. The widths of airspace segments A–B and B–C are obtained from the AP/1B document. An excerpt from AP/1B and a graphic representation of VR-1074 were provided in Section 2.1. Data listed for each airspace segment include: the name; width in nautical miles; total number of defined operations (rows of aircraft operations data); percent relative humidity; temperature in degrees Celsius; and the number of days in the busiest month. The aircraft flight parameters are then listed for each operation. The ID references a NOISE data set for a particular aircraft and flight configuration, which is defined by the power and airspeed. Appendix B lists each configuration along with the associated ID. Additional flight parameters include the altitude in feet, flight track offset from the route centerline in nautical miles, the number of monthly daytime and nighttime sorties, and the standard deviation of the flight tracks about the centerline in nautical miles.

The calculation module is used to compute the noise levels and generate a noise distribution report, specific points report, and plot file for each airspace segment. Figure 3-10 shows a sample noise distribution report for airspace segment A–B. The report is identified by the MTR name, airspace segment name, and the date it was created. Two sections of this report list the operations data and cumulative noise levels. The operations data includes: the aircraft type; engine power; airspeed in knots; altitude in feet; offset from the MTR centerline in nautical miles; number of monthly daytime and nighttime operations; and the flight track standard deviation in nautical miles. L_{dnmr}, L_{dn}, and L_{eq} are reported each half-nautical-mile over a range spanning from ±15 nautical miles from the airspace segment centerline.

```
:   MTR VR-1074

::  SEGMENT A-B
    RTwidth  7.00
    NumOps. =02     Rel.Hum. =070     Temp. =059     NumDays(Mo.) =030
    ID          Power    Airspeed  Altitude   Offset    #(Day)    #(Night)   σ(nm.)
    121         82.00      550.0     500.0      .00       50.0       5.0       1.19
    128         84.00      500.0     500.0      .00       50.0       5.0       1.19

::  SEGMENT B-C
    RTwidth  10.00
    NumOps. =02     Rel.Hum. =070     Temp. =059     NumDays(Mo.) =030
    ID          Power    Airspeed  Altitude   Offset    #(Day)    #(Night)   σ(nm.)
    121         82.00      550.0     500.0      .00       50.0       5.0       1.70
    128         84.00      500.0     500.0      .00       50.0       5.0       1.70
```

Figure 3-9. MTR Operations File.

Date: 08/03/95

MTR: VR-1074
SEG: A-B

Routemap Version 2.0
Noise Distribution Report

Operations Data: Temp=59 Humidity=70 Days/Month=30

Aircraft	Power	Speed	Alt	Offset	Day/Night	σ(nm.)
F-15A	82.00	550	500	.00	50.0/ 5.0	1.19
F-16A	84.00	500	500	.00	50.0/ 5.0	1.19

Noise Levels: (In dB At Locations Normal to MTR Centerline)

Dist(nm.)	Ldnmr	Ldn	Leq	Dist(nm.)	Ldnmr	Ldn	Leq
-15.00	.0	.0	.0	.00	64.5	60.7	58.1
-14.50	.0	.0	.0	.50	64.1	60.3	57.7
-14.00	.0	.0	.0	1.00	62.9	59.2	56.6
-13.50	.0	.0	.0	1.50	61.0	57.3	54.7
-13.00	.0	.0	.0	2.00	58.4	54.7	52.1
-12.50	.0	.0	.0	2.50	55.0	51.4	48.8
-12.00	.0	.0	.0	3.00	50.8	47.3	44.7
-11.50	.0	.0	.0	3.50	45.9	42.4	39.8
-11.00	.0	.0	.0	4.00	40.3	36.9	34.3
-10.50	.0	.0	.0	4.50	33.9	30.7	28.1
-10.00	.0	.0	.0	5.00	26.9	23.9	21.3
-9.50	.0	.0	.0	5.50	19.4	16.9	14.3
-9.00	.0	.0	.0	6.00	10.8	9.6	7.0
-8.50	.0	.0	.0	6.50	.0	.0	.0
-8.00	.0	.0	.0	7.00	.0	.0	.0
-7.50	.0	.0	.0	7.50	.0	.0	.0
-7.00	.0	.0	.0	8.00	.0	.0	.0
-6.50	.0	.0	.0	8.50	.0	.0	.0
-6.00	10.8	9.6	7.0	9.00	.0	.0	.0
-5.50	19.4	16.9	14.3	9.50	.0	.0	.0
-5.00	26.9	23.9	21.3	10.00	.0	.0	.0
-4.50	33.9	30.7	28.1	10.50	.0	.0	.0
-4.00	40.3	36.9	34.3	11.00	.0	.0	.0
-3.50	45.9	42.4	39.8	11.50	.0	.0	.0
-3.00	50.8	47.3	44.7	12.00	.0	.0	.0
-2.50	55.0	51.4	48.8	12.50	.0	.0	.0
-2.00	58.4	54.7	52.1	13.00	.0	.0	.0
-1.50	61.0	57.3	54.7	13.50	.0	.0	.0
-1.00	62.9	59.2	56.6	14.00	.0	.0	.0
-0.50	64.1	60.3	57.7	14.50	.0	.0	.0
---	---	---	---	15.00	.0	.0	.0

Figure 3-10. Noise Distribution Report.

Figure 3-11 shows a sample specific points report for airspace segment A–B. The MTR name, segment name, and date are provided. This report lists the major aircraft contributors, ordered by noise impact, at up to three user-specified locations. The following data is included: distance of the point from the airspace segment centerline in nautical miles; operation index; aircraft type; L_{dnmr}; and the percent highly annoyed. The operation index identifies the specific aircraft operation according to the sequential list of operations defined for that particular segment in the MTR operations file (i.e., operation index 2 corresponds to the second aircraft operation defined for that airspace segment).

