U-76-01
II A-456

WYLE LABORATORIES

WYLE RESEARCH
El Segundo, California

REPORT

WYLE LABORATORIES

WYLE RESEARCH REPORT

WR 77-19

CALCULATOR AIRPORT NOISE METHOD

VOLUME I: USER'S GUIDE

For

U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Noise Abatement and Control
Washington, D.C. 20590

(Contract No. 68-01-3514)

By

John Moran

WYLE RESEARCH
El Segundo, California 90245

DECEMBER 1977

REPORT

```
 D TO TRACK
          1400.
 D AL TRACK
         34000.
SL CODE
             2.
D/N OPS.
            16.
             6.

  76.03863676    LDN
           4.00

SL CODE
           1.00
D/N OPS.
          30.00
          10.00

          76.38    LDN
           7.00

SL CODE
           1.00
D/N OPS.
          15.00
           6.00

          76.45    LDN
           8.00

SL CODE
           1.00
D/N OPS.
           2.00
           1.00

[illegible]

D TO TRACK
  [illegible]6000.00
D AL TRACK
       37200.00
SL CODE
           3.00
D/N OPS.
           2.00
           1.00

          76.47    LDN
           1.00

SL CODE
           3.00
D/N OPS.
           5.00
           2.00
```

SECTIONED DOCUMENT

```
        76.49     LIN
         2.00

SL CODE
         2.00
D/N OPS.
         1.00
         0.00

        76.49     LIN
         1.00

SL CODE
         2.00
D/N OPS.
         1.00
         0.00

        76.49     LIN
        10.00


D TO TRACK
      6000.00
D AL TRACK
     16000.00
SL CODE
         0.00
D/N OPS.
         3.00
         1.00

        76.51     LIN
         1.00

SL CODE
         0.00
D/N OPS.
         5.00
         2.00

        76.53     LIN
         2.00

SL CODE
         0.00
D/N OPS.
        16.00
         6.00

        76.54     LIN
         4.00

SL CODE
         0.00
D/N OPS.
        15.00
         6.00
```

```
SL CODE
         0.00
D/N OPS.
        27.00
         1.00

        76.54     LDN
        10.00

D TO TRACK
      2000.00
D AL TRACK
      1500.00
SL CODE
        -1.00
D/N OPS.
        30.00
        10.00

        76.54     LDN
        13.00

SL CODE
        -1.00
D/N OPS.
        50.00
        12.00

        76.55     LDN
        15.00

SL CODE
        -1.00
D/N OPS.
        80.00
        20.00

        76.55     LDN
        17.00
```

~~Ldn (total) = 86.5 [illegible]~~

TABLE OF CONTENTS

ACKNOWLEDGMENT

The author wishes to acknowledge the assistance provided by the following members of Wyle Research: Dr. Robert Rackl for his guidance, Mr. Gary E. Mange for his helpful comments and suggestions, and Mr. Richard Negvesky for assistance in the preparation of this document.

FOREWORD

This Volume I (User's Guide) is intended for use by persons wishing to perform a simple but accurate noise prediction at selected points around an airport with a programmable calculator. These persons need not have acoustical training. Acquaintance with basic airport operations and with the Texas Instrument Model 59 Calculator are required.

Volume II constitutes a report on the study that resulted in this method. It gives background information, some details on calculator internal computational procedures and data storage formats, as well as sources of aircraft noise and performance data.

1.0 INTRODUCTION

In the past, the assessment of airport noise has been primarily in the domain of the experienced analyst. This method has been designed to provide an accurate day-night average noise level (L_{dn}) analysis tool for use by individuals with wide-ranging backgrounds and levels of technical experience.

The computer program used to implement the method has been written for the Texas Instruments TI-59 Programmable Calculator, with optional input and output recorded on the PC 100-A Printer. This powerful pocket-sized calculator, an airport area map, ground tracks, a distance measuring device, and aircraft mix information, form the tools needed to perform an airport analysis.

The intent of the method is to provide the means of computing the L_{dn} at a point due to aircraft noise. Although it is possible to develop a complete contour of equal noise about an airport using the method, the number of iterative calculations involved becomes very time-consuming.

Data for a wide range of air carrier and general aviation aircraft types are provided for use with this method. This enables the user to conduct analyses at airports of all sizes; however, complex situations with large numbers of flights often found at international airports are more efficiently handled by large digital computers.

Airport data, types of aircraft, and sound exposure level (SEL) noise data used in this methodology are compatible with recent work done for the U.S. Environmental Protection Agency in the field of airport noise.[1,2]

2.0 AIRPORT ANALYSIS

The accuracy of predicted L_{dn} values is entirely dependent upon the quality of the input data obtained. To determine the L_{dn} at a point, the required information includes a scaled airport area map with runways and major ground tracks drawn and a description of the aircraft following these ground tracks.

This section describes the acquisition of information required to perform an L_{dn} noise exposure analysis at a point in the vicinity of an airport.

2.1 Airport Area Maps

Scaled airport area maps with runway configurations drawn on them are often available from the airport operator or local planning agencies. In the event that they are not available, maps containing the airport area can be obtained from the U.S. Geological Survey (USGS).[3] The runway configurations printed on USGS maps are often out of date and need to be modified. Up-to-date runway descriptions can be obtained, often locally, from the airport, from published approach procedures by the National Ocean Survey, or from Jeppesen.[4,5]

2.2 Ground Tracks and Distances

A ground track is defined as the projection of the flight path of an aircraft upon the ground. Although aircraft do not precisely overfly any particular ground track, it is reasonable to define a set of average ground tracks which adequately describe an airport pattern.

The primary sources for this information are FAA tower personnel, the airport operator, and airlines servicing the airport. It is important that the developed ground tracks be verified visually or in conjunction with one or more of the above sources.

Once the acquisition of ground track information is complete, scaled drawings are then made on the airport area map or transparent overlay. All ground tracks in the vicinity of the area(s) you wish to analyze must be shown and numbered.

2.3 Approach Pattern Procedures

Pattern traffic structure varies widely from airport to airport. Local geography, air traffic, and flight instrument conditions affect the procedure by which a landing is conducted at an airport. All available information about the glide slope used by aircraft to approach the runways and holding pattern positions and altitudes should be noted on the ground track drawings. Section 3.2 discusses the utilization of this information for noise calculations.

2.4 Aircraft Mix Data and Track Utilization

Aircraft types and numbers of operations using each ground track in the analysis must be identified. This is accomplished through two basic techniques designated as (1) the direct assignment method, and (2) the percent utilization method. The direct assignment method involves determining only the distinct aircraft types and operations using the track. This is the preferred and most accurate method; however, it may be impractical, especially at general aviation airports. The percentage utilization method involves developing a percent use for each track. Every aircraft type using the airport is then applied to each track, multiplying their operations levels by the track percentage.

The calculation of L_{dn} is based upon developing for each aircraft type the average number of operations during the day (0700 - 2200 hrs) and night (2200 - 0700 hrs). The average number of operations for aircraft noise impact assessment usually represent arithmetic average values over an entire year. To assess the impact of seasonal variation, these average values may be calculated for the particular time span of interest.

For air carrier departures, it is important to determine the distance to be traveled by an aircraft since the differences in aircraft weight requirements produce significant variations in takeoff performance. This trip length need only be approximate, and is expressed in nautical miles.

