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REVISED DRAFT

USER'S GUIDE FOR THE AMS/EPA REGULATORY MODEL - AERMOD

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PREFACE

This revised draft User's Guide for the AMS/EPA Regulatory Model (AERMOD) provides user instructions for the AERMOD model. The technical description of the AERMOD algorithms is provided in a separate document (EPA, 1998a). The revised AERMOD model described in this user's guide includes the following modifications and enhancements: the PRIME building downwash algorithms based on the ISC-PRIME model; use of allocatable arrays for data storage; incorporation of EVENT processing for analyzing short-term source culpability; post-1997 PM10 processing; a non-regulatory default TOXICS option that includes optimizations for area sources and the Sampled Chronological Input Model (SCIM) option; explicit treatment of multiple-year meteorological data files and the ANNUAL average; and options to specify emissions that vary by season, hour-of-day and day-of-week.

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CONTENTS

PREFACE iii

ACKNOWLEDGMENTS iv

FIGURES ix

TABLES x

1.0 INTRODUCTION 1-1
1.1 HOW TO USE THE AERMOD MANUALS 1-1
1.1.1 Novice Users 1-1
1.1.2 Experienced Modelers 1-2
1.1.3 Management/Decision Makers 1-2
1.1.4 Programmers/Systems Analysts 1-3
1.2 OVERVIEW OF THE AERMOD MODEL 1-3
1.2.1 Regulatory Applicability 1-3
1.2.2 Basic Input Data Requirements 1-4
1.2.3 Computer Hardware Requirements 1-4
1.2.4 Overview of Available Modeling Options 1-5

2.0 GETTING STARTED - A BRIEF TUTORIAL 2-1
2.1 DESCRIPTION OF KEYWORD/PARAMETER APPROACH 2-1
2.1.1 Basic Rules for Structuring Input Runstream Files 2-2
2.1.2 Advantages of the Keyword Approach 2-5
2.2 REGULATORY MODELING OPTIONS 2-6
2.3 MODEL STORAGE LIMITS 2-7
2.4 SETTING UP A SIMPLE RUNSTREAM FILE 2-9
2.4.1 A Simple Industrial Source Application 2-11
2.4.2 Selecting Modeling Options - CO Pathway 2-11
2.4.3 Specifying Source Inputs - SO Pathway 2-15
2.4.4 Specifying a Receptor Network - RE Pathway 2-19
2.4.5 Specifying the Meteorological Input - ME Pathway 2-20
2.4.6 Selecting Output Options - OU Pathway 2-22
2.4.7 Using the Error Message File to Debug the Input Runstream File .. 2-26
2.4.8 Running the Model and Reviewing the Results 2-31
2.5 MODIFYING AN EXISTING RUNSTREAM FILE 2-38
2.5.1 Modifying Modeling Options 2-38
2.5.2 Adding or Modifying a Source or Source Group 2-38
2.5.3 Adding or Modifying a Receptor Network 2-39
2.5.4 Modifying Output Options 2-39

3.0 DETAILED KEYWORD REFERENCE 3-1
3.1 OVERVIEW 3-1
3.2 CONTROL PATHWAY INPUTS AND OPTIONS 3-2
3.2.1 Title Information 3-2
3.2.2 Dispersion Options 3-2
3.2.3 Averaging Time Options 3-5
3.2.4 Urban Modeling Option 3-6
3.2.5 Specifying the Pollutant Type 3-7
3.2.6 Modeling With Exponential Decay 3-7
3.2.7 Flagpole Receptor Height Option 3-8
3.2.8 To Run or Not to Run - That is the Question 3-8
3.2.9 Generating an Input File for EVENT Processing 3-9
3.2.10 The Model Re-start Capability 3-10
3.2.11 Post-1997 PM_{10} Processing 3-11
3.2.12 Pre-1997 PM_{10} Processing 3-13
3.2.13 Debugging Output Option 3-14
3.2.14 Detailed Error Listing File 3-14
3.3 SOURCE PATHWAY INPUTS AND OPTIONS 3-15
3.3.1 Identifying Source Types and Locations 3-16
3.3.2 Specifying Source Release Parameters 3-17
3.3.3 Specifying Building Downwash Information 3-27
3.3.4 Specifying Urban Sources 3-32
3.3.5 Using Variable Emission Rates 3-33
3.3.6 Adjusting the Emission Rate Units for Output 3-36
3.3.7 Specifying Variables for Settling, Removal and Deposition Calculations 3-37
3.3.8 Specifying Variables for Precipitation Scavenging and Wet Deposition Calculations 3-37
3.3.9 Specifying an Hourly Emission Rate File 3-37
3.3.10 Including Source Data From an External File 3-39
3.3.11 Using Source Groups 3-39
3.4 RECEPTOR PATHWAY INPUTS AND OPTIONS 3-41
3.4.1 Defining Networks of Gridded Receptors 3-42
3.4.2 Using Multiple Receptor Networks 3-48
3.4.3 Specifying Discrete Receptor Locations 3-49
3.4.4 Including Receptor Data From an External File 3-52
3.5 METEOROLOGY PATHWAY INPUTS AND OPTIONS 3-53
3.5.1 Specifying the Input Data Files and Formats 3-53
3.5.2 Specifying Station Information 3-55
3.5.3 Specifying the Base Elevation for Potential Temperature Profile 3-56
3.5.4 Specifying a Data Period to Process 3-56
3.5.5 Correcting Wind Direction Alignment Problems 3-59
3.5.6 Specifying Wind Speed Categories 3-59
3.5.7 Specifying SCIM Parameters 3-60

3.6 EVENT PATHWAY INPUTS AND OPTIONS 3-61
3.6.1 Using Events Generated by the AERMOD Model 3-62
3.6.2 Specifying Discrete Events 3-64
3.6.3 Including Event Data From an External File 3-64
3.7 OUTPUT PATHWAY INPUTS AND OPTIONS 3-65
3.7.1 Selecting Options for Tabular Printed Outputs. 3-65
3.7.2 Selecting Options for Special Purpose Output Files. 3-68
3.7.3 EVENT Processing Options 3-79
3.8 CONTROLLING INPUT AND OUTPUT FILES 3-79
3.8.1 Description of AERMOD Input Files 3-80
3.8.2 Description of AERMOD Output Files 3-81
3.8.3 Control of File Inputs and Outputs (I/O) 3-88

4.0 COMPUTER NOTES 4-1
4.1 MINIMUM HARDWARE REQUIREMENTS 4-1
4.2 COMPILING AND RUNNING THE MODEL ON A PC 4-1
4.2.1 Compaq Compiler Options 4-2
4.2.2 Lahey Compiler Options 4-3
4.2.3 Storage Limits 4-4
4.3 PORTING THE MODEL TO OTHER PLATFORMS 4-6

5.0 REFERENCES 5-1

APPENDIX A. ALPHABETICAL KEYWORD REFERENCE A-1

APPENDIX B. FUNCTIONAL KEYWORD/PARAMETER REFERENCE B-1

APPENDIX C. EXPLANATION OF ERROR MESSAGE CODES C-1
C.1 INTRODUCTION C-1
C.2 THE OUTPUT MESSAGE SUMMARY C-2
C.3 DESCRIPTION OF THE MESSAGE LAYOUT C-3
C.4 DETAILED DESCRIPTION OF THE ERROR/MESSAGE CODES C-5

APPENDIX D. DESCRIPTION OF FILE FORMATS D-1
D.1 AERMET METEOROLOGICAL DATA D-1
D.2 THRESHOLD VIOLATION FILES (MAXIFILE OPTION) D-3
D.3 POSTPROCESSOR FILES (POSTFILE OPTION) D-3
D.4 HIGH VALUE RESULTS FOR PLOTTING (PLOTFILE OPTION) D-5
D.5 TOXX MODEL INPUT FILES (TOXXFILE OPTION) D-6
D.6 MAXIMUM VALUES BY RANK (RANKFILE OPTION) D-7
D.7 ARC-MAXIMUM VALUES FOR EVALUATION (EVALFILE OPTION) . D-9
D.7 RESULTS BY SEASON AND HOUR-OF-DAY (SEASONHR OPTION) . D-10

APPENDIX E.
QUICK REFERENCE FOR AERMOD E-1

GLOSSARY GLOSSARY-1

INDEX INDEX-1

FIGURES

Figure		Page
2-1.	EXAMPLE INPUT FILE FOR AERMOD FOR SAMPLE PROBLEM	2-10
2-2.	EXAMPLE INPUT RUNSTREAM FILE FOR SAMPLE PROBLEM	2-25
2-3.	EXAMPLE MESSAGE SUMMARY TABLE FOR RUNSTREAM SETUP	2-29
2-4.	EXAMPLE OF KEYWORD ERROR AND ASSOCIATED MESSAGE SUMMARY TABLE	2-30
2-5.	ORGANIZATION OF AERMOD MODEL OUTPUT FILE	2-32
2-6.	SAMPLE OF MODEL OPTION SUMMARY TABLE FROM AN AERMOD MODEL OUTPUT FILE	2-35
2-7.	EXAMPLE OUTPUT TABLE OF HIGH VALUES BY RECEPTOR	2-36
2-8.	EXAMPLE OF RESULT SUMMARY TABLES FOR THE AERMOD MODEL	2-37
3-1.	RELATIONSHIP OF AREA SOURCE PARAMETERS FOR ROTATED RECTANGLE	3-23
3-2.	SCHEMATIC DIAGRAM IDENTIFYING NEW BUILDING DATA FOR PRIME DOWNWASH	3-31
C-1.	EXAMPLE OF AN AERMOD MESSAGE SUMMARY	C-3

TABLES

Table — Page

3-1. SUMMARY OF SUGGESTED PROCEDURES FOR ESTIMATING INITIAL LATERAL DIMENSIONS σ_{yo} AND INITIAL VERTICAL DIMENSIONS σ_{zo} FOR VOLUME AND LINE SOURCES 3-20

B-1. DESCRIPTION OF CONTROL PATHWAY KEYWORDS B-3

B-2. DESCRIPTION OF CONTROL PATHWAY KEYWORDS AND PARAMETERS B-4

B-3. DESCRIPTION OF SOURCE PATHWAY KEYWORDS B-7

B-4. DESCRIPTION OF SOURCE PATHWAY KEYWORDS AND PARAMETERS B-8

B-5. DESCRIPTION OF RECEPTOR PATHWAY KEYWORDS B-10

B-6. DESCRIPTION OF RECEPTOR PATHWAY KEYWORDS AND PARAMETERS B-11

B-7. DESCRIPTION OF METEOROLOGY PATHWAY KEYWORDS B-14

B-8. DESCRIPTION OF METEOROLOGY PATHWAY KEYWORDS AND PARAMETERS B-15

B-9. DESCRIPTION OF EVENT PATHWAY KEYWORDS B-17

B-10. DESCRIPTION OF EVENT PATHWAY KEYWORDS AND PARAMETERS B-18

B-11. DESCRIPTION OF OUTPUT PATHWAY KEYWORDS B-19

B-12. DESCRIPTION OF OUTPUT PATHWAY KEYWORDS AND PARAMETERS B-20

1.0 INTRODUCTION

This section provides an overall introduction to the AERMOD model and to the AERMOD user's guide. Some suggestions are offered on how various users would best benefit from using the manuals. Also provided is an overview of the model's applicability, range of options, and basic input data and hardware requirements. The input file needed to run the AERMOD model is based on an approach that uses descriptive keywords and allows for a flexible structure and format.

1.1 HOW TO USE THE AERMOD MANUALS

The AERMOD model user's guide has been designed in an attempt to meet the needs of various types of users, depending on their level of experience with the model. This section describes briefly how different types of users would benefit most from their use of the manual.