Figure 3-12 shows a graphic display of noise versus distance from the MTR VR-1074 centerline for airspace segment A–B. L_{dnmr}, L_{dn}, and L_{eq} are displayed to illustrate the effects of nighttime operations (L_{dn} greater than L_{eq}) and the onset rate penalty (L_{dnmr} greater than L_{dn}). The plot for airspace segment B–C is displayed in Figure 3-13 to illustrate the effects of flight track dispersion. The airspace segment widths specified for segments A–B and B–C are 7.0 and 10.0 nautical miles, respectively. The noise levels calculated for both airspace segments assume dispersed flight tracks in which the flight track standard deviation varies linearly with segment width. Comparing Figures 3-12 and 3-13, the effects of a wider flight track dispersion for segment B–C are evident. The percent highly annoyed versus distance from the MTR centerline can also be displayed graphically and is shown in Figure 3-14 for VR-1074 segment A–B.

Hard copies of the noise reports and plots can be generated from the print and plot modules, respectively.

Date: 08/03/95	ROUTEMAP Version 2.0 Specific Points Report
MTR: VR-1074 SEG: A-B	

Aircraft Ranked By Noise Contribution At Point(s)
Normal To MTR Centerline.

Dist(nm.)	Ops.#	Aircraft	Ldnmr(dB)	% Highly Annoyed
.00	1	F-15A	64.3	11.32
	2	F-16A	48.4	1.34
.50	1	F-15A	64.0	10.80
	2	F-16A	48.1	1.27
1.00	1	F-15A	62.8	9.34
	2	F-16A	46.9	1.08

Figure 3-11. Specific Points Report.

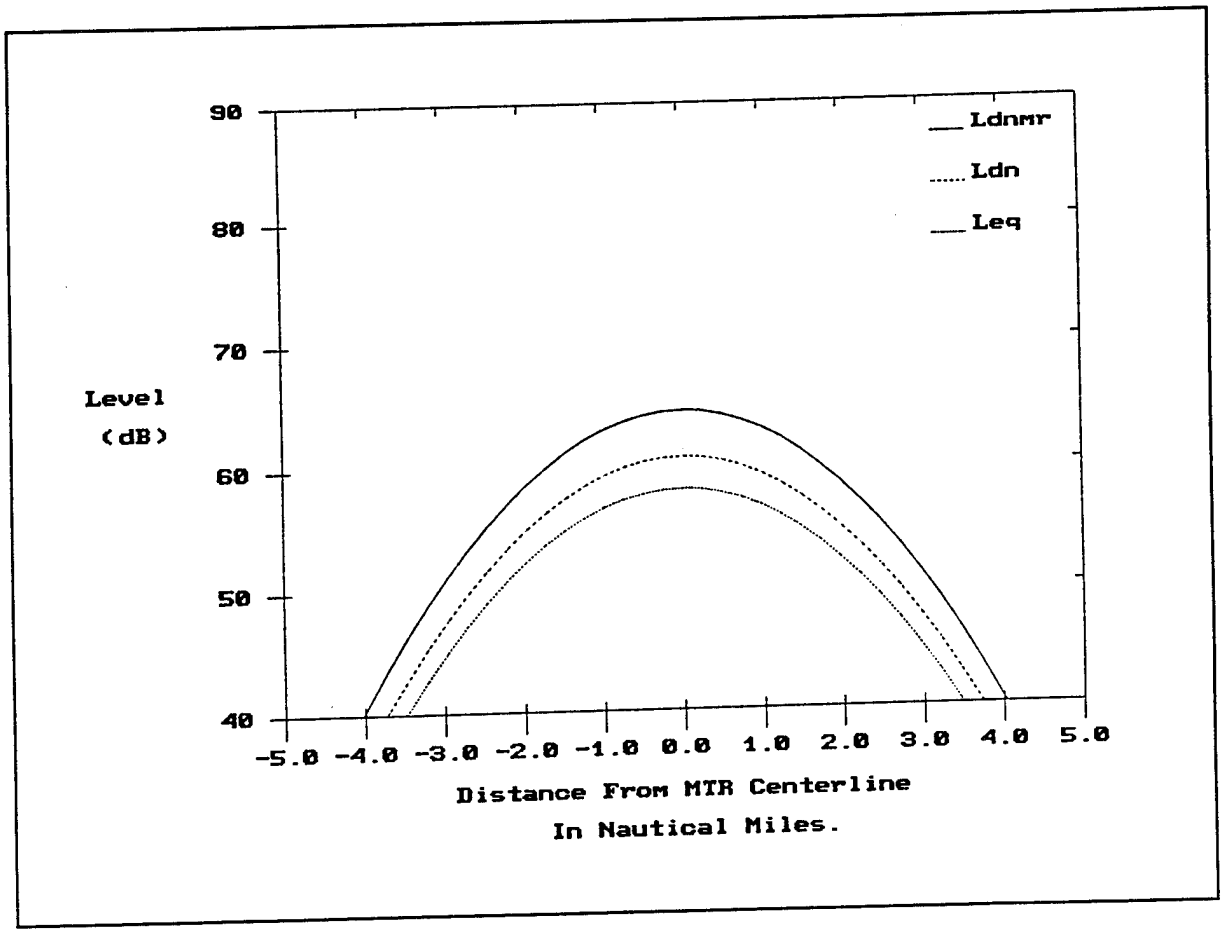

Figure 3-12. Noise Distribution Plot: VR-1074, Segment A–B.