Table 1 presents aircraft types to be used with this method and associates each type with a data reference number. Aircraft data cards to be used as input to the calculator

Table 1

Aircraft Descriptions

Aircraft Number	Aircraft Type	Representative Aircraft
1	4 Engine HBPR Turbofan	747
2	4 Engine LBPR Turbofan	707, DC-8
3	4 Engine LBPR Turbofan (Quiet Nacelle)	707 (QN) DC-8, (QN)
4	3 Engine LBPR Turbofan	727
5	3 Engine LBPR Turbofan (Quiet Nacelle)	727 (QN)
6	4 Engine HBPR Turbofan (Quiet Nacelle)	747 (QN)
7	2 Engine Business Jet (Composite)	Jetstar I, II Lear Jet 23-36
8	2 Engine LBPR Turbofan	737, DC-9
9	2 Engine LBPR Turbofan (Quiet Nacelle)	737 (QN) DC-9 (QN)
10	3 Engine HPBR Turbofan	DC-10, L1011
11	4 Engine Propeller	DC-4, DC-6
12	4 Engine Turboprop	Electra
13	2 Engine Turboprop	Twin Otter King Air
14	2 Engine Propeller	DC-3
15	2 Engine Propeller (Small)	Cessna 310
16	2 Engine Turbofan (Small)	Cessna Citation
17	1 Engine Propeller	Cessna 182 Piper Cherokee

program are identified by this same data reference number. The aircraft types are numbered in order of approximate noisiness. The aircraft numbering order must be strictly adhered to in the coding of the aircraft mix data.

At medium to large sized airports dominated by air carrier operations, the best source of data on aircraft types, number of operations and destinations are airline guides and schedules.* Sources for the information at smaller airports are local airlines, the airport operator, and if the airport has a tower, the tower personnel. While it is often difficult to obtain accurate information on track usage, the most reliable sources are tower personnel or the airport operator.

2.5 Data Acquisition Summary

1. Obtain scaled local airport area map covering all areas at which the L_{dn} noise assessment is to be made. Be sure the runways are correctly drawn and displaced landing thresholds noted.
2. Develop accurate ground tracks definitions. Draw all ground tracks in the vicinity of the area for analysis on the airport area map or overlay. It is always best to include tracks where doubt exists as to the noise contribution made by the aircraft using them. ?
3. Determine approach pattern procedures and altitude information and note this data on the ground track drawings. (This requirement will become clear when studying the subsequent sections of this guide.)
4. Develop aircraft types, number of operations day and night, and departure distance (stage length) (for air carrier aircraft only) in nautical miles for each ground track to be analyzed.

---

*Official Airline Guide.

3.0 USING THE PROGRAM

A familiarity with basic keyboard operations and the reading/writing of magnetic cards on the TI-59 calculator is required to successfully use the program. Two program cards and up to 17 aircraft data cards, one for each of the aircraft types listed in Table 1, are required for running the program. Each aircraft data card contains sound exposure level (SEL) noise and ground attenuation data, departure profiles, approach information, and program constants. Appendix B lists the contents of these data cards. Appendix A lists the contents of the two program cards. These two appendices are provided for the user in case magnetic cards become inoperative or lost. Magnetic cards can be recreated from these appendices. However, Volume II of this report series is required to understand the details.

3.1 Measurements

There are two distances (except for the special cases described in Section 3.3) which must be measured for each ground track in the vicinity of the location at which the L_{dn} is to be computed. These are designated as: distance along the track (DAT) in feet, and distance to the track (DTT) in feet. DTT is measured from the point of closest approach of the track to the location at which the noise is to be calculated. DAT for departures is measured from the start of takeoff roll to the point of closest approach. Figure 1 illustrates these distances for departures. DAT for landing is measured from the landing threshold to the point of closest approach. The value of DAT is positive for measurements outward along the track and negative for measurements backward along the runway. Figure 2 illustrates these distances for landings.

Visual determination on the ground track map of the point of closest approach will provide sufficient accuracy. This point can also be defined as the shortest perpendicular line that can be drawn from the track to the location at which the calculation is to be performed. It is suggested that the DAT measurement for curved tracks be done with a device known as a map measure, to save time and increase accuracy.

Care must be taken in cases where a track has both departures and approaches. It is best in these cases to use two track numbers to differentiate approach and departure tracks.

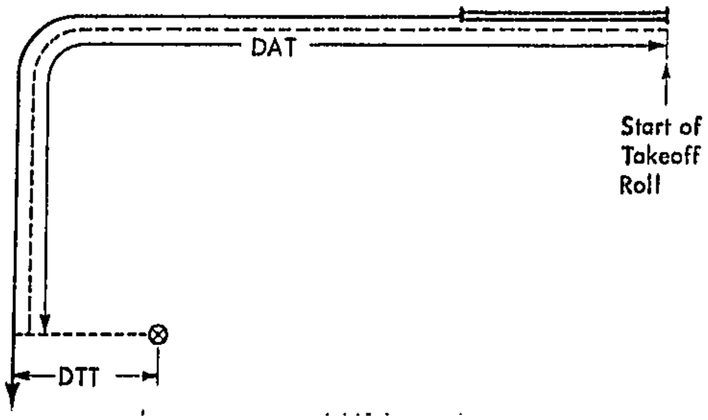


Figure 1. Definition of Ground Track Distances DAT and DTT for Departure

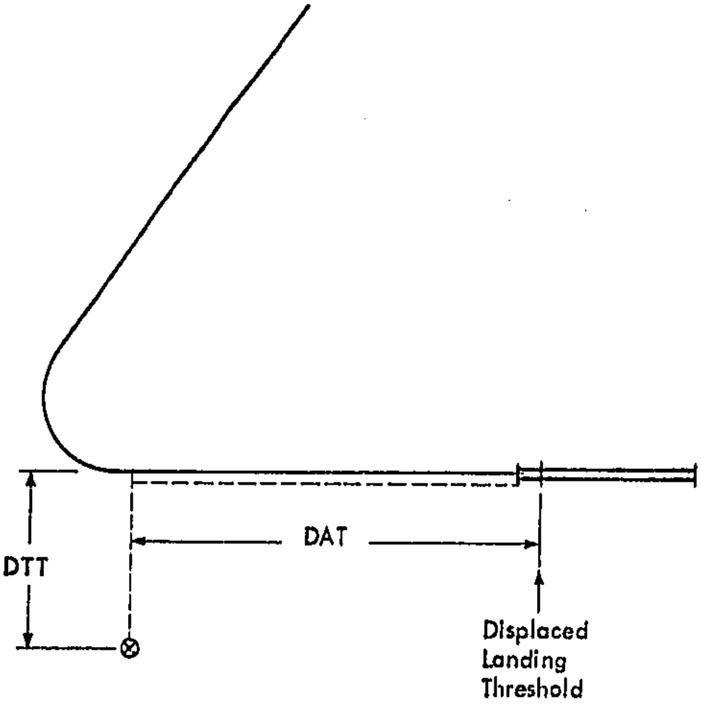


Figure 2. Definition of Ground Track Distances DAT and DTT for Approach

3.2 Departure Profiles

Departure profiles for air carrier aircraft, Types 1 through 6, 8, 9, and 10 in Table 1, were developed using recent Air Transport Association (ATA) noise abatement takeoff procedures.[6] For these aircraft, up to three different profiles are provided corresponding to different destination categories. The different destination categories are represented for input to the calculator program by a stage length code. Table 2 lists the different stage length codes, the operation type and program interpretation. For all other aircraft, generalized single segment departure profiles are used.[2]

Table 2

Stage Length Codes

Stage Length Code	Operation Type	Program Interpretation
3	Departure	Destination > 2500 nm
2	Departure	Destination 1000 to 2500 nm
1	Departure	Destination 0 to 1000 nm
0	Approach	Glide Slope/Runway
-1	Approach	Level Flight (DAT = Altitude)
-2	Approach	Pattern Entry (DAT = Altitude)

3.3 Approach Profiles

Approach profiles for all aircraft are based upon three separate segment options, allowing the user to tailor the calculations to specific airport situations and procedures. These options are glide slope/runway, level flight, and pattern entry.

The glide slope/runway option is used from the point the aircraft intercepts its glide slope through the complete landing process. This option should be used for all straight-in approach paths and when level flight is not specifically indicated. It is assumed that air carrier aircraft use a 3° glide slope and all others use a 4.5° glide slope. Instructions for modifying the glide slope are given in Section 4.5.