1.1.1 Novice Users

Novice users are those whose exposure to or experience with the AERMOD model has been limited. They may be new to dispersion modeling applications in general, or new to the AERMOD model and therefore unfamiliar with the keyword/parameter approach utilized for the input file. These users should review the remainder of this Introduction to gain an overall perspective of the use of AERMOD model, particularly for regulatory modeling applications. They should then concentrate their review on Section 2, which provides a brief tutorial on setting up an input file that illustrates the most commonly used options of the AERMOD model. Section 2 provides a basic description of the input file structure and explains some of the advantages of the keyword/parameter approach to specifying modeling options and inputs. As the user becomes more familiar with the operation of the model and encounters the need to use more advanced features of the model, he/she will want to review the contents of Section 3, which provides a more detailed and complete reference of the various options for running the model.

1.1.2 Experienced Modelers

Experienced modelers will have had considerable experience in applying the AERMOD model in a variety of situations. They should have basic familiarity with the overall goals and purposes of regulatory modeling in general, and with the scope of options available in the AERMOD model in particular. Experienced modelers who are new to the AERMOD model will benefit from first reviewing the contents of Section 2 of this volume, which will give them a basic orientation to the structure, organization and philosophy of the keyword/parameter approach used for the input runstream file. Once they have a basic grasp of the input file structure and syntax rules, they will benefit most from using Section 3 of this volume as a reference to learn the overall capabilities of the model, or to understand the mechanics for implementing particular options. The information in Section 3 has a functional organization with detailed descriptions of each of the individual keyword options by functional pathway. Once they are familiar with most or all of the keywords, they may find the functional keyword reference provided in Appendix B useful to quickly review the proper syntax and available options/parameters for a particular keyword. They may also find the Quick Reference available at the end of the user's guide sufficient as a simple reminder of the available keywords for each pathway and to ensure the proper order of parameters for each input image.

Experienced modelers may also need to refer to the description of model formulation for AERMOD (EPA, 1998a) in order to gain a more complete understanding of the technical basis for the AERMOD model.

1.1.3 Management/Decision Makers

Those involved in a management or decision-making role for dispersion modeling applications will be especially interested in the remainder of this section, which provides an overview of the model, including its role in various regulatory programs, a brief description of the range of available options, and basic input data and computer hardware requirements

needed to run the model. From this information they should understand the basic capabilities of the AERMOD model well enough to judge the suitability of the model for particular applications. They may also want to review the brief tutorial provided in Section 2 to learn about the nature and structure of the input runstream file, in order to better be able to review the modeling results.

1.1.4 Programmers/Systems Analysts

Programmers and systems analysts, specifically those involved with installing the AERMOD code on other computer systems or charged with maintaining the code, should review the contents of Section 4 of this document. This will give specific details on compiling and linking the code for various situations, and explain in detail the memory storage requirements and control of input and output (I/O). They may also wish to review the remainder of this Introduction and the brief tutorial in Section 2 of this volume in order to have a basic understanding of the nature and overall capabilities of the model, and to understand the basic input runstream file structure and organization.

1.2 OVERVIEW OF THE AERMOD MODEL

This section provides an overview of the AERMOD model, including a discussion of the regulatory applicability of the model, a description of the basic options available for running the model, and an explanation of the basic input data and hardware requirements needed for executing the model.

1.2.1 Regulatory Applicability

The U.S. Environmental Protection Agency (EPA) maintains a *Guideline on Air Quality Models* (hereafter, Guideline), which is published as Appendix W to 40 CFR Part 51 (as revised). The Guideline provides the agency's guidance on regulatory applicability of air quality dispersion models in general. AERMOD is currently being proposed for inclusion in

the Guideline and has been released for public review and comment. In general, regulatory modeling applications should be carried out in accordance with a modeling protocol that is reviewed and approved by the appropriate agency prior to conducting the modeling. The modeling protocol should identify the specific model, modeling options and input data to be used for a particular application.

1.2.2 Basic Input Data Requirements

One of the basic inputs to AERMOD is the runstream setup file which contains the selected modeling options, as well as source location and parameter data, receptor locations, meteorological data file specifications, and output options. Another type of basic type of input data needed to run the model is the meteorological data. AERMOD requires two types of meteorological data files, that are provided by the AERMET meteorological preprocessor program (EPA, 1998b). One file consists of surface scalar parameters, and the other file consists of vertical profiles of meteorological data. These meteorological data files are described briefly later in this section, and in more detail in Sections 2 and 3. For applications involving elevated terrain effects, the receptor and terrain data will need to be processed by the AERMAP terrain preprocessing program (EPA, 1998c) before input to the AERMOD model.

1.2.3 Computer Hardware Requirements

The current version of the AERMOD model was developed on an IBM-compatible PC using the Lahey Fortran 90 Compiler (Release 4.50i), and has been designed to run on PCs with an 80386 or higher central processing unit (CPU) chip, a minimum of 2 MB of RAM, a math coprocessor, and MS-DOS Version 3.2 or higher. In order to handle the input data files (runstream setup and meteorology) and the output files, it is required that the system have a hard disk drive. The amount of storage space required on the hard disk for a particular application will depend greatly on the output options selected. Some of the optional output

files of concentration data can be rather large. More information on output file products is provided in Sections 2 and 3.

1.2.4 Overview of Available Modeling Options

The AERMOD model includes a wide range of options for modeling air quality impacts of pollution sources, making it a popular choice among the modeling community for a variety of applications. The following sections provide a brief overview of the options available in the AERMOD model.

1.2.4.1 Dispersion Options.

Since the AERMOD model is especially designed to support the EPA's regulatory modeling programs, the regulatory modeling options will be the default mode of operation for the model. These options include the use of stack-tip downwash, and a routine for processing averages when calm winds or missing meteorological data occur. The model also includes non-default options for suppressing the use of stack-tip downwash, and to disable the date checking for non-sequential meteorological data files. The latter option is needed to facilitate evaluation of the model. Currently, the model only calculates concentration values - dry and wet deposition algorithms have not yet been implemented. The user can specify several short term averages to be calculated in a single run of the AERMOD model, as well as requesting the overall period (e.g. annual) averages.

1.2.4.2 Source Options.

The model is capable of handling multiple sources, including point, volume, and area source types. Line sources may also be modeled as a string of volume sources or as elongated area sources. Several source groups may be specified in a single run, with the source contributions combined for each group. This is particularly useful for PSD applications where combined impacts may be needed for a subset of the modeled background sources that

consume increment, while the combined impacts from all background sources (and the permitted source) are needed to demonstrate compliance with the National Ambient Air Quality Standards (NAAQS). The model contain algorithms for modeling the effects of aerodynamic downwash due to nearby buildings on point source emissions. The current version of AERMOD does not include algorithms for modeling depositional effects on particulate emissions.

Source emission rates can be treated as constant throughout the modeling period, or may be varied by month, season, hour-of-day, or other optional periods of variation. These variable emission rate factors may be specified for a single source or for a group of sources. The user may also specify a separate file of hourly emission rates for some or all of the sources included in a particular model run.

1.2.4.3 Receptor Options.

The AERMOD model has considerable flexibility in the specification of receptor locations. The user has the capability of specifying multiple receptor networks in a single run, and may also mix Cartesian grid receptor networks and polar grid receptor networks in the same run. This is useful for applications where the user may need a coarse grid over the whole modeling domain, but a denser grid in the area of maximum expected impacts. There is also flexibility in specifying the location of the origin for polar receptors, other than the default origin at (0,0) in x,y, coordinates.

The user can input elevated receptor heights in order to model the effects of terrain above (or below) stack base, and may also specify receptor elevations above ground level to model flagpole receptors. There is no distinction in AERMOD between elevated terrain below release height and terrain above release height, as with earlier regulatory models that distinguished between simple terrain and complex terrain. For applications involving elevated terrain, the user must also input a hill height scale along with the receptor elevation. To

facilitate the generation of hill height scales for AERMOD, a terrain preprocessor, called AERMAP, has been developed (EPA, 1998c).

1.2.4.4 Meteorology Options.

The AERMOD model utilizes a file of surface boundary layer parameters and a file of profile variables including wind speed, wind direction, and turbulence parameters. These two types of meteorological inputs are generated by the meteorological preprocessor for AERMOD, which is called AERMET (EPA, 1998b). Both of these meteorological input files are sequential ASCII files, and the model automatically recognizes the format generated by AERMET as the default format. The model will process all available meteorological data in the specified input file by default, but the user can easily specify selected days or ranges of days to process.

1.2.4.5 Output Options.

The basic types of printed output available with AERMOD are:

- Summaries of high values (highest, second highest, etc.) by receptor for each averaging period and source group combination;
- Summaries of overall maximum values (e.g., the maximum 50) for each averaging period and source group combination; and
- Tables of concurrent values summarized by receptor for each averaging period and source group combination for each day of data processed. These "raw" concentration values may also be output to unformatted (binary) files, as described below.

The tables by receptor and maximum value tables can be output for the source group values or for the individual source values, or both. In addition, when maximum values for individual sources are output, the user has the option of specifying whether the maximum source values are to be the maximum values for each source independently, or the contribution of each source to the maximum group values, or both.

In addition to the tabular printed output products described above, the AERMOD model provides options for several types of file output products. One of these options for AERMOD is to output an unformatted ("binary") file of all concentration values as they are calculated. These files are often used for special postprocessing of the data. In addition to the unformatted concentration files, AERMOD provides options for two additional types of file outputs. One option is to generate a file of (X,Y) coordinates and design values (e.g., the second highest values at each receptor for a particular averaging period and source group combination) that can be easily imported into many graphics plotting packages to generate contour plots of the concentration values. Separate files can be specified for all of the averaging period and source group combinations of interest to the user.

Another output file option of the AERMOD model is to generate a file of all occurrences when a concentration value equals or exceeds a user-specified threshold. Again, separate files are generated for only those combinations of averaging period and source group that are of interest to the user. These files include the date on which the threshold violation occurred, the receptor location, and the concentration value.

AERMOD includes options for two types of output files that are designed to facilitate model evaluation. One type of file lists concentrations by rank, where only one value per date is included. This file may be used to generate Q-Q (quantile) plots of results, where values from different models and/or observed data are paired by rank. The other type of output file provides arc maxima results along with detailed information about the plume characteristics associated with the arc maximum.

1.2.4.6 Source Contribution Analyses.

In air quality dispersion modeling applications, the user may have a need to know the contribution that a particular source makes to an overall concentration value for a group of sources. This section provides a brief introduction to how these types of source contribution

(sometimes referred to as source culpability) analyses are performed using the AERMOD model. More detailed information about exercising these options is provided in Section 3.

The AERMOD model provides the option of specifying source groups for which the model calculates high values independently. However, users may often have to run the model a second time selecting only specific days where the high values occurred, and setting up each source in its own source group in order to obtain source contribution results. Rather than running a separate EVENT model, as was done with ISCST2 (the original precursor to the AERMOD model), the EVENT processing has been incorporated into the AERMOD model, as in the current version of ISCST3.

2.0 GETTING STARTED - A BRIEF TUTORIAL

This section provides a brief tutorial for setting up a simple application problem with the AERMOD model, which serves as an introduction for novice users to the AERMOD model. The example illustrates the usage of the most commonly used options in the AERMOD model. A more complete description of the available options for setting up the AERMOD model is provided in Section 3.