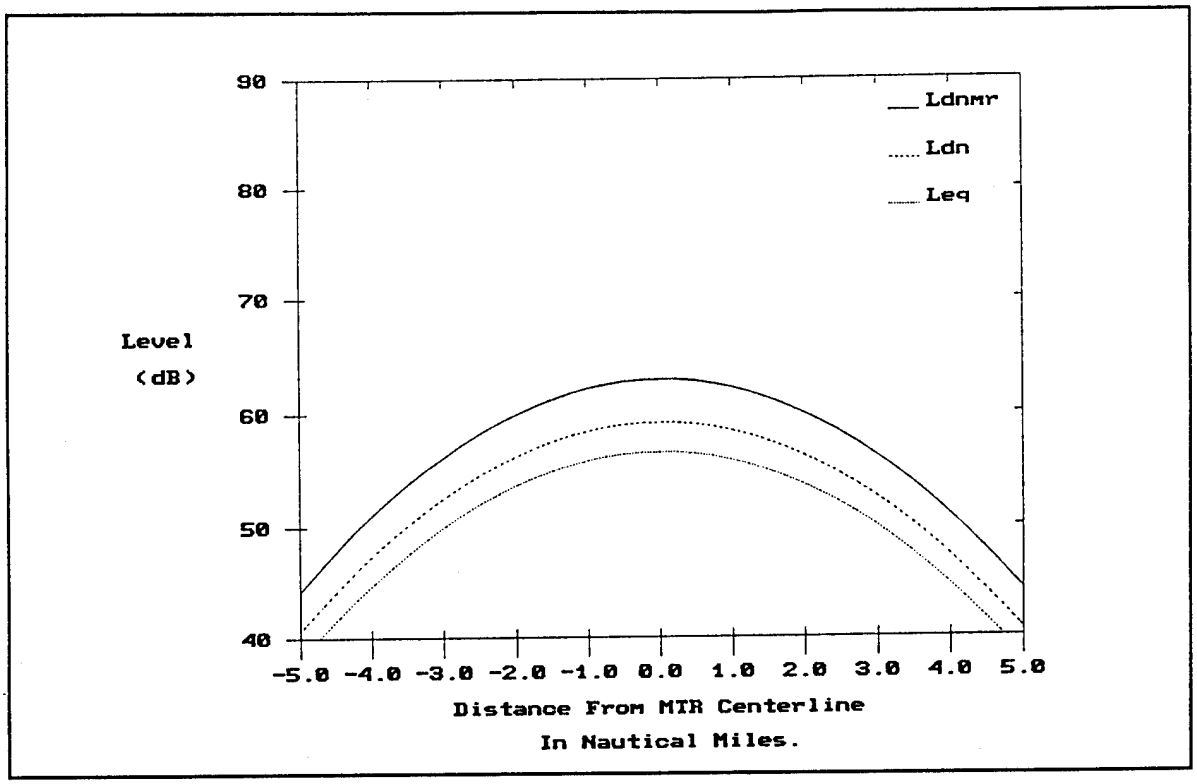

Figure 3-13. Noise Distribution Plot: VR-1074, Segment B–C.

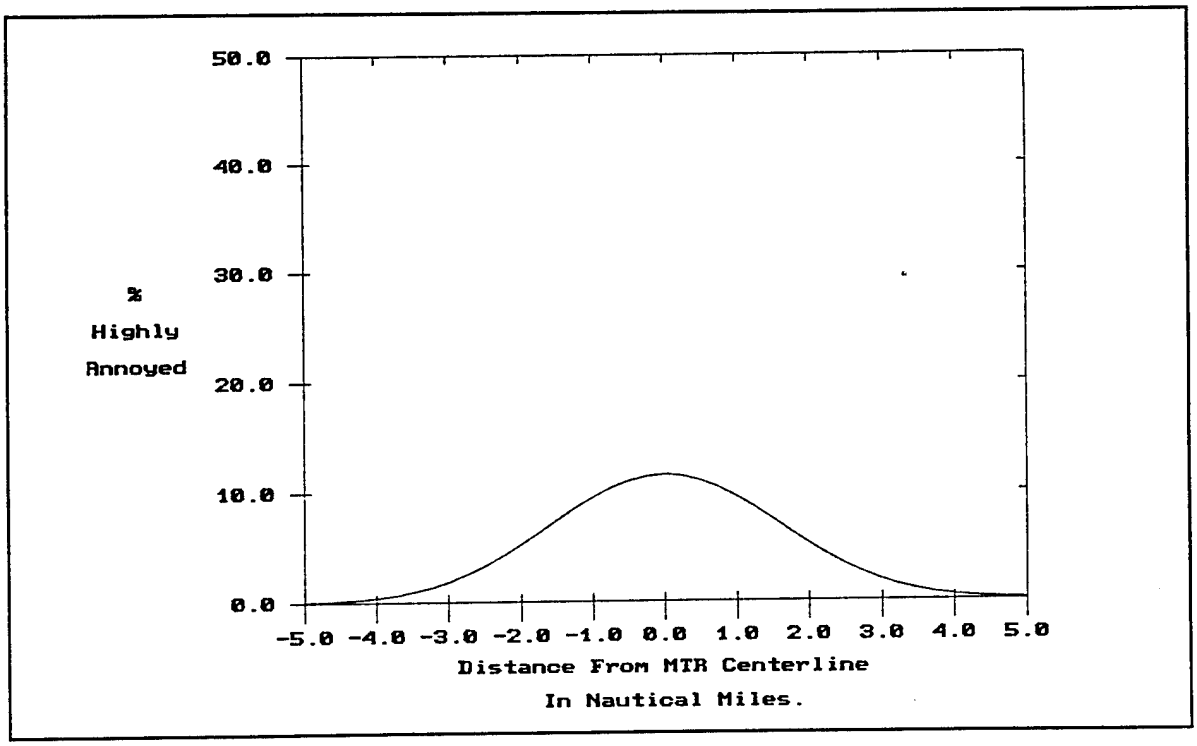

Figure 3-14. Percent Highly Annoyed Plot: VR-1074, Segment A–B.