Level flight and pattern entry options both require the user to substitute the aircraft altitude in feet above ground level for the distance along the track (DAT) as input to the program. The level flight option is used to assess such operations as go-arounds and holding pattern traffic where level flying aircraft may cause noise intrusions. The pattern entry option is used primarily at large airports where high flying aircraft are thought to be a noise source as they enter the traffic pattern.

Table 2 lists the stage length codes for these approach options.

3.4 Coding Instructions

Figure 3 illustrates the coding form to be used for each calculation location. It provides space for coding the user defined track number, distances, aircraft number, stage length code and operations.

The order in which the developed data is placed upon the coding form can reduce the number of calculations required to compute the correct L_{dn}. The three basic guidelines are as follows:

1. Always list first those tracks with aircraft whose numbers from Table 1 are 7 or less.
2. List the departure tracks first, unless the distance to an approach track is less than one-third the distance to the departure track.
3. List the lowest aircraft numbers on a track first unless an aircraft with a higher number has more than twice the number of night operations.

These general guidelines will not produce the most convenient ordering in every case. Experience with the method at a specific airport will enable the user to improve the guidelines and further simplify the calculations. Section 4.1 discusses simplifications during the calculation process.

Data Coding Form

Airport ______________ Location ______________ Date __________

Track Number	Distance		Aircraft Number	Stage Length Code	Operations	
	DTT	DAT			Day	Night

Figure 3. Data Coding Form

3.5 Program User Instructions

Table 3 provides a step-by-step procedure for executing the aircraft noise program on the TI-59 calculator. The operation of the program is divided into the following categories:

- Steps 1 through 3 describe program initialization procedures.
- Steps 4 through 7 describe input, calculations and reinitialization procedures.
- Steps 8 through 10 describe logical decision options.

The "enter" column lists items to be input either to the keyboard or magnetic card reader. In the "press" column, the calculator keys to be pressed at each stage of the procedure are listed. The "display" column lists the value that will appear in the calculator display as a result of the enter and press functions. The "printer" column describes the interactive input prompts and title information in quotes, and input/output values printed on the PC-100A printer. Although the use of the PC-100A is optional, the value of a complete calculation record and of ease of interactive input strongly suggests its use.

Table 3

Airport Noise Program User Instructions

Step	Procedure	Enter	Press	Display	Printer
1	Partition the Calculator	4	2nd Op 17	639.39	
2	Read Program Cards		CLR	0	
	a) Read Side 1	Card		1	
			CLR	0	
	b) Read Side 2	Card		2	
			CLR	0	
	c) Read Side 3	Card		3	
			CLR	0	
3	Read Aircraft Data Card				
	Read Side 4	Card		4	
4	Program Start				
	Key A		A		'D to Track'
5	Input Distance to the Track (DTT, feet)	DTT	R/S	0	DTT 'D AL Track'
	Input Distance Along the Track (DAT, feet)	DAT	R/S	0	DAT 'SL Code'

Table 3 (Continued)

Step	Procedure	Enter	Press	Display	Printer
6	Input Stage Length Code (SLC)	SLC	R/S	0	SLC 'DN Ops'
	Input Day Operations (DOPS)	DOPS	R/S	0	DOPS
	Input Night Operations (NOPS)	NOPS	R/S		NOPS Value 'L_{dn}' Aircraft #
	All Tracks and Aircraft Complete - End - Otherwise Continue to Step 7				
7	Read Next Aircraft Data Card - Read Side 4	Card	CLR	0 4	
8	For New Track - Key A Continue at Step 5		A	0	'D to Track'
9	Same Track, New Aircraft Key C - Continue at Step 6		C	0	'SL Code'
10	New Calculation Location Clear Previous L_{dn} Value Continue at Step 3		CLR STO 30	0 0	

4.0 ANALYSIS OF CALCULATIONS

In the assessment of airport noise, there is no substitute for having experience with the method and tools used to perform the analysis. The following sections are intended to provide the user with this experience to develop facility with the method using the TI-59 calculator. It is recommended that the user execute and fully understand the example in Section 4.2 before utilizing the method in an actual case.

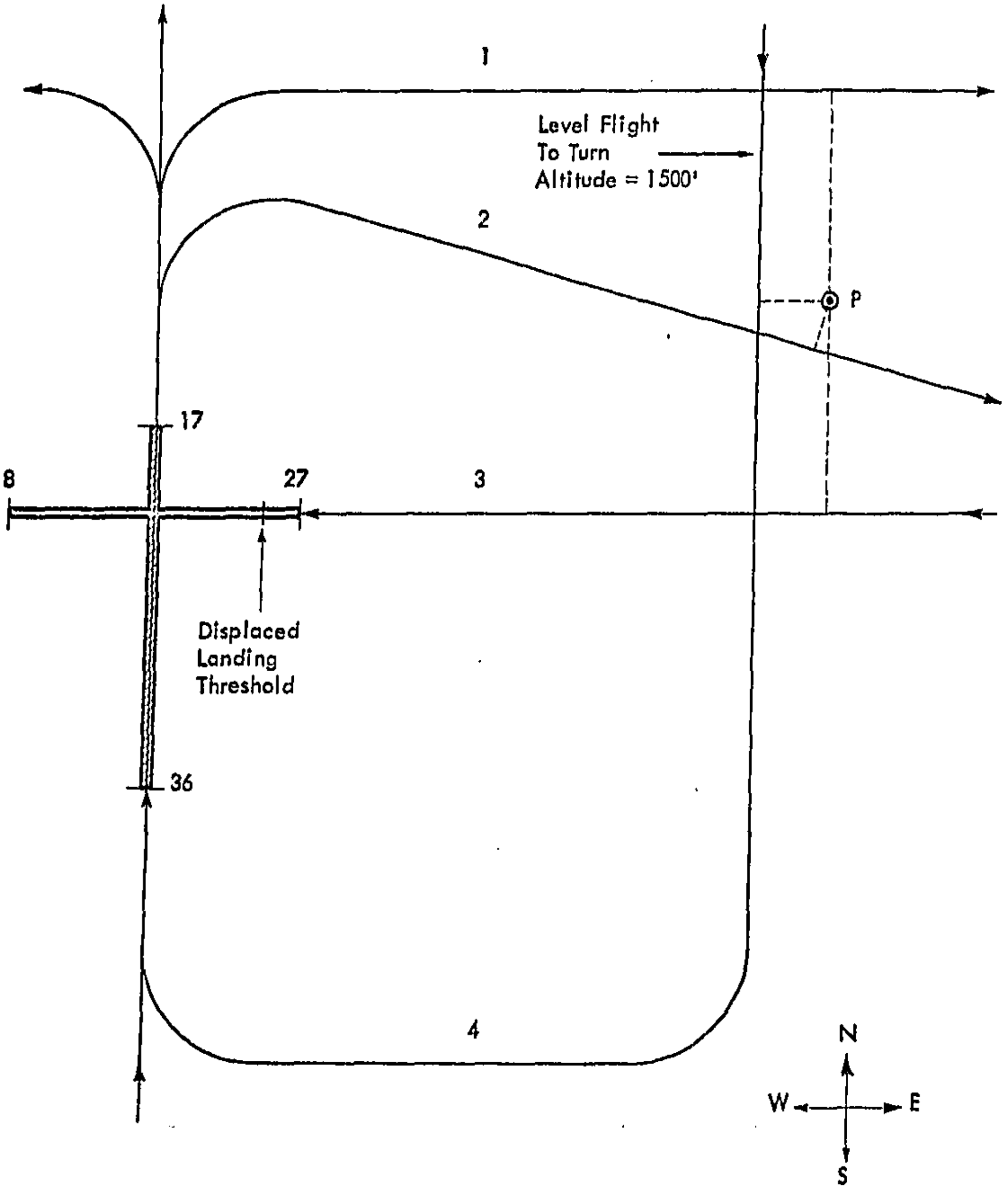
4.1 Unnecessary Calculations

During the calculation process, the structure of the input data combined with the L_{dn} output allows the user, in certain situations, to eliminate calculations that will not significantly contribute to the cumulative L_{dn} value. This situation occurs when a noisier aircraft (lower number) on a track contributes less than .05 decibels to the cumulative L_{dn} value. If the next aircraft types to be used in the calculation have higher aircraft numbers and the same or less operations by day and night, they may be neglected. It is not advisable to neglect an entire track, even if used by very quiet aircraft, in the calculation process. At least the first two aircraft on the track should be analyzed to assess what contribution, if any, they have to the cumulative L_{dn}.