The example problem presented in this section is a simple application of the AERMOD model to a single point source. The source is a hypothetical stack at a small isolated facility in a rural setting. Since the stack is below the Good Engineering Practice (GEP) stack height, the emissions from the source are subject to the influence of aerodynamic downwash due to the presence of nearby buildings. The tutorial leads the user through selection and specification of modeling options, specification of source parameters, definition of receptor locations, specification of the input meteorological data, and selection of output options. Since this discussion is aimed at novice users of the AERMOD model, a general description of the input file keyword/parameter approach is provided first.

2.1 DESCRIPTION OF KEYWORD/PARAMETER APPROACH

The input file for the AERMOD model makes use of a keyword/parameter approach to specifying the options and input data for running the model. The descriptive keywords and parameters that make up this input runstream file may be thought of as a command language through which the user communicates with the model what he/she wishes to accomplish for a particular model run. The keywords specify the type of option or input data being entered on each line of the input file, and the parameters following the keyword define the specific options selected or the actual input data. Some of the parameters are also input as descriptive secondary keywords.

The runstream file is divided into five functional "pathways." These pathways are identified by a two-character pathway ID placed at the beginning of each runstream image. The pathways and the order in which they are input to the model are as follows:

CO - for specifying overall job **CO**ntrol options;

SO - for specifying **SO**urce information;

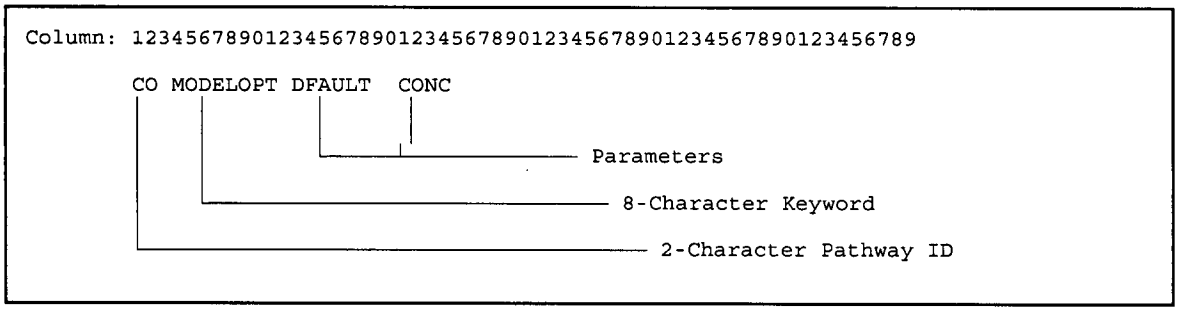
RE - for specifying **RE**ceptor information;

ME - for specifying **ME**teorology information;

EV - for specifiying **EV**ent processing;

OU - for specifying **OU**tput options.

Each line of the input runstream file consists of a pathway ID, an 8-character keyword, and a parameter list. An example of a line of input from a runstream file, with its various parts identified, is shown below:



The following sections describe the rules for structuring the input runstream file, and explain some of the advantages of the keyword/parameter approach.

2.1.1 Basic Rules for Structuring Input Runstream Files

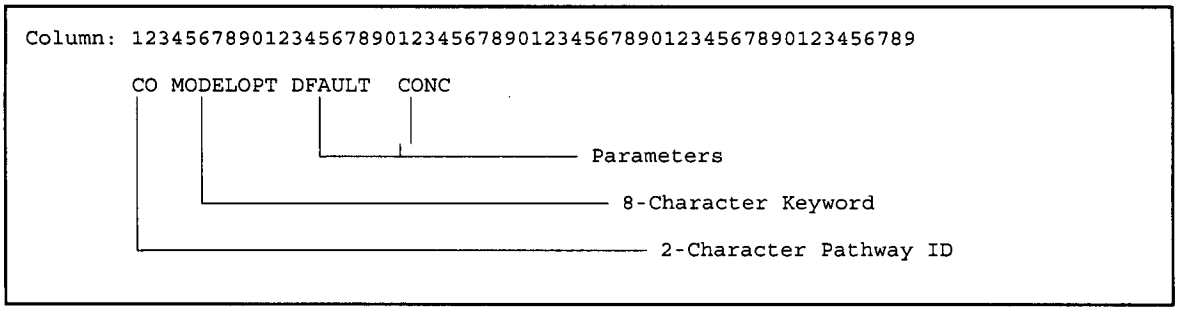
While the input runstream file has been designed to provide the user with considerable flexibility in structuring the input file, there are some basic syntax rules that need to be followed. These rules serve to maintain some consistency between input files generated by

different users, to simplify the job of error handling performed by the model on the input data, and to provide information to the model in the appropriate order wherever order is critical to the interpretation of the inputs. These basic rules and the various elements of the input runstream file are described in the paragraphs that follow.

One of the most basic rules is that all inputs for a particular pathway must be contiguous, i.e., all inputs for the CO pathway must come first, followed by the inputs for the SO pathway, and so on. The beginning of each pathway is identified with a "STARTING" keyword, and the ending of the pathway with the "FINISHED" keyword. Thus the first functional record of each input file must be "CO STARTING" and the last record of each input file must be "OU FINISHED." The rest of the input images will define the options and input data for a particular run.

Each record in the input runstream file is referred to as a runstream "image." These records are initially read into the model as 132-character images. The information on each input image consists of a "pathway," a "keyword," and one or more "parameters." Each of these "fields" on the runstream image must be separated from other fields by at least one blank space. To simplify the interpretation of the runstream image by the model, the runstream file must be structured with the two-character pathway in columns 1 and 2, the eight-character keyword in columns 4 through 11, followed by the parameters in columns 13 through 132, as necessary. For most keywords, the order of parameters following the keyword is important -- the exact spacing of the parameters is not important, as long as they are separated from each

other by at least one blank space and do not extend beyond the 132 character limit. The example of a runstream image from the CO pathway shown above is repeated here:



Alphabetical characters can be input as either lower case or upper case letters. The model convert all character input to upper case letters internally, with the exception of the title fields and file names to be discussed later. Throughout this document, the convention of using upper case letters is followed. For numeric input data, it should be noted that all data are assumed to be in metric units, i.e., length units of meters, speed units of meters per second, temperature units of degrees Kelvin, and emission units of grams per second. In a few instances, the user has the option of specifying units of feet for length and the model will perform the conversion to meters. These exceptions are the input of receptor heights for elevated terrain and the specification of anemometer height, since these values are often more readily available in feet than in meters.

Certain keywords are mandatory and must be present in every runstream file, such as the MODELOPT keyword shown in the example above which identifies the modeling options. Other keywords are optional and are only needed to exercise particular options, such as the option to allow for the input of flagpole receptor heights. Some of the keywords are repeatable, such as the keywords to specify source parameters, while other keywords may only appear once. The keyword references in Section 3, Appendices A and B and the Quick Reference at the end of this volume identify each keyword as to its type, either mandatory or optional, and either repeatable or non-repeatable.

With a few exceptions that are described below, the order of keywords within each pathway is not critical. For the SO pathway, the LOCATION keyword must be specified before other keywords for a particular source, and the SRCGROUP keyword must be the last keyword before SO FINISHED. For keywords on the SO pathway that accept a range of source IDs, the source parameters specified by those keywords will only be applied to the sources already defined, and will exclude any sources that are specified latter in the input file.

The PARAMETER ILEN_FLD is used to specify the maximum length of individual fields on the input runstream image, and also to declare the length of all filename and format variables. This PARAMETER is initially assigned a value of 80, and is in MODULE MAIN1 in MODULES.FOR.

2.1.2 Advantages of the Keyword Approach

The keyword approach provides some advantages over the type of input file used by other models that require formatted input of several numeric switches. One advantage is that the keywords are descriptive of the options and inputs being used for a particular run, making it easier for a reviewer to ascertain what was accomplished in a particular run by reviewing the input file. Another advantage is that the user has considerable flexibility in structuring the inputs to improve their readability and understandability, as long as they adhere to the few basic rules described above.

Some special provisions have been made to increase the flexibility to the user in structuring the input files. One provision is to allow for blank records in the input file. This allows the user to separate the pathways from each other, or to separate a group of images, such as source locations, from the other images. Another provision is for the use of "comment lines," identified by a "**" in the pathway field. Any input image that has "**" for the pathway ID will be ignored by the model. This is especially useful for labeling the columns in the source parameter input images, as illustrated in the example problem later in this section. It may also be used to "comment out" certain options for a particular run without deleting the

options and associated data (e.g., elevated terrain heights) completely from the input file. Because of the descriptive nature of the keyword options and the flexibility of the inputs it is generally much easier to make modifications to an existing input runstream file to obtain the desired result.

Another reason for improved "user-friendliness" is that detailed error-handling has been built into the model. The model provides descriptions of the location and nature of all of the errors encountered for a particular run. Rather than stopping execution at each occurrence of an input error, the model will read through and attempt to process all input records and report all errors encountered. If a fatal error occurs, then the model will not attempt to execute the model calculations.

2.2 REGULATORY MODELING OPTIONS

The regulatory default option is controlled from the MODELOPT keyword on the CO pathway. As its name implies, this keyword controls the selection of modeling options. It is a mandatory, non-repeatable keyword, and it is an especially important keyword for understanding and controlling the operation of the AERMOD model. Unless specified otherwise through the available keyword options, the AERMOD model implements the following default options:

- Use the elevated terrain algorithms requiring input of terrain height data;
- Use stack-tip downwash (except for building downwash cases);
- Use the calms processing routines;
- Use the missing data processing routines;
- Use a 4-hour half life for exponential decay of SO_2 for urban sources.

The parameters used to specify options on the MODELOPT keyword are character strings, called "secondary keywords," that are descriptive of the option being selected. For example, to ensure that the regulatory default options are used for a particular run, the user would include the secondary keyword "DFAULT" on the MODELOPT input. The presence of this secondary keyword tells the model to override any attempt to use a non-regulatory default option. The model will warn the user if a non-regulatory option is selected along with the DFAULT option, but will not halt processing. For regulatory modeling applications, it is strongly suggested that the DFAULT switch be set, even though the model defaults to the regulatory options without it. The MODELOPT keyword is described in more detail in the Section 3.2.2.

For any application in which a non-regulatory option is to be selected, the DFAULT switch must not be set, since it would otherwise override the non-regulatory option. The non-regulatory options are also specified by descriptive secondary keywords; for example, "NOSTD" invokes the option not to use stack-tip downwash.

2.3 MODEL STORAGE LIMITS

The AERMOD model has been designed using a dynamic storage allocation approach, where the model allocates data storage as needed based on the number of sources, receptors, source groups, and input requirements, up to the maximum amount of memory available on the computer being used.

The AERMOD model uses dynamic arrays to allocate data storage at model runtime rather than at compile time, as done by the previous version of AERMOD. The AERMOD model preprocesses the model runstream input file to determine the data storage requirements for a particular model run, and then allocates the input data arrays before processing the setup data. Once the setup processing is completed, the model allocates storage for the result arrays. When allocating data storage, the AERMOD model traps for errors, e.g., not enough memory available to allocate. If the allocation is unsuccessful, then an error message is generated by

the model and further processing is prevented. If the CO RUNORNOT NOT option is selected, the model will still go through all array allocations so that the user can determine if sufficient memory is available to complete the run. Also, an estimate of the total amount of memory needed for a particular run is printed out as part of the first page of printed output.