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APPENDIX A

APPENDIX A

ROUTEMAP Version 2.0 Technology Update

The noise calculation procedure in ROUTEMAP 2.0 has been updated to incorporate the findings of recent Military Training Route (MTR) noise studies. Two seperate studies have improved the understanding of: (1) aircraft flight track dispersion characteristics,[9] and (2) human annoyance to MTR noise events.[10-12] Updated algorithms for these and other computations are described here, along with the noise calculation procedure.

A.1 Aircraft Flight Track Dispersion

ROUTEMAP 2.0 calculates the aircraft flight track dispersion for various types of training missions. In all cases, the dispersion is calculated assuming a Gaussian distribution of flight tracks with a standard deviation specified by the user. Three options are available:

- Centerline Flight Tracks – This option should be selected for training missions conducted under Instrument Flying Rules, using electronic navigation. These missions are conducted with a high degree of precision and involve no maneuvers other than navigation corrections. Operations of this kind have a lateral dispersion described by a Gaussian distribution with a standard deviation of 0.43 nautical mile.[2]

- Dispersed Flight Tracks – Use this option to model training missions that use visual point-to-point navigation. In this case, the aircraft flight track dispersion is proportional to the width of the airspace segment corridor. The following relation, which defines the standard deviation of the flight tracks, has been verified through field measurements on MTRs having an airspace segment width from 4 to 20 nautical miles:[9]

$$\sigma = \begin{cases} 0.17 \cdot w, & w \geq 6 \text{ nm} \\ 1.0, & w < 6 \text{ nm} \end{cases}$$

  where w is the airspace segment width in nautical miles.

- Specify Track Dispersion – This option allows the user to model the flight track dispersion by specifying a standard deviation within the range of 0.34 to 5.1 nautical miles. This should be used when specific dispersion data are available.

A.2 Lateral Attenuation Calculation Procedure

To calculate the noise contribution from each aircraft operation, source noise levels for the specified aircraft and flight condition are obtained from the database. Two attenuation mechanisms considered are air and ground absorption. Program OMEGA108R computes the sound exposure levels (SELs) tabulated as a function of profile distance. In this computation, the specified humidity and temperature data are used to determine the air absorption coefficient and, in turn, the SEL reduction.

The lateral attenuation is a factor when the elevation angle is less than or equal to 45 degrees. ROUTEMAP 2.0 uses the following updated relationship:[8]

$$\text{SEL Lateral Attenuation (dB)} = \begin{cases} 0.0 & \beta > 45 \text{ degrees} \\ 20.49/\beta - 0.1818 & 2 \le \beta \le 45 \text{ degrees} \\ 10.06 & \beta < 2 \text{ degrees} \end{cases}$$

where β is the elevation angle as shown in Figure A-1.

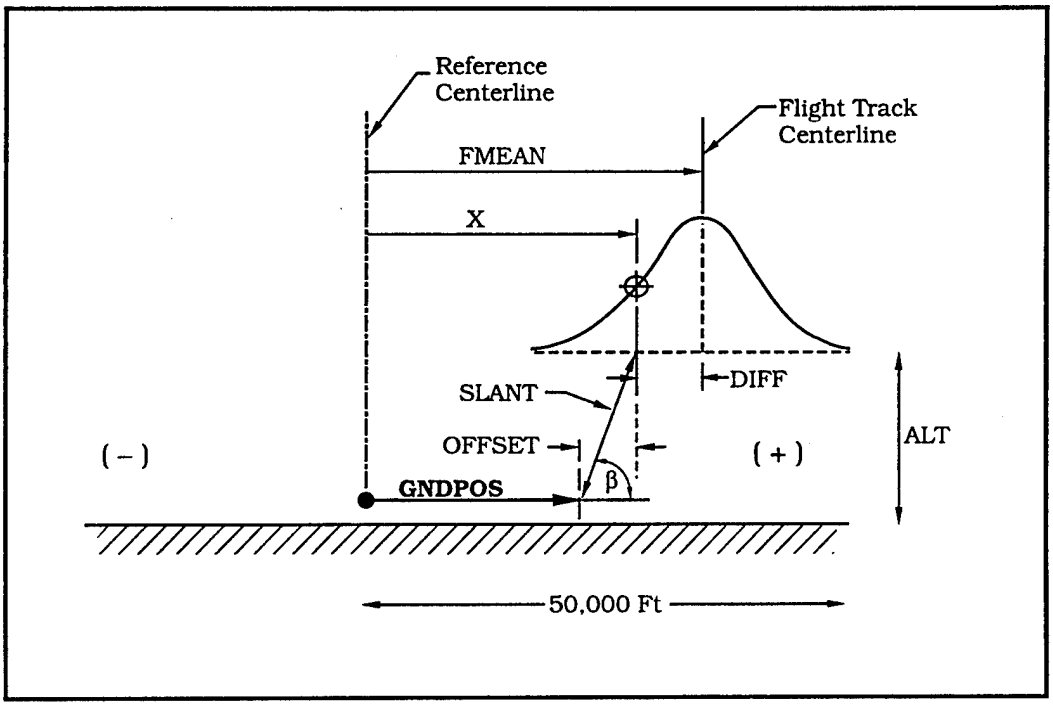

Figure A-1. Schematic Illustgrating MTR Symbol Notations.