4.2 Example – Fictitious Airport Analysis

The fictitious airport constructed for the example analysis contains situations found at large and small airports. It has been designed to fully illustrate the major program functions and options to be used in realistic situations.

Figure 4 shows the scaled airport area map with ground tracks drawn. The L_{dn} is to be calculated at location P and each ground track to be used in the analysis is numbered, with the point of closest approach to location P indicated with dashed lines. Tracks 1 and 2 are used for departures and tracks 3 and 4 for approaches. A displaced threshold for approaches to Runway Number 27 is drawn and indicated on the runway. Also, pattern altitude information for level flight on track number 4 is shown.



Scale: 1 inch = 4000 feet

Figure 4. Fictitious Airport Layout and Ground Track Map

Distance along the track (DAT) and distance to the track (DTT) were measured in inches with a map measure and ruler. These distances, except for track 4 where DAT is an altitude, were then multiplied by the scale factor to obtain the correct units in feet, as indicated in Figure 5, the data worksheet. Figure 5 also shows the aircraft data to be entered on the coding form (Figure 3), associating aircraft types with number, destination distance, and calculation option with stage length code (SLC) and operations day and night. The aircraft on each track are listed according to the criteria in Section 3.4.

Information from the data worksheet is transferred to the data coding form, shown in Figure 6, for input to the program. The DTT and DAT data need only be entered into the program once per track calculation and should be listed with the first aircraft entry for a track. Tracks are listed according to the criteria of Section 3.4.

Program execution begins by entering the codes data into the program by the sequence described in Table 3, Airport Noise Program User Instructions. Figure 7, Example Printer Output Listing, illustrates the complete calculation process. Interactive data prompts, input data, output cumulative L_{dn}, and aircraft type number are shown.

From the listing of Figure 7, it can be seen that several of the indicated calculations from the coding form were not performed. Figure 7 should be carefully studied and the application of simplification procedures to the aircraft indicated in Table 4 understood.

Table 4

Aircraft Eliminated from Example Calculations

Track Number	Aircraft Number
1	10
3	8 & 10
4	17

DISTANCES

Track Number	Distance Calculation	DTT	Distance Calculation	DAT
1	1.5" x 4000 =	6000'	9.3" x 4000 =	37200'
2	.35" x 4000 =	1400'	8.5" x 4000 =	34000'
3	1.5" x 4000 =	6000'	4.0" x 4000 =	16000'
4	.50" x 4000 =	2000'	Altitude =	1500'

AIRCRAFT DATA

Departures

Track Number	Aircraft		Destination Distance (NM)	SLC	Operations	
	Type	Number			Day	Night
1	747	1	3000	3	2	1
	DC-8	2	2600	3	5	2
	747	1	1500	2	1	0
	DC-10	10	1500	2	1	0
2	727	4	1200	2	16	6
	B.Jet	7	--	1	30	10
	737	8	300	1	15	6
	DC-10	10	300	1	7	1

Approaches

Track Number	Aircraft		Calculation Option	SLC	Operations	
	Type	Number			Day	Night
3	747	1	GS/Runway	0	3	1
	707	2	"	0	5	2
	727	4	"	0	16	6
	737	8	"	0	15	6
	DC-10	10	"	0	7	1
4	King Air	13	Level Flight	-1	30	10
	2 Eng Prop	15	"	-1	50	12
	1 Eng Prop	17	"	-1	80	20

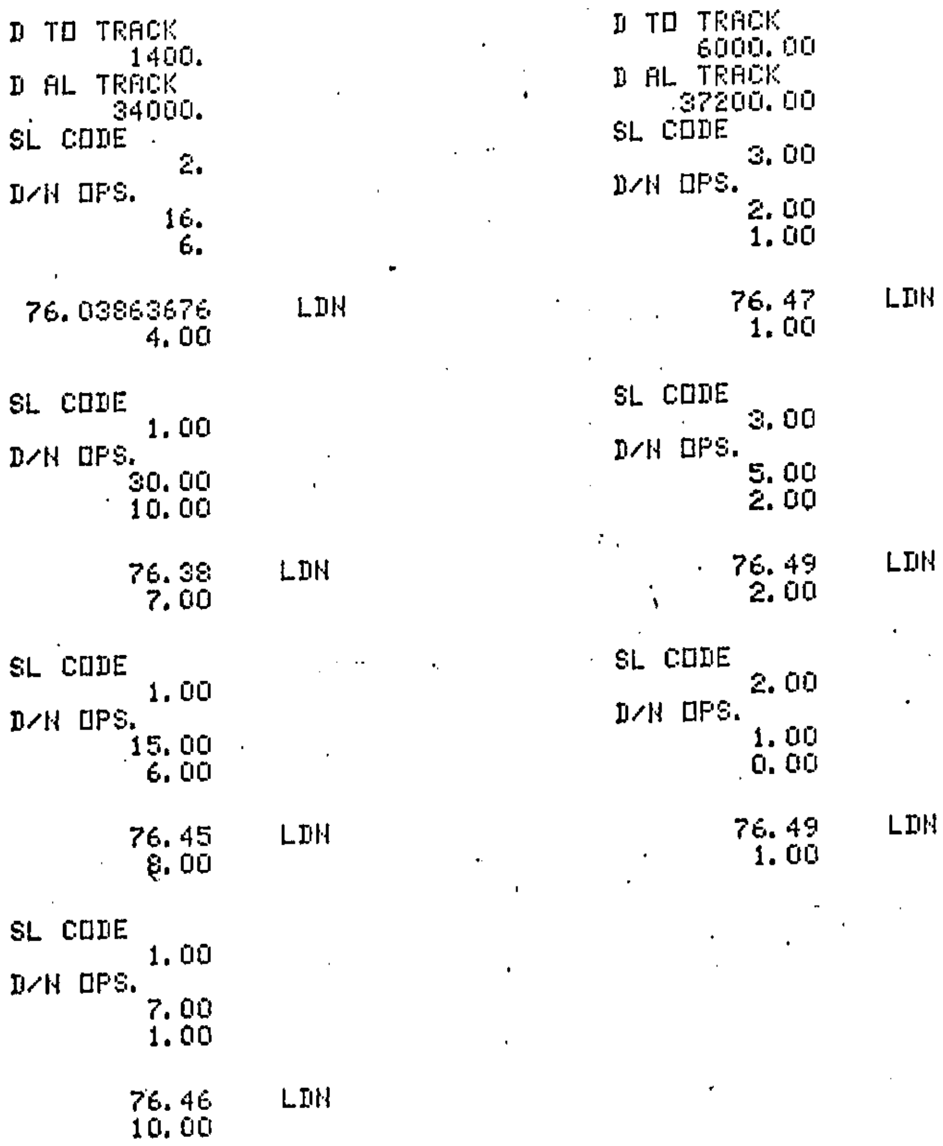
Figure 5. Data Worksheet for Fictitious Airport