The parameters that are established at model runtime are as follows:

NSRC	= Number of Sources
NREC	= Number of Receptors
NGRP	= Number of Source Groups
NAVE	= Number of Short Term Averaging Periods
NVAL	= Number of High Values by Receptor (RECTABLE Keyword)
NTYP	= Number of Output Types (CONC currently is the only output type)
NMAX	= Number of Overall Maximum Values (MAXTABLE Keyword)
NQF	= Number of Variable Emission Rate Factors Per Source
NPDMAX	= Number of Particle Diameter Categories Per Source
IXM	= Number of X-coord (Distance) Values Per Receptor Network
IYM	= Number of Y-coord (Direction) Values Per Receptor Network
NNET	= Number of Cartesian and/or Polar Receptor Networks
NARC	= Number of Receptor Arcs Used with EVALCART Keyword
NEVE	= Number of Events for EVENT processing

In the case of NPDMAX, if no particle information is present in the input runstream, then NPDMAX is set to 1, otherwise it is set to 20. Other parameters are set to the actual numbers required for a particular model run.

There are several static array limits defined in AERMOD. These limits are controlled by PARAMETER statements in the Fortran source code. The variable name, description, and current value are defined in Section 4.2.2. If any of these static limits are changed, then AERMOD must be recompiled and linked. This process is described in Section 4.2.1.

2.4 SETTING UP A SIMPLE RUNSTREAM FILE

This section goes through a step-by-step description of setting up a simple application problem, illustrating the most commonly used options of the AERMOD model. The example problem is based on a simple industrial source application. The input file for AERMOD for the example problem is shown in Figure 2-1. The remainder of this section explains the various parts of the input file for the AERMOD model, and also illustrates some of the flexibility in structuring the input file.

```
CO STARTING
CO TITLEONE  A Simple Example Problem for the AERMOD-PRIME Model
CO MODELOPT  CONC   FLAT
CO AVERTIME  3  24  PERIOD
CO POLLUTID  SO2
CO RUNORNOT  RUN
CO FINISHED

SO STARTING
SO LOCATION  STACK1  POINT  0.0   0.0   0.0
SO SRCPARAM  STACK1  500.0   65.00  425.  15.0   5.
SO BUILDHGT  STACK1    36*50.
SO BUILDWID  STACK1    62.26   72.64   80.80   86.51   89.59   89.95
SO BUILDWID  STACK1    87.58   82.54   75.00   82.54   87.58   89.95
SO BUILDWID  STACK1    89.59   86.51   80.80   72.64   62.26   50.00
SO BUILDWID  STACK1    62.26   72.64   80.80   86.51   89.59   89.95
SO BUILDWID  STACK1    87.58   82.54   75.00   82.54   87.58   89.95
SO BUILDWID  STACK1    89.59   86.51   80.80   72.64   62.26   50.00
SO BUILDLEN  STACK1    82.54   87.58   89.95   89.59   86.51   80.80
SO BUILDLEN  STACK1    72.64   62.26   50.00   62.26   72.64   80.80
SO BUILDLEN  STACK1    86.51   89.59   89.95   87.58   82.54   75.00
SO BUILDLEN  STACK1    82.54   87.58   89.95   89.59   86.51   80.80
SO BUILDLEN  STACK1    72.64   62.26   50.00   62.26   72.64   80.80
SO BUILDLEN  STACK1    86.51   89.59   89.95   87.58   82.54   75.00
SO XBADJ     STACK1   -47.35  -55.76  -62.48  -67.29  -70.07  -70.71
SO XBADJ     STACK1   -69.21  -65.60  -60.00  -65.60  -69.21  -70.71
SO XBADJ     STACK1   -70.07  -67.29  -62.48  -55.76  -47.35  -37.50
SO XBADJ     STACK1   -35.19  -31.82  -27.48  -22.30  -16.44  -10.09
SO XBADJ     STACK1    -3.43    3.34   10.00    3.34   -3.43  -10.09
SO XBADJ     STACK1   -16.44  -22.30  -27.48  -31.82  -35.19  -37.50
SO YBADJ     STACK1    34.47   32.89   30.31   26.81   22.50   17.50
SO YBADJ     STACK1    11.97    6.08    0.00   -6.08  -11.97  -17.50
SO YBADJ     STACK1   -22.50  -26.81  -30.31  -32.89  -34.47  -35.00
SO YBADJ     STACK1   -34.47  -32.89  -30.31  -26.81  -22.50  -17.50
SO YBADJ     STACK1   -11.97   -6.08    0.00    6.08   11.97   17.50
SO YBADJ     STACK1    22.50   26.81   30.31   32.89   34.47   35.00
SO SRCGROUP  ALL
SO FINISHED

RE STARTING
RE GRIDPOLR POL1 STA
RE GRIDPOLR POL1 ORIG STACK1
RE GRIDPOLR POL1 DIST 175. 350. 500. 1000.
RE GRIDPOLR POL1 GDIR 36 10 10
RE GRIDPOLR POL1 END
RE FINISHED

ME STARTING
ME SURFFILE  AERMET2.SFC
ME PROFFILE  AERMET2.PFL
ME SURFDATA  14735  1988  ALBANY,NY
ME UAIRDATA  14735  1988  ALBANY,NY
ME PROFBASE  0.0  METERS
ME FINISHED

OU STARTING
OU RECTABLE  ALLAVE  FIRST-SECOND
OU MAXTABLE  ALLAVE  50
OU FINISHED
```

FIGURE 2-1. EXAMPLE INPUT FILE FOR AERMOD FOR SAMPLE PROBLEM

2.4.1 A Simple Industrial Source Application

For this simple tutorial, an application is selected involving a single point source of SO_2 that is subject to the influences of building downwash. The source consists of a 50-meter stack with a buoyant release that is adjacent to a building. We will assume that the stack is situated in flat terrain in a rural setting. A polar receptor network will be placed around the stack location to identify areas of maximum impact.

2.4.2 Selecting Modeling Options - CO Pathway

The modeling options are input to the model on the Control pathway. The mandatory keywords for the CO pathway are listed below. A complete listing of all keywords is provided in Appendix B.

STARTING - Indicates the beginning of inputs for the pathway; this keyword is mandatory on each of the pathways.

TITLEONE - A user-specified title line (up to 68 characters) that will appear on each page of the printed output file (an optional second title line is also available with the keyword TITLETWO).

MODELOPT - Controls the modeling options selected for a particular run through a series of secondary keywords.

AVERTIME - Identifies the averaging periods to be calculated for a particular run.

POLLUTID - Identifies the type of pollutant being modeled. At the present time, this option has no influence on the results.

RUNORNOT - A special keyword that tells the model whether to run the full model executions or not. If the user selects not to run, then the runstream setup file will be processed and any input errors reported, but no dispersion calculations will be made.

FINISHED - Indicates that the user is finished with the inputs for this pathway; this keyword is also mandatory on each of the other pathways.

The first two keywords are fairly self-explanatory. As discussed above in Section 2.2, the MODELOPT keyword on the CO pathway is pivotal to controlling the modeling options used for a particular run. For this example, we intend to use the regulatory default option, and have specified for the model to output concentration values. After the first three input records our input file will look something like this:

```
CO STARTING
CO TITLEONE  A Simple Example Problem for the AERMOD-PRIME Model
CO MODELOPT  CONC FLAT
```

Note that the title parameter field does not need to be in quotations, even though it represents a single parameter. The model simply reads whatever appears in columns 13 through 80 of the TITLEONE card as the title field, without changing the lower case to upper case letters. Leading blanks are therefore significant if the user wishes to center the title within the field. Note also that the spacing and order of the secondary keywords on the MODELOPT card are not significant. A MODELOPT card that looked like this:

```
CO MODELOPT    CONC                FLAT
```

would have an identical result as the example above. It is suggested that the user adopt a style that is consistent and easy to read. A complete description of the available modeling options that can be specified on the MODELOPT keyword is provided in Section 3.

Since the pollutant in this example is SO_2, we will probably need to calculate average values for 3-hour and 24-hour time periods, and we also need to calculate averages for the full

annual time period. Our runstream file might therefore look something like this after adding two more keywords:

```
CO STARTING
CO TITLEONE  A Simple Example Problem for the AERMOD-PRIME Model
CO MODELOPT  CONC FLAT
CO AVERTIME  3  24  PERIOD
CO POLLUTID  SO2
```

Note again that the order of the parameters on the AVERTIME keyword is not critical, although the order of the short term averages given on the AVERTIME keyword will also be the order in which the results are presented in the output file. The order of the keywords within each pathway is also not critical in most cases, although the intent of the input runstream file may be easier to decipher if a consistent and logical order is followed. It is suggested that users follow the order in which the keywords are presented in Section 3, in Appendix B, and in the Quick Reference, unless there is a clear advantage to doing otherwise.

The only remaining mandatory keywords for the CO pathway are RUNORNOT and FINISHED. We will set the RUNORNOT switch to RUN for this example. If a user is unsure about the operation of certain options, or is setting up a complex runstream file to run for the first time, it may be desirable to set the model NOT to run, but simply to read and analyze the input file and report any errors or warning messages that are generated. Once the input file has been debugged using these descriptive error/warning messages, then the RUNORNOT switch can be set to RUN, avoiding a possible costly waste of resources generating erroneous results. Even if the model is set NOT to run, all of the inputs are summarized in the output file for the user to review.

Our complete runstream file for the CO pathway may look something like this:

```
CO STARTING
CO TITLEONE  A Simple Example Problem for the AERMOD-PRIME Model
CO MODELOPT  CONC FLAT
CO AVERTIME  3  24  PERIOD
CO POLLUTID  SO2
CO RUNORNOT  RUN
CO FINISHED
```

The following set of runstream images has a more structured look, but it is equivalent to the example above:

```
CO STARTING
   TITLEONE  A Simple Example Problem for the AERMOD-PRIME Model
   MODELOPT  CONC FLAT
   AVERTIME  3  24  PERIOD
   POLLUTID  SO2
   RUNORNOT  RUN
CO FINISHED
```

Since the pathway ID is required to begin in column 1 (see Section 2.4.8 for a discussion of this restriction), the model will assume that the previous pathway is in effect if the pathway field is left blank. The model will do the same for blank keyword fields, which will be illustrated in the next section.

In addition to these mandatory keywords on the CO pathway, the user may select optional keywords to allow the use of receptor heights above ground-level for flagpole receptors, to specify a decay coefficient or a half-life for exponential decay, and to generate an input file containing events for EVENT processing. The user also has the option of having the model periodically save the results to a file for later re-starting in the event of a power failure or other interruption of the model's execution. These options are described in more detail in Section 3 of this volume.

2.4.3 Specifying Source Inputs - SO Pathway

Besides the STARTING and FINISHED keywords that are mandatory for all pathways, the Source pathway has the following mandatory keywords:

LOCATION - Identifies a particular source ID and specifies the source type and location of that source.

SRCPARAM - Specifies the source parameters for a particular source ID identified by a previous LOCATION card.

SRCGROUP - Specifies how sources will be grouped for calculational purposes. There is always at least one group, even though it may be the group of ALL sources and even if there is only one source.

Since the hypothetical source in our example problem is influenced by a nearby building, we also need to include the optional keywords BUILDHGT and BUILDWID in our input file.