A.3 Onset Rate Adjustments

A revised onset rate penalty[12] has been developed from recent psycoacoustic studies designed to examine human annoyance to MTR noise events. If the onset rate is greater than or equal to 15 dB/sec, the SEL values are penalized according to the relation:

$$\text{Onset Rate Penalty} = \begin{cases} 11.0 & \text{OR} > 150 \\ 11.0 \bullet \text{Log10(OR)} - 12.9 & 15 \le \text{OR} \le 150 \\ 0.0 & \text{OR} < 15 \end{cases}$$

where OR is the onset rate in decibels per second.

The onset rate for a given situation is predicted from the following updated relationship:[13]

$$\text{Onset Rate (dB/sec)} = 3.671596 + \exp(-1.16677 - 0.001848 \bullet \text{ALT} - 0.000580 \bullet \text{OFFSET} + 0.0045 \bullet \text{VEL} + 0.028842 \bullet \text{SEL})$$

where: VEL = aircraft airspeed in nautical miles per hour.

ALT = aircraft altitude in feet.

OFFSET = aircraft slant range to a ground point in feet.

SEL = sound exposure level at a ground point adjusted for air absorption and lateral attenuation.

The percent highly annoyed[14] can be computed for a single location or can be plotted versus distance across an airspace segment corridor. It is computed from L_{dnmr} as follows:

$$\text{PHA (\%)} = 100.0 / [1.0 + \exp(11.13 - 0.141 \bullet L_{dnmr})]$$

APPENDIX B

APPENDIX B

Aircraft Identification Codes

The NOISE database contains the reference noise data for fixed wing aircraft and helicopters operating at MTR flight conditions. Available aircraft and flight conditions can be selected within the ROUTEMAP 2.0 menu system as described in section 3.1.1. The user may also create a MTR operations file (*.MTR) using a text editor. In this case an identification code can be used to reference a particular NOISE data set. Program CODE.EXE has been created to read the NOISE file and write the descriptors for each data set to a text file named AIRCRAFT.DAT. If and when the NOISE file is updated, a new version of the AIRCRAFT.DAT file can be created by typing 'CODE' at the DOS prompt in the program directory. CODE.EXE and NOISE must be in the same directory for this to work. CODE.EXE will automatically overwrite the old version of AIRCRAFT.DAT.

The following is a listing of the AIRCRAFT.DAT file (current as of August 1995):

ID	AIRCRAFT TYPE	DESCRIPTION	POWER	SPEED (KTS)
001	A-4C	TAKEOFF POWER	100% NC	250
002	A-4C	CRUISE POWER	83% NC	300
003	A-4C	APPROACH POWER	93% NC	150
004	A-5C	AFTERBURNER POWER	100% RPM	250
005	A-5C	TAKEOFF POWER	100% RPM	249
006	A-5C	APPROACH POWER	83% RPM	160
007	A-6A	TAKEOFF POWER	100% RPM	250
008	A-6A	APPROACH POWER	95% RPM	160
009	A-7E	TAKEOFF POWER	96% NC	300
010	A-7E	CRUISE POWER	85% NC	301
011	A-7E	APPROACH POWER	82% NC	160
012	AV-8A	TAKEOFF POWER	103.5% RPM	300
013	AV-8A	CRUISE POWER	75% RPM	350
014	AV-8A	APPROACH POWER	70% RPM	150
015	AV-8B	TAKEOFF POWER	95% RPM	300
016	AV-8B	APPROACH POWER	84% RPM	150
017	AV-8B	TRAFFIC PATTERN	70% RPM	230
018	A-10A	APPROACH POWER	5225 NF	150
019	A-10A	MAX RATED THRUST	6700 NF	350
020	A-10A	NORMAL RATED THRUST	6200 NF	300
021	A-10A	TRAFFIC PATTERN	5325 NF	160
022	A-10A	TRAINING ROUTE	5333 NF	325
023	A-37	TAKEOFF POWER	100% RPM	300
024	A-37	CRUISE POWER	90% RPM	300
025	A-37	APPROACH POWER	91% RPM	170
026	B-1B	AFTERBURNER POWER	97.5% RPM	275
027	B-1B	CRUISE POWER	89.9% RPM	360
028	B-1B	APPROACH POWER	90% RPM	165
029	B-1B	INTERMED POWER (MIL)	98.5% RPM	270
030	B-1B	TRAINING ROUTE	101% RPM	550
031	B-2A	TAKEOFF POWER	88 PLA	230
032	B-2A	INTERMEDIATE POWER	70 PLA	220
033	B-2A	APPROACH POWER	41 PLA	210
034	B-2A	FLT IDLE-200 KNOTS	21 PLA	200