Data Coding Form

Airport Fictitious Location P Date ----

Track Number	Distance		Aircraft Number	Stage Length Code	Operations	
	DTT	DAT			Day	Night
2	1400	34000	4	2	16	6
			7	1	30	10
			8	1	15	6
			10	1	7	1
1	6000	37200	1	3	2	1
			2	3	5	2
			1	2	1	0
			10	2	1	0
3	6000	16000	1	0	3	1
			2	0	5	2
			4	0	16	6
			8	0	15	6
			10	0	7	1
4	2000	1500	13	-1	30	10
			15	-1	50	12
			17	-1	80	20

Figure 6. Fictitious Airport Coded Input Data



Column 1
Track 2

```
D TO TRACK
       1400.
D AL TRACK
      34000.
SL CODE
          2.
D/N OPS.
         16.
          6.

 76.03863676     LDN
        4.00

SL CODE
        1.00
D/N OPS.
       30.00
       10.00

       76.38    LDN
        7.00

SL CODE
        1.00
D/N OPS.
       15.00
        6.00

       76.45    LDN
        8.00

SL CODE
        1.00
D/N OPS.
        7.00
        1.00

       76.46    LDN
       10.00
```

Column 2
Track 1

```
D TO TRACK
     6000.00
D AL TRACK
    37200.00
SL CODE
        3.00
D/N OPS.
        2.00
        1.00

       76.47    LDN
        1.00

SL CODE
        3.00
D/N OPS.
        5.00
        2.00

       76.49    LDN
        2.00

SL CODE
        2.00
D/N OPS.
        1.00
        0.00

       76.49    LDN
        1.00
```

Figure 7. Example Printer Output Listing

Column 3
Track 3

```
D TO TRACK
     6000.00
D AL TRACK
    16000.00
SL CODE
        0.00
D/N OPS.
        3.00
        1.00

       76.51     LDN
        1.00

SL CODE
        0.00
D/N OPS.
        5.00
        2.00

       76.53     LDN
        2.00

SL CODE
        0.00
D/N OPS.
       16.00
        6.00

       76.54     LDN
        4.00
```

Column 4
Track 4

```
D TO TRACK
     2000.00
D AL TRACK
     1500.00
SL CODE
       -1.00
D/N OPS.
       30.00
       10.00

       76.54     LDN
       13.00

SL CODE
       -1.00
D/N OPS.
       50.00
       12.00

       76.54     LDN
       15.00
```

Figure 7 (Continued)

4.3 Errors, Recovery and Glide Slope Modification

Errors on input data are completely recoverable up to but not including the R/S press entry, Step 6 in Table 3, for night operations. To recover, press A if revised distance entry is required, or C to correct stage length codes or operations entry errors. Recovery from distance entry errors will destroy the 'D AL Track' program prompt, but this does not affect the data input process.

Computational errors require the user to input and store in register number 30, the last correct cumulative L_{dn} value and continue on from that point. The reading or writing of magnetic cards for this method must always be done under the partitioning indicated in Step 1 of Table 3.

If, for any reason, damage to a magnetic program or aircraft data card occurs, Appendix A contains a program listing and Appendix B contains aircraft data card listings from which new cards can be made.

To modify the approach glide slope of an aircraft, the user should read into the calculator the desired aircraft data card and execute the following key strokes from the keyboard:

4
INV
2nd Log
STO
30
1/x
X
RCL
26
=
2nd INT
X
RCL
30
=
x≷t
'Enter Glide Slope in Degrees'
2nd TAN
X
RCL
30
=
2nd INT
x≷t
=
STO
26
'Write Block 4 to New Magnetic Card'

REFERENCES

1. Bishop, D.E., Mills, J.F., and Beckmann, J.M., "Sound Exposure Level versus Distance Curves for Civil Aircraft," BBN Report 2759, prepared for the U.S. Environmental Protection Agency, February 1976.

2. Bishop, D.E., Hays, A.P., and Reddingius, N.H., "Calculation of Day-Night Levels (L_{dn}) Resulting from Civil Aircraft Operations," U.S. Environmental Protection Agency Report No. EPA 550/9-77-450, January 1977.

3. U.S. Geological Survey Distribution Section, Federal Center, Denver, Colorado 80225.

4. National Ocean Survey, Distribution Division, C44, Riverdale, Maryland 20840.

5. Jeppesen and Co., 8025 E. 40th Avenue, Denver, Colorado 80207.

6. Air Transport Association Operations Policy Manual, OPS-9, Revision No. 1, November 16, 1977.

APPENDIX A

Airport Noise Program Listing and Documentation

PROGRAM DOCUMENTATION
ABBREVIATIONS

DOPS	Day Operations
NOPS	Night Operations
DAT	Distance Along the Track
DTT	Distance To the Track
SEL	Sound Exposure Level
SLC	Stage Length Code
SLR	Slant Range
AI	Acoustic Impedance
EA	Elevation Angle
ES	Engine Shielding
GA	Ground Attenuation
GS	Glide Slope
LM	Linear Multiplier
VR	Velocity Ratio
A	Ground Attenuation of SEL Calculation Coefficient
B	Ground Attenuation of SEL Calculation Coefficient
C	Control
H	High
L	Low
M	Slope
P	Profile
R	Register
X	Distance
Y	Altitude
Δ	Delta
B'	Y-axis Intercept
t	t Register
x	x Register
ΔX_N	Calculated Differential Distance

WYLE LABORATORIES

WYLE RESEARCH REPORT

WR 77-19

CALCULATOR AIRPORT
NOISE METHOD
VOLUME I:
USER'S GUIDE

For

U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Noise Abatement and Control
Washington, D.C. 20590

(Contract No. 68-01-3514)