The input file for the SO pathway for this example will look something like this:

```
SO STARTING
SO LOCATION  STACK1  POINT  0.0    0.0    0.0
SO SRCPARAM  STACK1  500.0   65.00  425.   15.0    5.0
SO BUILDHGT  STACK1    50.00   50.00   50.00   50.00   50.00   50.00
SO BUILDHGT  STACK1    50.00   50.00   50.00   50.00   50.00   50.00
SO BUILDHGT  STACK1    50.00   50.00   50.00   50.00   50.00   50.00
SO BUILDHGT  STACK1    50.00   50.00   50.00   50.00   50.00   50.00
SO BUILDHGT  STACK1    50.00   50.00   50.00   50.00   50.00   50.00
SO BUILDHGT  STACK1    50.00   50.00   50.00   50.00   50.00   50.00
SO BUILDWID  STACK1    62.26   72.64   80.80   86.51   89.59   89.95
SO BUILDWID  STACK1    87.58   82.54   75.00   82.54   87.58   89.95
SO BUILDWID  STACK1    89.59   86.51   80.80   72.64   62.26   50.00
SO BUILDWID  STACK1    62.26   72.64   80.80   86.51   89.59   89.95
SO BUILDWID  STACK1    87.58   82.54   75.00   82.54   87.58   89.95
SO BUILDWID  STACK1    89.59   86.51   80.80   72.64   62.26   50.00
SO BUILDLEN  STACK1    82.54   87.58   89.95   89.59   86.51   80.80
SO BUILDLEN  STACK1    72.64   62.26   50.00   62.26   72.64   80.80
SO BUILDLEN  STACK1    86.51   89.59   89.95   87.58   82.54   75.00
SO BUILDLEN  STACK1    82.54   87.58   89.95   89.59   86.51   80.80
SO BUILDLEN  STACK1    72.64   62.26   50.00   62.26   72.64   80.80
SO BUILDLEN  STACK1    86.51   89.59   89.95   87.58   82.54   75.00
SO XBADJ     STACK1   -47.35  -55.76  -62.48  -67.29  -70.07  -70.71
SO XBADJ     STACK1   -69.21  -65.60  -60.00  -65.60  -69.21  -70.71
SO XBADJ     STACK1   -70.07  -67.29  -62.48  -55.76  -47.35  -37.50
SO XBADJ     STACK1   -35.19  -31.82  -27.48  -22.30  -16.44  -10.09
SO XBADJ     STACK1    -3.43    3.34   10.00    3.34   -3.43  -10.09
SO XBADJ     STACK1   -16.44  -22.30  -27.48  -31.82  -35.19  -37.50
SO YBADJ     STACK1    34.47   32.89   30.31   26.81   22.50   17.50
SO YBADJ     STACK1    11.97    6.08    0.00   -6.08  -11.97  -17.50
SO YBADJ     STACK1   -22.50  -26.81  -30.31  -32.89  -34.47  -35.00
SO YBADJ     STACK1   -34.47  -32.89  -30.31  -26.81  -22.50  -17.50
SO YBADJ     STACK1   -11.97   -6.08    0.00    6.08   11.97   17.50
SO YBADJ     STACK1    22.50   26.81   30.31   32.89   34.47   35.00
SO SRCGROUP  ALL
SO FINISHED
```

There are a few things to note about these inputs. Firstly, the source ID (STACK1 in this example) is an alphanumeric parameter (up to eight characters) that identifies the inputs for different keywords with a particular source. It is crucial that the source be identified with a LOCATION card before any other keyword makes reference to that source, since this identifies the source type (POINT in this case), and therefore which parameters the model will allow. Besides POINT sources, the current version of the AERMOD model also allows VOLUME and AREA sources to be specified. Since the effects of elevated terrain are included in this analysis, it is important to specify the source base elevation above mean sea level (MSL) on the LOCATION card. For this example, the source base elevation is 0.0 meters MSL.

Another thing to note is that since the model uses direction-specific building dimensions for all sources with downwash, there are 36 building heights and 36 building widths entered on the appropriate keywords, one value for each 10 degree sector beginning with the 10 degree flow vector (direction toward which the wind is blowing), and continuing clockwise. Since the user could not fit all 36 values on a single record, the pathway, keyword and source ID were repeated as many times as were necessary. In this case there were 6 values given on each of 6 lines for each of the building dimensions. There could have been fewer or more lines as long as exactly 36 values were entered before starting with a new keyword. Since all of the building heights were the same across the sectors (fairly realistic for the height but not for widths, unless the structure was circular), there is a short cut available for specifying numeric input in the runstream files for the model. The user can specify "repeat values" by entering a field such as "36*50.0" as a parameter for the BUILDHGT keyword. The model will interpret this as "36 separate entries, each with a value of 50.0," and store the values in the appropriate arrays within the model. Since the model must identify this as a single parameter field, there must not be any spaces between the repeat-value and the value to be repeated.

The final keyword before finishing the SO pathway must be the SRCGROUP keyword. In this example, since there is only one source, we have taken advantage of a short cut provided by the model by specifying a source group ID (which may be up to eight characters) of ALL. Whenever this card appears in an input file, it will generate a source group with a source-group ID of ALL, consisting of all sources defined for that run. The sources do not have to be explicitly identified. In a run involving multiple sources, the user may specify multiple source groups by repeating the SRCGROUP keyword. The use of the SRCGROUP card is explained in more detail in Section 3.

Using some of the formatting options discussed above, the SO pathway for our example may look like this, with the same result as above:

```
SO STARTING
   LOCATION   STACK1   POINT   0.0     0.0     0.0

** Point Source        QS      HS      TS      VS      DS
** Parameters:        ----    ----    ----    ----    ---
   SRCPARAM   STACK1   500.0   65.0    425.    15.0    5.0

   BUILDHGT   STACK1   36*50.
SO BUILDWID   STACK1     62.26    72.64    80.80    86.51    89.59    89.95
              STACK1     87.58    82.54    75.00    82.54    87.58    89.95
              STACK1     89.59    86.51    80.80    72.64    62.26    50.00
              STACK1     62.26    72.64    80.80    86.51    89.59    89.95
              STACK1     87.58    82.54    75.00    82.54    87.58    89.95
              STACK1     89.59    86.51    80.80    72.64    62.26    50.00
SO BUILDLEN   STACK1     82.54    87.58    89.95    89.59    86.51    80.80
              STACK1     72.64    62.26    50.00    62.26    72.64    80.80
              STACK1     86.51    89.59    89.95    87.58    82.54    75.00
              STACK1     82.54    87.58    89.95    89.59    86.51    80.80
              STACK1     72.64    62.26    50.00    62.26    72.64    80.80
              STACK1     86.51    89.59    89.95    87.58    82.54    75.00
SO XBADJ      STACK1    -47.35   -55.76   -62.48   -67.29   -70.07   -70.71
              STACK1    -69.21   -65.60   -60.00   -65.60   -69.21   -70.71
              STACK1    -70.07   -67.29   -62.48   -55.76   -47.35   -37.50
              STACK1    -35.19   -31.82   -27.48   -22.30   -16.44   -10.09
              STACK1     -3.43     3.34    10.00     3.34    -3.43   -10.09
              STACK1    -16.44   -22.30   -27.48   -31.82   -35.19   -37.50
SO YBADJ      STACK1     34.47    32.89    30.31    26.81    22.50    17.50
              STACK1     11.97     6.08     0.00    -6.08   -11.97   -17.50
              STACK1    -22.50   -26.81   -30.31   -32.89   -34.47   -35.00
              STACK1    -34.47   -32.89   -30.31   -26.81   -22.50   -17.50
              STACK1    -11.97    -6.08     0.00     6.08    11.97    17.50
              STACK1     22.50    26.81    30.31    32.89    34.47    35.00
SRCGROUP  ALL
SO FINISHED
```

This version of the SO pathway inputs illustrates the use of the comment card to label the stack parameters on the SRCPARAM card, i.e., QS for emission rate (g/s), HS for stack height (m), TS for stack exit temperature (K), VS for exit velocity (m/s), and DS for stack diameter (m). A complete description of the source parameter card, with a list of parameters for each source type, is provided in Section 3.3 and in Appendix B.

Other optional inputs that may be entered on the SO pathway include specifying variable emission rate factors for sources whose emissions vary as a function of month, season, hour-of-day, or season and hour-of-day (see Section 3.3.4 for more details). The

number of factors entered depends on the option selected, and factors may be input for single sources or for a range of sources.

2.4.4 Specifying a Receptor Network - RE Pathway

As mentioned above, this example will illustrate the use of a single polar receptor network centered on the stack location. Other options available on the REceptor pathway include specifying a Cartesian grid receptor network, and specifying discrete receptor locations in either a polar or a Cartesian system. These other options are described in more detail in Section 3.4.

The RE pathway for this example will look like this:

```
RE STARTING
   GRIDPOLR POL1 STA
   GRIDPOLR POL1 ORIG STACK1
   GRIDPOLR POL1 DIST 175. 350. 500. 1000.
   GRIDPOLR POL1 GDIR 36 10 10
   GRIDPOLR POL1 END
RE FINISHED
```

Looking at the example for the RE pathway, the first thing to note about these inputs is that there is a new set of keywords, including something that looks like a STArting and ENDing. In fact the GRIDPOLR keyword can be thought of as a "sub-pathway," in that all of the information for a particular polar network must be in contiguous records, and that the starting and ending of the sub-pathway are identified. The order of secondary keywords within the sub-pathway is not critical, similar to the main pathways. Each card must be identified with a network ID (up to eight alphanumeric characters), in this case it is "POL1." Multiple networks may be specified in a single model run. The model waits until the END secondary keyword is encountered to set the variables, which may include terrain heights for receptors on elevated terrain or flagpole receptor heights if those options are being exercised

by the user. The use of these optional secondary keywords is described in detail in Section 3.4.

For this example, the ORIG secondary keyword specifies the location of the origin for the polar network being defined as being the location of the source STACK1. The origin can also be specified as X and Y-coordinates. The ORIG keyword is optional, and the model will default to an origin of (0.0, 0.0) if it is omitted. The DIST keyword identifies the distances along each direction radial at which the receptors will be located. In this case there are four distances. More distances could be added by adding values to that input card or by including a continuation card with the DIST keyword, if needed. The GDIR keyword specifies that the model will Generate DIRection radials for the network, in this case there will be 36 directions, beginning with the 10 degree flow vector and incrementing every 10 degrees clockwise. The user may elect to define Discrete DIRection radials instead by using the DDIR keyword in place of the GDIR keyword.

2.4.5 Specifying the Meteorological Input - ME Pathway

The MEteorology pathway has the following four mandatory keywords (besides STARTING and FINISHED, of course):

SURFFILE - Specifies the filename and format for the input surface meteorological data file.

PROFFILE - Specifies the filename and format for the input profile meteorological data file.

SURFDATA - Specifies information about the surface meteorological data which will be used in the modeling.

UAIRDATA - Specifies information about the upper air meteorological data which will be used in the modeling.

PROFBASE - Specifies the base elevation above MSL for the potential temperature profile.

For the purposes of this example we will assume that the meteorological data files are for Albany, NY and that an on-site location called Hudson has also been used. We will also assume that the surface and profile data files were generated by the AERMET preprocessor, and are in the default format for AERMOD. The filename of the surface file is AERMET2.SFC and it consist of four days of data for Albany/Hudson from March 1988. The filename of the profile file is AERMET2.PFL. The data files used in this example correspond with the on-site example files used for the AERMET preprocessor program. The runstream images for the MEteorology pathway would look something like this:

```
ME STARTING
   SURFFILE  AERMET2.SFC
   PROFFILE  AERMET2.PFL
   SURFDATA  14735  1988  ALBANY,NY
   UAIRDATA  14735  1988  ALBANY,NY
   SITEDATA  99999  1988  HUDSON
   PROFBASE  0.0  METERS
ME FINISHED
```

The first parameters on the SURFFILE and PROFFILE keywords are the filenames for the surface and profile data file, respectively, which can be entered as a full DOS pathname, including the drive specification and subdirectories, up to a total of 80 characters (with the maximum number of characters controlled by the ILEN_FLD PARAMETER located in MODULE MAIN1 - see Section 2.1.1). Since there is no second parameter, the model will assume the default ASCII format for the data files. The format of the surface and profile data files is described in Appendix D.