ID	AIRCRAFT TYPE	DESCRIPTION	POWER	SPEED (KTS)
035	B-52B&D&E	TAKEOFF POWER	94% RPM	170
036	B-52B&D&E	CRUISE POWER	83.5% RPM	250
037	B-52B&D&E	APPROACH POWER	86% RPM	140
038	B-52G	TAKEOFF POWER	94% RPM	170
039	B-52G	CRUISE POWER	83.5% RPM	250
040	B-52G	APPROACH POWER	86% RPM	140
041	B-52G	TRAINING ROUTE	88% RPM	340
042	B-52H	TAKEOFF POWER	8200 LBS/HR	170
043	B-52H	CRUISE POWER	2110 LBS/HR	250
044	B-52H	APPROACH POWER	3965 LBS/HR	150
045	B-52H	TRAINING ROUTE	4500 LBS/HR	350
046	FB-111A	AFTERBURNER POWER	100% NC	250
047	FB-111A	TAKEOFF POWER	100% NC	240
048	FB-111A	APPROACH POWER	92% NC	160
049	FB-111A	TRAINING ROUTE	98% NC	525
050	C-5A	TAKEOFF POWER	4.9 EPR	185
051	C-5A	CRUISE POWER	2.48 EPR	250
052	C-5A	APPROACH POWER	2.99 EPR	150
053	C-5A	INTERMEDIATE POWER	3.38 EPR	130
054	C-5A	TRAFFIC PATTERN	3.07 EPR	165
055	C-5A	INTERMED POWER (MIL)	4.0 EPR	185
056	C-7A	TAKEOFF POWER	2700 RPM	160
057	C-7A	APPROACH POWER	2250 RPM	90
058	C-7A	INTERMEDIATE POWER	2550 RPM	140
059	C-9A	TAKEOFF POWER	1.97 EPR	250
060	C-9A	APPROACH POWER	1.35 EPR	160
061	C-9A	INTERMEDIATE POWER	1.70 EPR	300
062	C-17	TAKEOFF	30000 LBS	160
063	C-17	CRUISE	10000 LBS	160
064	C-17	APPROACH	5000 LBS	160
065	C-18A	TAKEOFF POWER	1.84 EPR	300
066	C-18A	CRUISE POWER	1.12 EPR	250
067	C-18A	APPROACH POWER	1.26 EPR	140
068	C-18A	TRAINING ROUTE	1.10 EPR	240
069	C-21A	TAKEOFF POWER	96.0% NC	300
070	C-21A	APPROACH POWER	70.4% NC	140
071	C-21A	INTERMEDIATE POWER	80.0% NC	225
072	C-130A&D	TAKEOFF POWER	970 C TIT	170
073	C-130A&D	APPROACH POWER	580 C TIT	140
074	C-130E	TAKEOFF POWER	970 C TIT	170
075	C-130E	APPROACH POWER	580 C TIT	140
076	C-130H&N&P	TAKEOFF POWER	970 C TIT	170
077	C-130H&N&P	APPROACH POWER	580 C TIT	140
078	C-131B	TAKEOFF POWER	2800 RPM	140
079	C-131B	CRUISE POWER	2000 RPM	180
080	C-131B	APPROACH POWER	2400 RPM	120
081	C-135A	TAKEOFF POWER	96% RPM	199
082	C-135A	CRUISE POWER	86% RPM	300
083	C-135A	APPROACH POWER	90% RPM	160
084	C-135A	TRAINING ROUTE	86% RPM	250
085	C-135B	TAKEOFF POWER	100% RPM	250
086	C-135B	CRUISE POWER	76% RPM	300
087	C-135B	APPROACH POWER	90% RPM	160
088	KC-135R	APPROACH POWER	66.5% NC	150
089	KC-135R	INTERMEDIATE POWER	80.3% NC	240
090	KC-135R	MAX RATED THRUST	89.6% NC	300
091	KC-135R	TRAFFIC PATTERN	70.5% NC	225
092	C-141A	TAKEOFF POWER	96% NF	250
093	C-141A	CRUISE POWER	85% NF	300
094	C-141A	APPROACH POWER	68% NF	140
095	C-141A	INTERMEDIATE POWER	68% NF	140
096	C-141A	NORMAL RATED THRUST	91% NF	250
097	C-141A	TRAINING ROUTE	80% NF	200
098	F-4C	AFTERBURNER POWER	100% RPM	300
099	F-4C	TAKEOFF POWER	100% RPM	299
100	F-4C	APPROACH POWER	87% RPM	190
101	F-4C	TRAFFIC PATTERN	86.5% RPM	200
102	F-4C	TRAINING ROUTE	98% RPM	550

ID	AIRCRAFT TYPE	DESCRIPTION	POWER	SPEED (KTS)
103	F-5A&B	AFTERBURNER POWER	101% RPM	350
104	F-5A&B	TAKEOFF POWER	101% RPM	300
105	F-5A&B	CRUISE POWER	86% RPM	325
106	F-5A&B	APPROACH POWER	82% RPM	170
107	F-5E	AFTERBURNER POWER	101% RPM	350
108	F-5E	TAKEOFF POWER	101% RPM	300
109	F-5E	CRUISE POWER	86% RPM	325
110	F-5E	APPROACH POWER	82% RPM	170
111	F-14A	AFTERBURNER POWER	100% NC	300
112	F-14A	TAKEOFF POWER	100% NC	299
113	F-14A	CRUISE POWER	82.5% NC	350
114	F-14A	APPROACH POWER	85% NC	150
115	F-15A	AFTERBURNER POWER	91% NC	350
116	F-15A	TAKEOFF POWER	90% NC	300
117	F-15A	CRUISE POWER	73.5% NC	280
118	F-15A	APPROACH POWER	75% NC	170
119	F-15A	MID SPD TRAINING RT	81% NC	520
120	F-15A	HIGH SPD TRAINING RT	88% NC	570
121	F-15A	TRAINING ROUTE	82% NC	550
122	F-15A	LOW SPD TRAINING RT	77% NC	450
123	F-16A	AFTERBURNER POWER	90% NC	350
124	F-16A	TAKEOFF POWER	90% NC	350
125	F-16A	APPROACH POWER	82% NC	130
126	F-16A	INTERMEDIATE POWER	85% NC	300
127	F-16A	MAX RATED THRUST	92% NC	350
128	F-16A	TRAINING ROUTE	84% NC	500
129	F-16A	MAX ENDURANCE	78% NC	250
130	F-16A	LOW SPD TRAINING RT	82% NC	370
131	F-16A	MID SPD TRAINING RT	87% NC	450
132	F-16(G100)	AFTERBURNER POWER	105% NC	450
133	F-16(G100)	TAKEOFF POWER	104% NC	340
134	F-16(G100)	APPROACH POWER	87% NC	140
135	F-16(G100)	INTERMEDIATE POWER	97% NC	235
136	F-16(G100)	MAX ENDURANCE	85% NC	225
137	F-16(G100)	HIGH SPD TRAINING RT	101% NC	585
138	F-16(G100)	LOW SPD TRAINING RT	94% NC	465
139	F-16(G100)	MID SPD TRAINING RT	95.4% NC	500
140	F-16(G100)	HIGH CRU TRAINING RT	99% NC	540
141	F-18	AFTERBURNER POWER	101.5% NC	250
142	F-18	TAKEOFF POWER	101% NC	250
143	F-18	APPROACH POWER	86% NC	250
144	F-18	TRAFFIC PATTERN	68% NC	250
145	F-105D	AFTERBURNER POWER	102.5% NC	350
146	F-105D	TAKEOFF POWER	102% NC	300
147	F-105D	APPROACH POWER	96.5% NC	210
148	F-105D	INTERMEDIATE POWER	93% NC	290
149	F-106	AFTERBURNER POWER	108% RPM	350
150	F-106	TAKEOFF POWER	106% RPM	350
151	F-106	APPROACH POWER	93% RPM	200
152	F-106	INTERMEDIATE POWER	86.5% RPM	300
153	F-111A&E	AFTERBURNER POWER	97% NC	350
154	F-111A&E	TAKEOFF POWER	97% NC	300
155	F-111A&E	APPROACH POWER	81% NC	150
156	F-111A&E	INTERMEDIATE POWER	86% NC	350
157	F-111D	AFTERBURNER POWER	97% NC	350
158	F-111D	TAKEOFF POWER	97% NC	300
159	F-111D	APPROACH POWER	81% NC	150
160	F-111D	INTERMEDIATE POWER	86% NC	350
161	F-111F	AFTERBURNER POWER	97% NC	350
162	F-111F	TAKEOFF POWER	97% NC	300
163	F-111F	APPROACH POWER	81% NC	150
164	F-111F	INTERMEDIATE POWER	86% NC	350
165	F-111F	HIGH SPD TRAINING RT	97% NC	610
166	F-111F	LOW SPD TRAINING RT	88% NC	450
167	F-111F	LOW CRU TRAINING RT	94% NC	490
168	F-111F	MID SPD TRAINING RT	90% NC	500
169	F-111F	HIGH CRU TRAINING RT	93% NC	540