By

John Moran

WYLE RESEARCH
El Segundo, California 90245

DECEMBER 1977

REPORT

Airport Noise Program for TI-59 Calculator

```
000   91  R/S   Start/End
001   76  LBL   Initial and
002   11  A     New Track Label
003   71  SBR   Prompt:  DTT
004   69  OP
005   91  R/S   Input
006   99  PRT
007   52  EE    DTT ÷ 100 ⟶ R32
008   02  2
009   94  +/-
010   42  STO
011   32  32
012   25  CLR
013   03  3
014   42  STO
015   00  00
016   71  SBR   Prompt:  DAT
017   69  OP
018   91  R/S   Input
019   99  PRT
020   42  STO   DAT ⟶ R33
021   33  33
022   76  LBL   New Aircraft
023   13  C     Same Track Label
024   01  1
025   42  STO
026   00  00
027   71  SBR   Prompt:  SLC
028   69  OP
029   91  R/S   Input
030   99  PRT
031   42  STO   SLC ⟶ R31
032   31  31
033   03  3
034   08  8
035   42  STO
036   00  00
037   71  SBR   Prompt:  DOPS, NOPS
038   69  OP
039   91  R/S   Input
040   99  PRT
041   32  X:T   DOPS ⟶ t
042   25  CLR
043   91  R/S   Input
044   99  PRT   NOPS ⟶ x
045   65  ×
046   01  1     10 log (DOPS + 10NOPS)
047   00  0     ⟶ R34
048   85  +
049   32  X:T
```

```
050   95  =
051   28  LOG
052   65  ×
053   01  1
054   00  0
055   95  =
056   42  STO
057   34  34
058   43  RCL   Set Ldn Print
059   35  35
060   69  OP
061   04  04
062   01  1     Profile Analysis
063   32  X:T
064   43  RCL   SLC ⟶ x
065   31  31
066   22  INV
067   77  GE    x < t:  Approach
068   10  E'
069   67  EQ    x = t - Departure
070   14  D     SL 1
071   32  X:T
072   03  3
073   67  EQ    x = t:  Departure
074   18  C'    SL 3
075   05  5     SL 2 Analysis
076   44  SUM
077   07  07
078   76  LBL   SL Modification
079   18  C'
080   73  RC*   ΔR ⟶ x
081   08  08
082   71  SBR   Unpack ΔX and ΔY
083   99  PRT
084   52  EE    Left Adjust
085   05  5
086   32  X:T   ΔX, ΔY ⟶ t
087   07  7
088   44  SUM   R8+7 = Profile R#
089   08  08
090   32  X:T
091   74  SM*   ΔX, ΔY + X, Y
092   08  08
093   08  8
094   22  INV   R8 - 8 = ΔR#
095   44  SUM
096   08  08
097   97  DSZ   Modifications Complete?
098   09  09
099   18  C'    C ⟶ C'
```

```
100  76  LBL   Departure Profile
101  14   D    Analysis
102  25  CLR
103  02   2
104  04   4    H P R # --> R9
105  42  STO
106  09   09
107  43  RCL   # P Segments --> R8
108  10   10
109  42  STO
110  08   08
111  43  RCL   DAT --> x
112  33   33
113  52  EE    Left Justify
114  05   5
115  42  STO   DAT--> R6
116  06   06
117  32  X:T   DAT--> t
118  25  CLR
119  76  LBL   Search Loop
120  30  TAN
121  73  RC*   P Segment --> x
122  09   09
123  22  INV
124  77   GE   x < t: Trapped
125  58  FIX
126  69  OP
127  39   39
128  97  DSZ
129  08   08
130  30  TAN   Continue Search
131  76  LBL   Check for Last Segment
132  58  FIX
133  43  RCL
134  10   10
135  32  X:T   # of Segments --> t
136  43  RCL   Trap R # --> x
137  08   08
138  22  INV
139  77   GE   x < t - Not Last
140  59  INT
141  69  OP
142  39   39
143  76  LBL   Compute - Altitude, Thrust,
144  59  INT   Velocity, Ratio
145  43  RCL
146  06   06   DAT--> x
147  75   -
148  73  RC*   DAT - L Trap R
149  09   09
```

```
150  42  STO   L Trap R --> R6
151  06   06
152  95   =
153  42  STO   ΔX_N --> R8
154  08   08
155  69  OP
156  29   29
157  73  RC*   H Trap R --> x
158  09   09
159  75   -
160  43  RCL   H Trap R - L Trap R
161  06   06
162  95   =    ΔX, ΔY (Packed)
163  22  INV
164  49  PRD   ΔX_N ÷ ΔX --> R8
165  08   08
166  32  X:T   ΔX, ΔY--> t
167  07   7
168  42  STO
169  07   07
170  02   2
171  42  STO
172  06   06
173  32  X:T   ΔX, ΔY--> x
174  71  SBR
175  99  PRT   Unpack ΔY
176  49  PRD
177  08   08   ΔY (ΔX_N ÷ΔX) --> R8
178  69  OP
179  39   39
180  73  RC*   L Trap R--> x
181  09   09
182  71  SBR
183  99  PRT   Unpack Y
184  85   +
185  43  RCL   Y + ΔY (ΔX_N ÷ ΔX)
186  08   08
187  95   =    = Altitude
188  42  STO   Altitude --> R14
189  14   14
190  05   5
191  42  STO
192  07   07
193  73  RC*
194  09   09
195  71  SBR   Unpack VR
196  99  PRT
197  42  STO   VR --> 15
198  15   15
199  03   3
```

```
200  42 STO
201  07  07
202  42 STO
203  06  06
204  73 RC*
205  09  09
206  71 SBR    Unpack Thrust
207  99 PRT
208  42 STO    Thrust —> R16
209  16  16
210  43 RCL    VR -> x
211  15  15
212  61 GTO    C —> Corrections
213  12  B
214  76 LBL    General
215  99 PRT    Unpacking
216  22 INV    Subroutine
217  52 EE
218  55  ÷
219  53  (
220  43 RCL    Digit Position—> x
221  07  07
222  22 INV
223  28 LOG
224  54  )
225  54  )
226  22 INV
227  59 INT
228  65  ×
229  53  (
230  43 RCL    # of Digits—> x
231  06  06
232  22 INV
233  28 LOG
234  54  )
235  54  )
236  59 INT    Unpacked Value —> x
237  92 RTN
238  76 LBL    Approach Profile
239  10 E'     Analysis
240  32 X:T    SLC —> t
241  03  3
242  42 STO
243  06  06
244  43 RCL    DAT—> x
245  33  33
246  52 EE
247  02  2
248  94 +/-
249  42 STO
```

```
250  14  14    DAT ÷ 100 —> R14
251  25 CLR
252  67  EQ    x = t: Standard 3° or 4.5°
253  02  02
254  88  88    C—> 288
255  02  2
256  05  5
257  42 STO    L P R #—> R9
258  09  09
259  01  1
260  94 +/-
261  67  EQ    x = t:  Level Flight
262  60 DEG
263  02  2     Pattern Entry R#—> R9
264  44 SUM
265  09  09
266  76 LBL
267  60 DEG
268  03  3
269  42 STO
270  07  07
271  73 RC*    P R—> x
272  09  09
273  71 SBR    Unpack Thrust
274  99 PRT
275  42 STO    Thrust—> R16
276  16  16
277  69 OP
278  36  36
279  05  5
280  42 STO
281  07  07
282  73 RC*    P R—> x
283  09  09
284  71 SBR    Unpack Velocity Ratio
285  99 PRT
286  61 GTO    C—> Corrections
287  12  B
288  43 RCL    Standard Analysis
289  33  33
290  77  GE    x ≥ t: GS Calculation
291  03  03
292  00  00
293  25 CLR    Runway Calculation
294  42 STO    0—> R14
295  14  14
296  43 RCL    Change P R's
297  25  25
298  42 STO
299  26  26
```

```
300   43  RCL     P R→x
301   26   26
302   55   ÷
303   01   1      Unpack Tan (GS)
304   52  EE
305   04   4
306   95   =
307   22  INV
308   59  INT
309   49  PRD     DAT · Tan (GS)
310   14   14     = Altitude →14
311   08   8
312   42  STO
313   07   07
314   43  RCL     P R→x
315   26   26
316   71  SBR     Unpack Thrust
317   99  PRT
318   42  STO     Thrust →R16
319   16   16
320   02   2
321   44  SUM
322   07   07
323   69  OP
324   36   36
325   43  RCL     P R→x
326   26   26
327   71  SBR     Unpack VR
328   99  PRT
329   76  LBL     Corrections Analysis
330   12   B
331   28  LOG     Compute
332   65   x      Velocity
333   01   1      Correction
334   00   0
335   75   -
336   01   1
337   00   0
338   95   =
339   94  +/-     Velocify
340   42  STO     Correction→R15
341   15   15
342   43  RCL     Compute SLR
343   14   14     Y→x
344   33  X²
345   85   +
346   43  RCL
347   32   32     DTT→x
348   33  X²
349   95   =

350   34  √X
351   42  STO     SLR→R13
352   13   13
353   35  1/X     Compute EA
354   65   ×
355   43  RCL     DTT ÷ SLR
356   32   32
357   95   =
358   22  INV
359   39  COS
360   42  STO     EA→R12
361   12   12
362   38  SIN     Compute ES
363   34  √X
364   94  +/-
365   85   +
366   01   1
367   95   =
368   65   ×
369   03   3
370   94  +/-
371   95   =
372   44  SUM     ES + R15→R15
373   15   15
374   43  RCL     Compute AI
375   14   14
376   32  X:T     Y→t
377   03   3
378   00   0
379   77   GE     X ≥ t:  AI = O
380   89   π      C→π
381   09   9
382   09   9
383   77   GE     X ≥ t:  AI = -1
384   79   x̄
385   02   2
386   94  +/-
387   44  SUM     AI + R15→R15
388   15   15
389   61  GTO
390   89   π      C→π
391   76  LBL
392   79   x̄
393   01   1
394   94  +/-
395   44  SUM     AI + R15→R15
396   15   15
397   76  LBL     Compute GA
398   89   π
399   43  RCL
```

```
400  12  12
401  32  X⇌T
402  07   7
403  22  INV
404  77   GE    x < t:  GA = 0
405  48  EXC    C → EXC
406  01   1
407  42  STO    Initialize LM
408  10  10
409  04   4
410  77   GE    x ≥ t: Full GA
411  68  NOP    C → NOP
412  94  +/-
413  85   +     Compute
414  32  X⇌T    LM for GA
415  95   =
416  55   ÷
417  03   3
418  95   =
419  42  STO    LM → R10
420  10  10
421  76  LBL    Compute GA
422  68  NOP
423  05   5
424  42  STO
425  07  07
426  02   2
427  42  STO
428  06  06
429  43  RCL    SLC → t
430  31  31
431  32  X⇌T
432  00   0
433  77   GE    x ≥ t: Approach
434  04  04     C → 439
435  39  39
436  05   5     Set Departure
437  44  SUM    Constants
438  07  07
439  43  RCL    GA R → x
440  11  11
441  71  SBR    Unpack B
442  99  PRT    Coefficient
443  52  EE
444  01   1     Adjust Units
445  94  +/-
446  33  X²
447  65   x
448  02   2
449  95   =

450  32  X⇌T    2B² → t
451  03   3
452  42  STO
453  06  06
454  02   2
455  22  INV
456  44  SUM
457  07  07
458  43  RCL    GA R → x
459  11  11
460  71  SBR    Unpack A
461  99  PRT    Coefficient
462  52  EE
463  01   1     Adjust Units
464  94  +/-
465  42  STO    A → R6
466  06  06
467  43  RCL    SLR → x
468  13  13
469  55   ÷
470  05   5     (SLR ÷ 10) · 2 = Q
471  75   -
472  02   2
473  02   2
474  95   =
475  33  X²
476  94  +/-
477  55   ÷
478  32  X⇌T    (Q - 22)² ÷ 2B² = Q'
479  95   =
480  22  INV
481  23  LNX    e^Q'
482  65   x
483  43  RCL
484  06  06
485  85   +
486  05   5
487  95   =
488  65   x
489  43  RCL
490  10  10
491  95   =     (e^Q' · A + 5) · LM = GA
492  94  +/-
493  44  SUM    -GA + R15 → R15
494  15  15
495  76  LBL    Compute SEL
496  48  EXC
497  01   1
498  00   0
499  22  INV
```

```
500  49 PRD   Thrust ÷ 10
501  16  16
502  02  2
503  08  8
504  42 STO   A Coefficient
505  09  09   R # → R9
506  76 LBL   Two Loop
507  36 PGM   Label
508  05  5
509  42 STO
510  07  07
511  42 STO
512  06  06
513  73 RC*   A/B Coefficients
514  09  09   → x
515  71 SBR
516  99 PRT   Unpack B'
517  52 EE
518  02  2
519  94 +/-
520  32 X:T   B' → t
521  05  5
522  44 SUM
523  07  07
524  42 STO
525  06  06
526  73 RC*   A/B Coefficients
527  09  09   → x
528  71 SBR   Unpack M
529  99 PRT
530  52 EE
531  04  4
532  94 +/-
533  65  ×
534  43 RCL   Thrust → x
535  16  16
536  85  +
537  32 X:T
538  95  =    M · Thrust + B'
539  72 ST*   A → R28
540  09  09   B → R29
541  69 OP
542  29  29
543  87 IFF   Test Flag
544  00  00
545  45 Y×    C → Y^X
546  86 STF   Set Flag
547  00  00
548  61 GTO
549  36 PGM   C → PGM
```

```
550  76 LBL   Elliptical
551  45 Y×    Evaluation
552  43 RCL   SLR → x
553  13  13
554  28 LOG
555  85  +
556  02  2
557  95  =
558  33 X²
559  55  ÷
560  43 RCL   B → x
561  29  29
562  33 X²
563  95  =    (Log (SLR) )²÷ B² = Q
564  94 +/-
565  85  +
566  01  1
567  95  =
568  65  ×
569  43 RCL   A → x
570  28  28
571  33 X²    SEL² = A²(1 - Q)
572  95  =
573  34 ΓX
574  85  +
575  43 RCL   Operations
576  34  34   Factor → x
577  75  -
578  43 RCL   49.4 → x
579  05  05
580  95  =
581  44 SUM   Ldn for Flight
582  15  15
583  93  .    Log Sum for
584  01  1    Total Ldn
585  49 PRD
586  15  15
587  49 PRD
588  30  30
589  43 RCL
590  30  30
591  22 INV
592  28 LOG
593  85  +
594  43 RCL
595  15  15
596  22 INV
597  28 LOG
598  95  =
599  28 LOG
```

```
600  65  X
601  01  1
602  00  0
603  95  =
604  22  INV
605  52  EE
606  42  STO      Total Ldn→R30
607  30   30
608  98  ADV
609  69  OP       Print Ldn
610  06   06
611  32  X:T      Ldn→t
612  58  FIX
613  02   02
614  43  RCL
615  27   27      Print Aircraft #
616  71  SBR
617  99  PRT
618  99  PRT
619  98  ADV      Clear Print R'
620  69  OP
621  00   00      C→000
622  32  X:T      Ldn→x
623  81  RST      Subroutine
624  76  LBL      Alpha > x
625  69  OP
626  73  RC*      Increment R#
627  00   00
628  69  OP
629  01   01
630  69  OP
631  20   20
632  73  RC*
633  00   00
634  69  OP
635  02   02      Print Message
636  25  CLR
637  69  OP       End of Program
638  05   05
639  92  RTN
```