The next two mandatory inputs identify the location and data period of the input meteorological data. A separate keyword is used for the surface meteorological data and for the upper air (mixing height) data. The parameters on these cards are the station number (e.g. WBAN number for NWS stations), the data period (year), and a station name. In order to identify potential errors in the model inputs, the model compares the station number from the runstream input file with values provided in the first record of the surface meteorology file, and issues warning messages if there are any mismatches. The user may also optionally input

the (X,Y) coordinates for the location of the station(s), although these values are not currently used by the model. In this case, we have also included the optional SITEDATA keyword to identify the location for the on-site meteorological data that were preprocessed by AERMET.

The final mandatory keyword is PROFBASE, which is used to specify the base elevation (above MSL) for the potential temperature profile generated by AERMOD for use in the plume rise calculations. This should correspond to the base elevation for the main meteorological tower, which in this example is specified as 0.0 meters and is the same as the source base elevation.

Other optional keywords available on the ME pathway provide the user with options to specify selected days to process from the meteorological data file, and a wind direction rotation correction term. These optional inputs are described in more detail in Section 3.5.

2.4.6 Selecting Output Options - OU Pathway

All of the keywords on the Output pathway are optional, although the model will warn the user if no printed outputs are requested and will halt processing if no outputs (printed results or file outputs) are selected. The user has considerable flexibility to select only the outputs that are needed for a particular application. The printed table keywords are:

RECTABLE - Specifies the selection of high value by receptor table output options.

MAXTABLE - Specifies the selection of overall maximum value table output options.

DAYTABLE - Specifies the selection of printed results (by receptor) for each day of data processed (this option can produce very large files and such be used with care).

The RECTABLE keyword provides the highest, second-highest and third-highest values by receptor. The MAXTABLE keyword provides the overall maximum 50 table. For both of these keywords, the user has additional flexibility to specify for which short term

averaging periods the outputs are selected. For the MAXTABLE keyword the user can also specify the number of overall maximum values to summarize for each averaging period selected, up to a maximum number controlled by a parameter in the computer code. For this example problem we will select the highest and second-highest values by receptor, and the maximum 50 values for all averaging periods. These OU pathway inputs will look something like this:

```
OU STARTING
   RECTABLE  ALLAVE  FIRST  SECOND
   MAXTABLE  ALLAVE  50
OU FINISHED
```

To simplify the input for users who request the same printed table output options for all averaging periods, these keywords recognize the secondary keyword "ALLAVE" as the first parameter for that purpose. In order to obtain the overall maximum 10 values for the 24-hour averages only, then the OU pathway images would look like this:

```
OU STARTING
   RECTABLE  ALLAVE  FIRST  SECOND
   MAXTABLE  24  10
OU FINISHED
```

It should also be noted that these output table options apply only to the short-term averaging periods, such as the 3-hour and 24-hour averages used in our example. If the user has selected that PERIOD averages be calculated (on the CO AVERTIME keyword), then the output file will automatically include a table of period averages summarized by receptor (the RECTABLE option does not apply since there is only one period value for each receptor). In addition, the printed output file will include tables summarizing the highest values for each averaging period and source group.

Other options on the OU pathway include several keywords to produce output files for specialized purposes, such as generating contour plots of high values, identifying occurrences

of violations of a particular threshold value (e.g. a NAAQS), and for postprocessing of the raw concentration data. These options are described in detail in Section 3.7.

The complete input runstream file for this simple example is shown in Figure 2-2. Note that a consistent style has been used for formatting and structuring the file in order to improve its readability. This input file is comparable to the version shown earlier in Figure 2-1, which used a somewhat different style.

```
CO STARTING
   TITLEONE A Simple Example Problem for the AERMOD Model
   MODELOPT  DFAULT  CONC
   AVERTIME  3  24  PERIOD
   POLLUTID  SO2
   RUNORNOT  RUN
CO FINISHED

SO STARTING
   LOCATION  STACK1  POINT  0.0   0.0   0.0
** Point Source       QS     HS    TS    VS   DS
** Parameters:       ----   ----  ----  ----  ---
   SRCPARAM  STACK1  500.0  65.0  425.  15.0  5.0
   BUILDHGT  STACK1  36*50.
SO BUILDWID  STACK1    62.26   72.64   80.80   86.51   89.59   89.95
             STACK1    87.58   82.54   75.00   82.54   87.58   89.95
             STACK1    89.59   86.51   80.80   72.64   62.26   50.00
             STACK1    62.26   72.64   80.80   86.51   89.59   89.95
             STACK1    87.58   82.54   75.00   82.54   87.58   89.95
             STACK1    89.59   86.51   80.80   72.64   62.26   50.00
SO BUILDLEN  STACK1    82.54   87.58   89.95   89.59   86.51   80.80
             STACK1    72.64   62.26   50.00   62.26   72.64   80.80
             STACK1    86.51   89.59   89.95   87.58   82.54   75.00
             STACK1    82.54   87.58   89.95   89.59   86.51   80.80
             STACK1    72.64   62.26   50.00   62.26   72.64   80.80
             STACK1    86.51   89.59   89.95   87.58   82.54   75.00
SO XBADJ     STACK1   -47.35  -55.76  -62.48  -67.29  -70.07  -70.71
             STACK1   -69.21  -65.60  -60.00  -65.60  -69.21  -70.71
             STACK1   -70.07  -67.29  -62.48  -55.76  -47.35  -37.50
             STACK1   -35.19  -31.82  -27.48  -22.30  -16.44  -10.09
             STACK1    -3.43    3.34   10.00    3.34   -3.43  -10.09
             STACK1   -16.44  -22.30  -27.48  -31.82  -35.19  -37.50
SO YBADJ     STACK1    34.47   32.89   30.31   26.81   22.50   17.50
             STACK1    11.97    6.08    0.00   -6.08  -11.97  -17.50
             STACK1   -22.50  -26.81  -30.31  -32.89  -34.47  -35.00
             STACK1   -34.47  -32.89  -30.31  -26.81  -22.50  -17.50
             STACK1   -11.97   -6.08    0.00    6.08   11.97   17.50
             STACK1    22.50   26.81   30.31   32.89   34.47   35.00
SRCGROUP  ALL
SO FINISHED

RE STARTING
   GRIDPOLR POL1 STA
   GRIDPOLR POL1 ORIG STACK1
   GRIDPOLR POL1 DIST 175. 350. 500. 1000.
   GRIDPOLR POL1 GDIR 36 10 10
   GRIDPOLR POL1 END
RE FINISHED

ME STARTING
   SURFFILE  AERMET2.SFC
   PROFFILE  AERMET2.PFL
   SURFDATA  14735  1988  ALBANY,NY
   UAIRDATA  14735  1988  ALBANY,NY
   SITEDATA  99999  1988  HUDSON
   PROFBASE  0.0  METERS
ME FINISHED

OU STARTING
   RECTABLE  ALLAVE  FIRST  SECOND
   MAXTABLE  ALLAVE  50
OU FINISHED
```

FIGURE 2-2. EXAMPLE INPUT RUNSTREAM FILE FOR SAMPLE PROBLEM

2.4.7 Using the Error Message File to Debug the Input Runstream File

The previous sections in this tutorial have lead through the step-by-step construction of a sample runstream input file for AERMOD. This simple example problem illustrated the usage of the most commonly used options of the AERMOD model. However, many real-time applications of the model will be much more complex than this example, perhaps involving multiple sources and source groups, multiple receptor networks, the addition of discrete receptor locations, and/or elevated terrain heights. Since humans are prone to make errors from time to time, an effort has been made to develop detailed error handling capabilities for the AERMOD model.

The error handling capabilities of the AERMOD model are designed to accomplish two things for the user. First, the model should read through the complete input file and report all occurrences of errors or suspect entries before stopping, rather than stopping on the first instance (and every instance thereafter) of an error in the input file. Second, the model should provide error and warning messages that are detailed and descriptive enough that they will help the user in his/her effort to debug the input file. The remainder of this section provides of brief introduction to the use of the model's error handling capabilities. Appendix C of this volume provides more details about the error handling provided by the AERMOD model, including a listing and explanation of all error and other types of messages generated by the model.

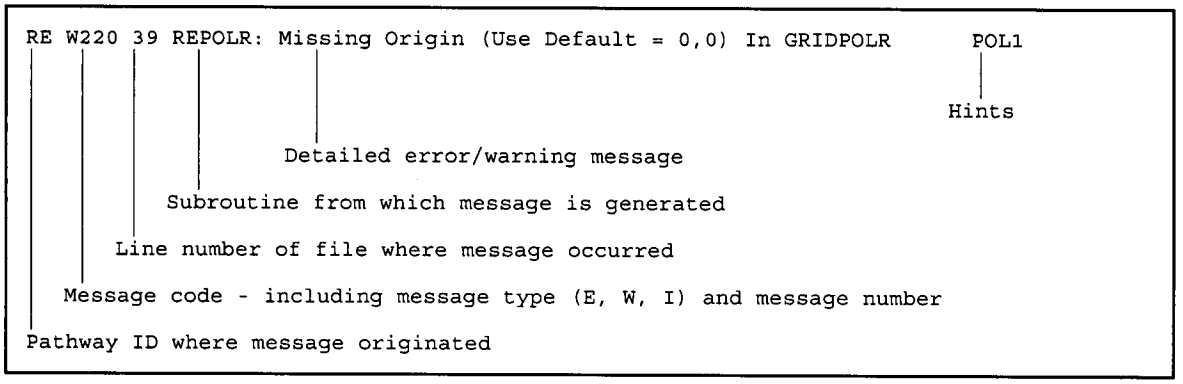
The AERMOD model generates messages during the processing of the input data and during the execution of model calculations. These messages inform the user about a range of possible conditions including:

- Errors that will halt any further processing, except to identify additional error conditions;
- Warnings that do not halt processing but indicate possible errors or suspect conditions; and

- Informational messages that may be of interest to the user but have no direct bearing on the validity of the results.

As the model encounters a condition for which a message is generated, the model writes the message to a temporary storage file. At the completion of the setup processing for a run, and at the completion of the model calculations, the model rereads the message file and generates a summary of the messages which is included in the main printed output file. If the processing of the model setup information indicates no errors or warnings, and the user has selected the option to RUN the model calculations on the CO RUNORNOT card, then the model will simply write a statement to the print file that the model setup was completed successfully. Otherwise, the model will report a summary of the messages encountered. The summary of model setup messages that would be generated for the example problem if the option NOT to run was chosen is shown in Figure 2-3. This summary table reports the total number of occurrences for each of the message types, and lists the detailed message for any fatal errors or warning messages that were generated. In this case, since there were no errors or suspicious conditions in the setup file, there are no error or warning messages listed.

An example of the warning message that would have been generated had we left out the card on the RE pathway that specifies the origin of the polar receptor network is shown below:



Since this is a warning message, it would have appeared at the end of the message summary table in the output file, but it would not have halted processing of the data. The last item on the message line, "Hints," may include such information as the keyword or parameter name causing the error, the source ID, group ID or (as in this case) the network ID involved, or perhaps the date variable identifying when the message occurred during the processing of the meteorological data, such as an informational message identifying the occurrence of a calm wind.

For new users and for particularly complex applications, it is strongly recommended that the model first be run with the RUNORNOT keyword (on the CO pathway) set NOT to run. In this way, the user can determine if the model is being setup properly by the runstream file before committing the resources to perform a complete run. The user should make a point of examining any warning messages carefully to be sure that the model is operating as expected for their application, since these messages will not halt processing by the model. In most cases, the detailed messages will provide enough information for the user to determine the location and nature of any errors in the runstream setup file. If the intent of the message is not immediately clear, then the user should refer to the more detailed descriptions provided in Appendix C for the particular error code generated.