ID	AIRCRAFT TYPE	DESCRIPTION	POWER	SPEED (KTS)
170	F-117A	TAKEOFF POWER	96% RPM	400
171	F-117A	CRUISE POWER	92% RPM	425
172	F-117A	APPROACH POWER	87% RPM	180
173	F-117A	TRAFFIC PATTERN	84.5% RPM	250
174	OV-10A	TAKEOFF POWER	100% RPM	150
175	OV-10A	APPROACH POWER	97% RPM	100
176	OV-10A	INTERMEDIATE POWER	97% RPM	140
177	P-3A	TAKEOFF POWER	3875 ESHP	140
178	P-3A	CRUISE POWER	2000 ESHP	180
179	P-3A	APPROACH POWER	900 ESHP	120
180	S-3A	TAKEOFF POWER	97.2% NC	250
181	S-3A	CRUISE POWER	60% NC	251
182	S-3A	APPROACH POWER	69% NC	140
183	T-2C	TAKEOFF POWER	101.7% RPM	180
184	T-2C	CRUISE POWER	75.0% RPM	250
185	T-2C	APPROACH POWER	72.5% RPM	140
186	T-33A	TAKEOFF POWER	100% RPM	200
187	T-33A	CRUISE POWER	90% RPM	300
188	T-33A	APPROACH POWER	80% RPM	125
189	T-37B	TAKEOFF POWER	99% RPM	170
190	T-37B	CRUISE POWER	90% RPM	225
191	T-37B	APPROACH POWER	80% RPM	105
192	T-38A	AFTERBURNER POWER	100% RPM	300
193	T-38A	TAKEOFF POWER	100% RPM	299
194	T-38A	CRUISE POWER	90% RPM	301
195	T-38A	APPROACH POWER	91% RPM	170
196	T-39A	TAKEOFF POWER	100% RPM	180
197	T-39A	CRUISE POWER	89% RPM	250
198	T-39A	APPROACH POWER	79.5% RPM	115
199	T-43A	TAKEOFF POWER	1.97 EPR	200
200	T-43A	APPROACH POWER	1.46 EPR	140
201	T-43A	INTERMEDIATE POWER	1.21 EPR	250
202	A109	TAKEOFF POWER	60 KNOTS	60
203	A109	APPROACH POWER	60 KNOTS	60
204	A109	FLYOVER POWER	116 KNOTS	116
205	AH-1G	LFO LITE 100 KTS	100 KNOTS	100
206	AH-1G	LND LITE 40 KTS	40 KNOTS	40
207	AH64	LFO LITE 40 KTS	40 KNOTS	40
208	AH64	LFO LITE 70 KTS	70 KNOTS	70
209	AH64	LFO LITE 100 KTS	100 KNOTS	100
210	AH64	LFO LITE 130 KTS	130 KNOTS	130
211	AH64	LFO LITE 150 KTS	150 KNOTS	150
212	AH64	LND LITE 40 KTS	40 KNOTS	40
213	AH64	TKF LITE 40 KTS	40 KNOTS	40
214	BL212	TAKEOFF POWER	53 KNOTS	53
215	BL212	APPROACH POWER	55 KNOTS	55
216	BL212	FLYOVER POWER	94 KNOTS	94
217	BL222	TAKEOFF POWER	65 KNOTS	65
218	BL222	APPROACH POWER	65 KNOTS	65
219	BL222	FLYOVER POWER	123 KNOTS	123
220	BOKW150	TAKEOFF POWER	67 KNOTS	67
221	BOKW150	APPROACH POWER	70 KNOTS	70
222	BOKW150	FLYOVER POWER	117 KNOTS	117
223	CH-3C	FLT AT 60 KTS	100% RPM	60
224	CH-3C	FLT AT 100 KTS	100% RPM	100
225	CH-46E	CRUISE POWER	79%Q-BPA	110
226	CH-46E	LEVEL FLIGHT (LPA)	86%Q-BPA	70
227	CH-46E	LEVEL FLIGHT (HPA)	94%Q-BPA	130
228	CH-46E	MAX POWER	98%Q-BPA	150
229	CH-47C	FLT AT 100 KTS	100% RPM	100
230	CH-47D	TAKEOFF POWER	85 KNOTS	85
231	CH-47D	APPROACH POWER	85 KNOTS	85
232	CH-47D	FLYOVER POWER	120 KNOTS	120
233	CH-53E	CRUISE POWER	68%Q-BPA	120
234	CH-53E	LEVEL FLIGHT (LPA)	56%Q-BPA	80
235	CH-53E	LEVEL FLIGHT (HPA)	90%Q-BPA	150
236	CH-53E	MAX POWER	90%Q-BPA	150
237	CH-54B	FLT AT 60 KTS	100% RPM	60
238	CH-54B	FLT AT 80 KTS	100% RPM	80