APPENDIX B

Aircraft Data

AIRCRAFT DATA

AIRCRAFT TYPE 1

Data	Register Number
36.	00
3627001532.	01
1617000000.	02
1600132700.	03
3735131526.	04
49.4	05
5.	06
5.	07
17.	08
6.	09
7.	10
9007085030.	11
130003600.	12
280007700.	13
490114402.	14
740020600.	15
810021800.	16
930025800.	17
2315.	18
600005310.	19
1341010303.	20
2031211269.	21
3583013259.	22
4763314252.	23
5424016999.	24
540010455.	25
933600524.	26
113112.	27
245912244.	28
14400488.	29

AIRCRAFT TYPE 2

Data	Register Number
36.	00
3627001532.	01
1617000000.	02
1600132700.	03
3735131526.	04
49.4	05
5.	06
5.	07
17.	08
6.	09
7.	10
9007785053.	11
200004500.	12
390009200.	13
660116502.	14
1070025900.	15
1230028800.	16
1440034200.	17
2151.	18
540005148.	19
1181010145.	20
1741211120.	21
3283012116.	22
4513314112.	23
5144016999.	24
440010184.	25
912800524.	26
203040.	27
720212401.	28
45900460.	29

AIRCRAFT DATA

AIRCRAFT TYPE 3

Data	Register Number
36.	00
3627001532.	01
1617000000.	02
1600132700.	03
3735131526.	04
49.4	05
5.	06
5.	07
17.	08
6.	09
7.	10
9006690066.	11
200004500.	12
370009200.	13
660116502.	14
1070025900.	15
1230028800.	16
1440034200.	17
2151.	18
540005148.	19
1181010145.	20
1741211120.	21
3283012116.	22
4513314112.	23
5144016999.	24
440010184.	25
912800524.	26
313040.	27
1629810791.	28
34800479.	29

AIRCRAFT TYPE 4

Data	Register Number
36.	00
3627001532.	01
1617000000.	02
1600132700.	03
3735131526.	04
49.4	05
5.	06
5.	07
17.	08
6.	09
7.	10
9007585045.	11
210000000.	12
470000000.	13
960200000.	14
1280000000.	15
1390000000.	16
1670000000.	17
2179.	18
560005176.	19
1301010172.	20
2101311153.	21
3553013147.	22
4653314143.	23
5314016999.	24
412010094.	25
906000524.	26
413015.	27
1350011300.	28
76900446.	29

AIRCRAFT DATA

AIRCRAFT TYPE 5

Data	Register Number
36.	00
3627001532.	01
1617000000.	02
1600132700.	03
3735131526.	04
49.4	05
5.	06
5.	07
17.	08
6.	09
7.	10
9006290062.	11
210000000.	12
470000000.	13
960000000.	14
1280000000.	15
1390000000.	16
1670000000.	17
2119.	18
5600005117.	19
1301010115.	20
2101311102.	21
3553013098.	22
4653314095.	23
5314016999.	24
412010094.	25
906000524.	26
513015.	27
2149010244.	28
64400468.	29.