In deciphering the error and warning messages, the line number provided as part of the message may be particularly helpful in locating the error within the input file. However, if it is an error of omission that is caught by the error checking performed at the completion of inputs for a pathway, then the line number will correspond to the last record for that pathway. The user may need to examine all of the messages carefully before locating the error or errors, especially since a single occurrence of certain types of errors may lead to other error conditions being identified later in the input file which do not really constitute errors in themselves. An example of this is provided in Figure 2-4, which shows some inputs for the SO pathway where the building dimension keywords have been typed incorrectly, and the associated list of error messages. Since continuation cards were being used for the building width inputs, and the keyword was entered incorrectly on the first line, the subsequent records

were also taken by the model to be invalid keyword inputs. While the error messages are the same for these records, the message originates from a different part of the model (SUBROUTINE SOCARD) for the records with the blank keyword.

Since the detailed error and warning messages are listed in the output file as part of the message summary table, there will generally not be a need for the user to examine the contents of the detailed message file. For this reason, the default operation of the model is to write the messages that are generated by a particular run to a temporary file that is deleted when the run is completed. If the user wishes to examine the complete list of detailed messages (of all types), there is an optional keyword available on the CO pathway for that purpose. The ERRORFIL keyword, which is described in detail in Section 3.2.7, allows the user to save the complete list of detailed messages to a user-specified filename.

```
   *** Message Summary For AERMOD Model Setup ***


   --------- Summary of Total Messages ---------

A Total of           0 Fatal Error Message(s)
A Total of           0 Warning Message(s)
A Total of           0 Information Message(s)


    ******** FATAL ERROR MESSAGES ********
                *** NONE ***


    ********   WARNING MESSAGES   ********
                *** NONE ***


    ***********************************
    *** SETUP Finishes Successfully ***
    ***********************************
```

FIGURE 2-3. EXAMPLE MESSAGE SUMMARY TABLE FOR RUNSTREAM SETUP

```
SO STARTING
   LOCATION  STACK1  POINT  0.0    0.0    0.0
** Point Source       QS     HS     TS     VS    DS
** Parameters:        ----   ----   ----   ----  ---
   SRCPARAM  STACK1  500.0 65.0 425.0   15.0  5.0
   BUILDHTS  STACK1  36*50.
    BUILDWTS  STACK1     62.26   72.64   80.80   86.51   89.59   89.95
              STACK1     87.58   82.54   75.00   82.54   87.58   89.95
              STACK1     89.59   86.51   80.80   72.64   62.26   50.00
              STACK1     62.26   72.64   80.80   86.51   89.59   89.95
              STACK1     87.58   82.54   75.00   82.54   87.58   89.95
              STACK1     89.59   86.51   80.80   72.64   62.26   50.00
   XBADJ      STACK1   -47.35  -55.76  -62.48  -67.29  -70.07  -70.71
              STACK1    -69.21  -65.60  -60.00  -65.60  -69.21  -70.71
              STACK1    -70.07  -67.29  -62.48  -55.76  -47.35  -37.50
              STACK1    -35.19  -31.82  -27.48  -22.30  -16.44  -10.09
              STACK1     -3.43    3.34   10.00    3.34   -3.43  -10.09
              STACK1    -16.44  -22.30  -27.48  -31.82  -35.19  -37.50
    YBADJ      STACK1     34.47   32.89   30.31   26.81   22.50   17.50
              STACK1     11.97    6.08    0.00   -6.08  -11.97  -17.50
              STACK1    -22.50  -26.81  -30.31  -32.89  -34.47  -35.00
              STACK1    -34.47  -32.89  -30.31  -26.81  -22.50  -17.50
              STACK1    -11.97   -6.08    0.00    6.08   11.97   17.50
              STACK1     22.50   26.81   30.31   32.89   34.47   35.00
   SRCGROUP  ALL
SO FINISHED
```

```
 *** Message Summary For AERMOD Model Setup ***
 --------- Summary of Total Messages ---------
A Total of           6 Fatal Error Message(s)
A Total of           0 Warning Message(s)
A Total of           0 Information Message(s)

   ******** FATAL ERROR MESSAGES ********
SO E105   17 EXKEY : Invalid Keyword Specified. The Troubled Keyword is BUILDHTS
SO E105   18 EXKEY : Invalid Keyword Specified. The Troubled Keyword is BUILDWTS
SO E105   19 SOCARD: Invalid Keyword Specified. The Troubled Keyword is BUILDWTS
SO E105   20 SOCARD: Invalid Keyword Specified. The Troubled Keyword is BUILDWTS
SO E105   21 SOCARD: Invalid Keyword Specified. The Troubled Keyword is BUILDWTS
...

   ********   WARNING MESSAGES   ********
              ***  NONE  ***

   ***************************************
   *** SETUP Finishes UN-successfully ***
   ***************************************
```

FIGURE 2-4. EXAMPLE OF KEYWORD ERROR AND ASSOCIATED MESSAGE SUMMARY TABLE

2.4.8 Running the Model and Reviewing the Results

Now that we have a complete and error-free runstream input file, we are ready to run the model and then review the results. The PC-executable file available on the SCRAM website opens the runstream input and printed output files explicitly within the model using internally specified filenames of AERMOD.INP and AERMOD.OUT, respectively. The model can be executed from the command prompt by simply typing the name AERMOD, as follows:

```
C:\>AERMOD
```

The "c-prompt" of DOS has been represented by the characters "C:\>", but may appear different on different machines. The important points are that the AERMOD.EXE file either be in the directory from which you are attempting to run the model, or in a directory that is included on the DOS PATH command when the system is "booted-up." The runstream input file (AERMOD.INP) must also be located in the directory from which the model is being executed. The model can also be executed by double clicking on the executable file from Windows Explorer.

As mentioned above, the SCRAM PC-executable file for AERMOD opens the input and output files explicitly. One reason for this is to allow for the model to write an update on the status of processing to the PC terminal screen. For the AERMOD model, the model first indicates that setup information is being processed and then gives the Julian day currently being processed. If no status message is seen then the model did not load into memory properly. If the model stops after completing the setup processing, then either the RUNORNOT option was set NOT to run. If a fatal error is encountered during the setup processing, then a message to that effect will be written to the screen and model execution

will be stopped. Another reason for not sending the printed output to the default output device (i.e., to the screen or redirected to a file), is so that any DOS error messages will be visible on the screen and not be written to the printed file. One such message might be that there is insufficient memory available to run the program. Handling of DOS error messages may require some knowledge of DOS, unless the meaning of the message is obvious.

The order of contents and organization of the main output file for the AERMOD model is presented in Figure 2-5.

Echo of Input Runstream Images

Summary of Runstream Setup Messages

Summary of Inputs
- Summary of Modeling Options
- Summary of Source Data
- Summary of Receptor Data
- Summary of Meteorology Data

Model Results

- Daily Results for Each Averaging Period Selected for Each Day Processed (If Applicable)
  - DAYTABLE Keyword
- PERIOD Results for Each Source Group (If Applicable)
  - PERIOD Parameter on AVERTIME Keyword
- Short Term Average Results (High, Second High, etc.) by Receptor for Each Source Group (If Applicable)
  - RECTABLE Keyword
- Overall Maximum Short Term Average Results for Each Source Group (If Applicable)
  - MAXTABLE Keyword

Summary Tables of High Values for Each Averaging Period and Source Group (Always provided if PERIOD averages or the RECTABLE keyword are used)

Summary of Complete Model Execution Messages

FIGURE 2-5. ORGANIZATION OF AERMOD MODEL OUTPUT FILE

Each page of the output file, except for the echo of the input file images, is labeled with the model name and version number, user-specified title(s), page number, and, for the PC version

of the model, the date and time of the particular run. Also included as part of the header information for each page is a one-line summary of the modeling options used for that particular run. The modeling options are listed as the secondary keywords used to control the options, such as DFAULT, CONC, etc. (Details about the date/time routines and other PC-specific features of the computer code are discussed in Section 4.0.)

Since the complete input file is normally echoed back as part of the output file, and since processing of the inputs stops when the OU FINISHED card is reached, the run can be duplicated by simply specifying the output filename as the input runstream file. Alternatively, the input records could be "cut and pasted" from the output file to a separate file using a text editor.

By default, the model will echo each line of the input runstream file to the printed output file. This provides a convenient record of the inputs as originally read into the model, without any rounding of numerical values that may appear in the input summary tables. As noted above, it also means that the output file can be used as an input file to the model to reproduce a particular application. However, for some applications, the length of the input runstream file may be too cumbersome to include the entire set of inputs at the beginning of each output file. This may happen, for example, if a large number of sources are being defined or if a large number of discrete receptor locations are used. For this reason, the user is provided with the option to "turn off" the echoing of the input file at any point within the runstream file. This is accomplished by entering the keywords "NO ECHO" in the first two fields anywhere within the runstream file. In other words, place NO in the pathway field, followed by a space and then ECHO. None of the input runstream images after the NO ECHO will be echoed to the output file. Thus, a user may choose to place NO ECHO after the Control pathway in order to keep the control options echoed, but suppress echoing the rest of the input file.

The details of the message summary tables were discussed in the previous section. A portion of the summary of modeling option inputs is shown in Figure 2-6 for the simple

example described in this section. The summary of source parameter input data includes separate tables for each source type, rather than combining all sources onto a single table. In this way the column headings are specific to the source type.

Figure 2-7 presents an example of the results output for the second highest values by receptor for our sample problem. These values are the second highest 3-hour averages at each receptor location. The number in parentheses following each concentration value is the date corresponding to each value. The date is given as an eight digit integer variable that includes the year (2-digits), month, day, and hour corresponding to the end of the averaging period.

For each of the different types of model result tables, the controlling keyword is identified in Figure 2-5 at the end of the description. All of the outputs of the same type, e.g. high values by receptor, are printed together, and the order of tables loops through all source groups for a particular averaging period, and then loops through all averaging periods. The summary tables of high values at the end of the model results follow the same order of loops. An example of the summary tables for our sample problem is shown in Figure 2-8. The summaries for all averaging periods have been combined onto a single figure, but would appear on separate pages of the actual output file.

```
 *** AERMOD - VERSION 02222 ***     *** A Simple Example Problem for the AERMOD Model with PRIME             ***        08/10/02
                                    ***                                                                      ***        12:00:00
**MODELOPTs:                                                                                                            PAGE    1
CONC                                FLAT

                                          ***     MODEL SETUP OPTIONS SUMMARY       ***
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

**Model Is Setup For Calculation of Average CONCentration Values.

**Model Uses RURAL Dispersion Only.

**Model Uses User-Specified Options:
        1. Stack-tip Downwash.
        2. Model Assumes Receptors on FLAT Terrain.

**Model Assumes No FLAGPOLE Receptor Heights.

**Model Calculates  2 Short Term Average(s) of:   3-HR  24-HR
    and Calculates PERIOD Averages

**This Run Includes:     1 Source(s);      1 Source Group(s); and     144 Receptor(s)

**The Model Assumes A Pollutant Type of:  SO2

**Model Set To Continue RUNning After the Setup Testing.

**Output Options Selected:
         Model Outputs Tables of PERIOD Averages by Receptor
         Model Outputs Tables of Highest Short Term Values by Receptor (RECTABLE Keyword)
         Model Outputs Tables of Overall Maximum Short Term Values (MAXTABLE Keyword)

**NOTE:  The Following Flags May Appear Following CONC Values:  c for Calm Hours
                                                                m for Missing Hours
                                                                b for Both Calm and Missing Hours

**Misc. Inputs:  Base Elev. for Pot. Temp. Profile (m MSL) =     0.00 ;  Decay Coef. =    0.000     ;  Rot. Angle =     0.0
                 Emission Units = GRAMS/SEC                              ;  Emission Rate Unit Factor =   0.10000E+07
                 Output Units   = MICROGRAMS/M**3

**Approximate Storage Requirements of Model =     1.2 MB of RAM.
```