ID	AIRCRAFT TYPE	DESCRIPTION	POWER	SPEED (KTS)
239	CH47B	LFO LITE 100 KTS	100 KNOTS	100
240	CH47B	LFO LOAD 100 KTS	100 KNOTS	100
241	CH47B	LND LITE 40 KTS	40 KNOTS	40
242	CH47B	LND LOAD 40 KTS	40 KNOTS	40
243	CH47D	LFO LITE 40 KTS	40 KNOTS	40
244	CH47D	LFO LITE 70 KTS	70 KNOTS	70
245	CH47D	LFO LITE 100 KTS	100 KNOTS	100
246	CH47D	LFO LITE 130 KTS	130 KNOTS	130
247	CH47D	LFO LITE 135 KTS	135 KNOTS	135
248	CH47D	LFO LOAD 40 KTS	40 KNOTS	40
249	CH47D	LFO LOAD 70 KTS	70 KNOTS	70
250	CH47D	LFO LOAD 100 KTS	100 KNOTS	100
251	CH47D	LFO LOAD 120 KTS	120 KNOTS	120
252	CH47D	LND LITE 70 KTS	70 KNOTS	70
253	CH47D	LND LOAD 70 KTS	70 KNOTS	70
254	CH47D	TKF LITE 70 KTS	70 KNOTS	70
255	CH47D	TKF LOAD 70 KTS	70 KNOTS	70
256	HH-53	FLT AT 100 KTS	100% RPM	100
257	HU500D	TAKEOFF POWER	62 KNOTS	62
258	HU500D	APPROACH POWER	62 KNOTS	62
259	HU500D	FLYOVER POWER	111 KNOTS	111
260	OH-6A	FLT AT 90 KTS	100% RPM	90
261	OH58	LFO LITE 80 KTS	80 KNOTS	80
262	OH58	LND LITE 40 KTS	40 KNOTS	40
263	OH58D	LFO LITE 40 KTS	40 KNOTS	40
264	OH58D	LFO LITE 70 KTS	70 KNOTS	70
265	OH58D	LFO LITE 100 KTS	100 KNOTS	100
266	OH58D	LFO LITE 120 KTS	120 KNOTS	120
267	OH58D	LND LITE 40 KTS	40 KNOTS	40
268	OH58D	TKF LITE 40 KTS	40 KNOTS	40
269	SA330J	TAKEOFF POWER	69 KNOTS	69
270	SA330J	APPROACH POWER	70 KNOTS	70
271	SA330J	FLYOVER POWER	126 KNOTS	126
272	SA341G	TAKEOFF POWER	64 KNOTS	64
273	SA341G	APPROACH POWER	65 KNOTS	65
274	SA341G	FLYOVER POWER	128 KNOTS	128
275	SA350D	TAKEOFF POWER	63 KNOTS	63
276	SA350D	APPROACH POWER	63 KNOTS	63
277	SA350D	FLYOVER POWER	116 KNOTS	116
278	SA3555F	TAKEOFF POWER	63 KNOTS	63
279	SA3555F	APPROACH POWER	63 KNOTS	63
280	SA3555F	FLYOVER POWER	116 KNOTS	116
281	SA365N	TAKEOFF POWER	74 KNOTS	74
282	SA365N	APPROACH POWER	75 KNOTS	75
283	SA365N	FLYOVER POWER	120 KNOTS	120
284	SK61	TAKEOFF POWER	73 KNOTS	73
285	SK61	APPROACH POWER	74 KNOTS	74
286	SK61	FLYOVER POWER	130 KNOTS	130
287	SK65	TAKEOFF POWER	74 KNOTS	74
288	SK65	APPROACH POWER	76 KNOTS	76
289	SK65	FLYOVER POWER	146 KNOTS	146
290	SK70	TAKEOFF POWER	74 KNOTS	74
291	SK70	APPROACH POWER	69 KNOTS	69
292	SK70	FLYOVER POWER	150 KNOTS	150
293	SK76	TAKEOFF POWER	74 KNOTS	74
294	SK76	APPROACH POWER	74 KNOTS	74
295	SK76	FLYOVER POWER	130 KNOTS	130
296	TH-55A	FLT AT 80 KTS	100% RPM	80
297	TH55	LFO LITE 80 KTS	80 KNOTS	80
298	TH55	LND LITE 40 KTS	40 KNOTS	40
299	UH-13	FLT AT 50 KTS	100% RPM	50
300	UH-1N	FLT AT 80 KTS	100% RPM	80