AIRCRAFT TYPE 6

Data	Register Number
36.	00
3627001532.	01
1617000000.	02
1600132700.	03
3735131526.	04
49.4	05
5.	06
5.	07
17.	08
6.	09
7.	10
9007485058.	11
130003600.	12
280007700.	13
490114402.	14
740020600.	15
810021800.	16
930025800.	17
2315.	18
600005310.	19
1341010303.	20
2031211269.	21
3583013259.	22
4763314252.	23
5424016999.	24
540010455.	25
933600524.	26
613112.	27
351011352.	28
20400480.	29

AIRCRAFT DATA

AIRCRAFT TYPE 7

Data	Register Number
36.	00
3627001532.	01
1617000000.	02
1600132700.	03
3735131526.	04
49. 4	05
5.	06
5.	07
17.	08
6.	09
3.	10
9004990049.	11
0.	12
0.	13
0.	14
0.	15
0.	16
0.	17
0.	18
0.	19
0.	20
0.	21
5100.	22
450010100.	23
2002810100.	24
500011000.	25
1000000787.	26
713000.	27
1735511598.	28
2400528.	29

AIRCRAFT TYPE 8

Data	Register Number
36.	00
3627001532.	01
1617000000.	02
1600132700.	03
3735131526.	04
49. 4	05
5.	06
5.	07
17.	08
6.	09
7.	10
9007585045.	11
90000000.	12
180000000.	13
310000000.	14
490000000.	15
500000000.	16
610000000.	17
2134.	18
440005132.	19
1021010129.	20
1611211102.	21
3003013099.	22
3963214096.	23
4604016999.	24
408010066.	25
804600524.	26
813009.	27
1385611107.	28
74500444.	29

AIRCRAFT DATA

AIRCRAFT TYPE 9

Data	Register Number
36.	00
3627001532.	01
1617000000.	02
1600132700.	03
3735131526.	04
49.4	05
5.	06
5.	07
17.	08
6.	09
7.	10
9006290062.	11
90000000.	12
180000000.	13
310000000.	14
490000000.	15
500000000.	16
610000000.	17
2134.	18
440005132.	19
1021010129.	20
1611211102.	21
3003013099.	22
3963214096.	23
4604016999.	24
408010066.	25
804600524.	26
913009.	27
2189010005.	28
62700466.	29

AIRCRAFT TYPE 10

Data	Register Number
36.	00
3627001532.	01
1617000000.	02
1600132700.	03
3735131526.	04
49.4	05
5.	06
5.	07
17.	08
6.	09
7.	10
9007485058.	11
130002000.	12
300004600.	13
550108501.	14
860013200.	15
850013000.	16
980014800.	17
2313.	18
530005308.	19
1241010301.	20
1911212261.	21
3483013309.	22
4163214297.	23
4704016999.	24
440010392.	25
923000524.	26
1013072.	27
214711320.	28
17900478.	29

AIRCRAFT DATA

AIRCRAFT TYPE 11

Data	Register Number
36.	00
3627001532.	01
1617000000.	02
1600132700.	03
3735131526.	04
49.4	05
5.	06
5.	07
17.	08
6.	09
4.	10
9910399103.	11
0.	12
0.	13
0.	14
0.	15
0.	16
0.	17
0.	18
0.	19
0.	20
5100.	21
490010100.	22
2491510100.	23
4002510100.	24
500010000.	25
1000000524.	26
1110000.	27
1070510554.	28
11900551.	29

AIRCRAFT TYPE 12

Data	Register Number
36.	00
3627001532.	01
1617000000.	02
1600132700.	03
3735131526.	04
49.4	05
5.	06
5.	07
17.	08
6.	09
3.	10
8056780567.	11
0.	12
0.	13
0.	14
0.	15
0.	16
0.	17
0.	18
0.	19
0.	20
0.	21
5100.	22
280010100.	23
2001610100.	24
500011000.	25
1000000524.	26
1214000.	27
213310696.	28
15800524.	29

AIRCRAFT DATA

AIRCRAFT TYPE 13

DATA	REGISTER NUMBER
36.	00
3627001532.	01
1617000000.	02
1600132700.	03
3735131526.	04
49. 4	05
5.	06
5.	07
17.	08
6.	09
3.	10
9009285045.	11
0.	12
0.	13
0.	14
0.	15
0.	16
0.	17
0.	18
0.	19
0.	20
0.	21
8100.	22
150016100.	23
2002316100.	24
500013000.	25
1000000787.	26
1314000.	27
66510530.	28
37300471.	29

AIRCRAFT TYPE 14

DATA	REGISTER NUMBER
36.	00
260011100.	01
1617000000.	02
1600132700.	03
3735131526.	04
49. 4	05
5.	06
5.	07
17.	08
6.	09
3.	10
9910399103.	11
0.	12
0.	13
0.	14
0.	15
0.	16
0.	17
0.	18
0.	19
0.	20
0.	21
5100.	22
260011100.	23
3002411100.	24
500012000.	25
1000000787.	26
1415000.	27
1071210247.	28
12300545.	29

AIRCRAFT DATA

AIRCRAFT TYPE 15

DATA	REGISTER NUMBER
36.	00
3627001532.	01
1617000000.	02
1600132700.	03
3735131526.	04
49.4	05
5.	06
5.	07
17.	08
6.	09
3.	10
9911099110.	11
0.	12
0.	13
0.	14
0.	15
0.	16
0.	17
0.	18
0.	19
0.	20
0.	21
5100.	22
200010100.	23
2002110100.	24
500012000.	25
1000000787.	26
1517000.	27
613009584.	28
28100525.	29

AIRCRAFT TYPE 16

DATA	REGISTER NUMBER
36.	00
3627001532.	01
1617000000.	02
1600132700.	03
3735131526.	04
49.4	05
5.	06
5.	07
17.	08
6.	09
3.	10
9007590075.	11
0.	12
0.	13
0.	14
0.	15
0.	16
0.	17
0.	18
0.	19
0.	20
0.	21
5100.	22
280010100.	23
2002910100.	24
500012000.	25
1000000787.	26
1616000.	27
1105909689.	28
18300505.	29

too slow between calculations 1 minute ~~new~~ ~~track~~
30 sec ~~same~~ ~~track~~

read cards

equation for cumulative L_{dn} needed:

$$dB_{Tot} = 10 \log_{10} \sum_{i=1}^{N} 10^{\frac{dB_i}{10}}$$

AIRCRAFT DATA

AIRCRAFT TYPE 17

DATA	REGISTER NUMBER
36.	00
3627001532.	01
1617000000.	02
1600132700.	03
3735131526.	04
49.4	05
5.	06
5.	07
17.	08
6.	09
4.	10
9911099110.	11
0.	12
0.	13
0.	14
0.	15
0.	16
0.	17
0.	18
0.	19
0.	20
5100.	21
50010100.	22
140110100.	23
2001810100.	24
500012000.	25
1000000787.	26
1717000.	27
1190708802.	28
40100509.	29