FIGURE 2-6. SAMPLE OF MODEL OPTION SUMMARY TABLE FROM AN AERMOD MODEL OUTPUT FILE

CONC FLAT

*** THE 2ND HIGHEST 3-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): STACK1 ,
*** NETWORK ID: POL1 ; NETWORK TYPE: GRIDPOLR ***
** CONC OF SO2 IN MICROGRAMS/M**3 **

DIRECTION (DEGREES)	DISTANCE (METERS) 175.00	350.00	500.00	1000.00
10.0	0.76158 (88030321)	1.92853 (88030115)	3.31346 (88030115)	5.22765 (88030218)
20.0	0.63637 (88030212)	1.92844 (88030115)	5.85553 (88030218)	16.97758 (88030218)
30.0	0.62623 (88030212)	1.92797 (88030115)	5.83875 (88030218)	16.92332 (88030218)
40.0	0.62622 (88030212)	1.92504 (88030115)	3.31345 (88030115)	4.79368 (88030218)
50.0	0.62622 (88030212)	1.53776 (88030112)	2.70655 (88030112)	2.97378 (88030321)
60.0	0.62622 (88030212)	1.60102 (88030321)	2.70653 (88030112)	3.29819 (88030321)
70.0	0.62622 (88030212)	2.38433 (88030312)	3.14235 (88030312)	2.97029 (88030312)
80.0	1.22236 (88030321)	5.70971 (88030312)	7.70416 (88030312)	7.52613 (88030312)
90.0	5.25312 (88030112)	14.05461 (88030312)	19.21173 (88030312)	18.62586 (88030312)
100.0	10.56986 (88030115)	67.83944 (88030112)	68.92943 (88030112)	48.93400 (88030112)
110.0	13.40298 (88030115)	240.90436 (88030115)	261.11261 (88030112)	155.60106 (88030112)
120.0	11.83663 (88030115)	199.43596 (88030115)	266.38513 (88030115)	154.97153 (88030115)
130.0	7.82604 (88030115)	118.05672 (88030115)	151.17198 (88030115)	100.53476 (88030115)
140.0	3.76063 (88030312)	55.34053 (88030115)	71.91618 (88030115)	36.71769 (88030115)
150.0	1.38547 (88030209)	15.82063 (88030115)	18.09701 (88030115)	13.81106 (88030312)
160.0	0.62622 (88030212)	2.88999 (88030115)	4.68343 (88030115)	4.83882 (88030115)
170.0	0.62622 (88030212)	1.83427 (88030115)	3.66103 (88030112)	3.55293 (88030112)
180.0	0.69932 (88030321)	1.89684 (88030115)	3.31302 (88030115)	3.21311 (88030115)
190.0	0.62622 (88030212)	1.53751 (88030112)	2.97770 (88030415)	3.21308 (88030115)
200.0	0.62622 (88030212)	1.53790 (88030112)	2.70655 (88030112)	3.21308 (88030115)
210.0	0.62622 (88030212)	1.53802 (88030112)	2.70655 (88030112)	2.60891 (88030112)
220.0	0.62622 (88030212)	1.53802 (88030112)	2.70655 (88030112)	2.60891 (88030112)
230.0	0.62095 (88030321)	1.53802 (88030112)	2.70655 (88030112)	2.60891 (88030112)
240.0	0.52274 (88030321)	1.53802 (88030112)	2.70655 (88030112)	2.60891 (88030112)
250.0	0.42210 (88030321)	1.53802 (88030112)	2.70655 (88030112)	2.60891 (88030112)
260.0	0.35358 (88030209)	1.92853 (88030115)	2.70655 (88030112)	2.95926 (88030212)
270.0	0.32961 (88030209)	1.92853 (88030115)	3.31346 (88030115)	3.21308 (88030115)
280.0	0.30712 (88030209)	1.92853 (88030115)	3.31346 (88030115)	3.21308 (88030115)
290.0	0.30434 (88030321)	1.92853 (88030115)	3.31345 (88030115)	3.21308 (88030115)
300.0	0.30434 (88030321)	1.92853 (88030115)	3.31346 (88030115)	3.21308 (88030115)
310.0	0.30434 (88030321)	1.92853 (88030115)	3.31346 (88030115)	3.21308 (88030115)
320.0	0.30434 (88030321)	1.92853 (88030115)	3.31346 (88030115)	3.21308 (88030115)
330.0	0.30434 (88030321)	1.92853 (88030115)	3.31345 (88030115)	3.21308 (88030115)
340.0	0.30464 (88030306)	1.92853 (88030115)	3.31346 (88030115)	3.21308 (88030115)
350.0	0.37996 (88030306)	1.92853 (88030115)	2.70655 (88030112)	2.70615 (88030215)
360.0	0.52542 (88030321)	1.68995 (88030215)	3.04580 (88030215)	3.21308 (88030115)

FIGURE 2-7. EXAMPLE OUTPUT TABLE OF HIGH VALUES BY RECEPTOR

**MODELOPTs:
CONC FLAT

*** THE SUMMARY OF MAXIMUM PERIOD (96 HRS) RESULTS ***

** CONC OF SO2 IN MICROGRAMS/M**3 **

GROUP ID	AVERAGE CONC	RECEPTOR (XR, YR, ZELEV, ZHILL, ZFLAG)	OF TYPE	NETWORK GRID-ID
ALL	1ST HIGHEST VALUE IS	25.69162 AT (433.01, -250.00, 0.00, 0.00, 0.00)	GP	POL1
	2ND HIGHEST VALUE IS	24.36518 AT (469.85, -171.01, 0.00, 0.00, 0.00)	GP	POL1

*** THE SUMMARY OF HIGHEST 3-HR RESULTS ***

** CONC OF SO2 IN MICROGRAMS/M**3 **

GROUP ID	AVERAGE CONC	DATE (YYMMDDHH)	RECEPTOR (XR, YR, ZELEV, ZHILL, ZFLAG)	OF TYPE	NETWORK GRID-ID
ALL HIGH	1ST HIGH VALUE IS	335.81046	ON 88030112: AT (433.01, -250.00, 0.00, 0.00, 0.00)	GP	POL1
HIGH	2ND HIGH VALUE IS	266.38513	ON 88030115: AT (433.01, -250.00, 0.00, 0.00, 0.00)	GP	POL1

*** THE SUMMARY OF HIGHEST 24-HR RESULTS ***

** CONC OF SO2 IN MICROGRAMS/M**3 **

GROUP ID	AVERAGE CONC	DATE (YYMMDDHH)	RECEPTOR (XR, YR, ZELEV, ZHILL, ZFLAG)	OF TYPE	NETWORK GRID-ID
ALL HIGH	1ST HIGH VALUE IS	91.48365	ON 88030124: AT (433.01, -250.00, 0.00, 0.00, 0.00)	GP	POL1
HIGH	2ND HIGH VALUE IS	11.35450	ON 88030324: AT (866.03, -500.00, 0.00, 0.00, 0.00)	GP	POL1

*** RECEPTOR TYPES: GC = GRIDCART
GP = GRIDPOLR
DC = DISCCART
DP = DISCPOLR

FIGURE 2-8. EXAMPLE OF RESULT SUMMARY TABLES FOR THE AERMOD MODEL

2.5 MODIFYING AN EXISTING RUNSTREAM FILE

As noted earlier, one of the advantages of the keyword/parameter approach and the flexible format adopted for the input runstream file is that it will be easier for the user to make modifications to the runstream file and obtain the desired result. This section briefly illustrates some examples of how a runstream file can be modified. It is assumed that the reader is familiar with the operation of and basic editing commands for a text editor (i.e., a program that edits ASCII files), and is familiar with the previous sections of this tutorial.

2.5.1 Modifying Modeling Options

Depending on the type of analysis being performed, the user may need to modify the modeling options and run the model again. Because of the descriptive nature of the keywords and the secondary keywords used to control the modeling options, this can easily be done with the new runstream file, and usually without having to refer back to the user's guide each time a modification is attempted.

2.5.2 Adding or Modifying a Source or Source Group

Modifying the input file to add a source or a source group, or to add a source to a source group, is as simple as just adding it. There is no need to specify the total number of sources in the run, which would then have to be changed if more sources were added. The same applies to the number of groups, or the number of sources per group. If the user attempts to input more than the total number of sources or groups allowed for a particular run, an error message will be generated to that effect. Also, modifying a source group to delete a source is as easy as just deleting it from the input card, without having to change any other inputs.

Another way of "deleting" a source or a group from an input file is to place a "**" in the pathway field of the card or cards which define the source or group to "comment out" those inputs.

This approach, which was discussed above in Section 2.1.2, has the advantage of leaving the input data for the source or group in the input file for possible later use. It doesn't matter whether the "**" is entered with the text editor in "insert" mode, in which case the other inputs of that line are moved over, or if it is in "overtype" mode, which would replace the pathway ID that was already there.

2.5.3 Adding or Modifying a Receptor Network

As with source data, adding to or modifying the receptor information in the AERMOD model is relatively straight forward. The problem of having to make several changes to accomplish one small modification, such as adding a distance to a polar receptor network, has been avoided in the new model. All that the user needs to do is to add the new distance on the appropriate input card, which is easily identifiable because of the use of descriptive keywords. The model checks to ensure that the user does not attempt to specify more than the maximum number of receptors for a particular run, and generates an appropriate message if too many are input.

2.5.4 Modifying Output Options

Modifying the output options involves many of the same principles that are described above. In addition, all of the output options are structured in a way that allows the user to select options for specific averaging periods, so that the user may find it useful to copy a record or group of records set up for one averaging period and simply change the averaging period parameter. The other important short cut that is available for the printed table output options is to use the secondary keyword ALLAVE to indicate that the option applies to all averaging periods that are calculated. In this way, there will be no need to change the output options if a new averaging period is added to a run or if one is deleted.

3.0 DETAILED KEYWORD REFERENCE

This section of the AERMOD User's Guide provides a detailed reference for all of the input keyword options for the AERMOD model. The information provided in this section is more complete and detailed than the information provided in the Brief Tutorial in Section 2. Since this section is intended to meet the needs of experienced modelers who may need to understand completely how particular options are implemented in the model, the information for each keyword should stand on its own. This section assumes that the reader has a basic understanding of the keyword/parameter approach used by the model for specification of input options and data. Novice users should first review the contents of Section 2 in order to obtain that understanding.

3.1 OVERVIEW

The information in this section is organized by function, i.e., the keywords are grouped by pathway, and are in a logical order based on their function within the model. The order of keywords presented here is the same as the order used in the functional keyword reference in Appendix B, and the Quick Reference section at the end of the volume. The syntax for each keyword is provided, and the keyword type is specified - either mandatory or optional and either repeatable or non-repeatable. Unless noted otherwise, there are no special requirements for the order of keywords within each pathway, although the order in which the keywords are presented here and in Appendix B is recommended. Any keyword which has special requirements for its order within the pathway is so noted following the syntax and type description.

The syntax descriptions in the following sections use certain conventions. Parameters that are in all capital letters and underlined in the syntax description are secondary keywords that are to be entered as indicated for that keyword. Other parameters are given descriptive names to convey the meaning of the parameter, and are listed with an initial capital letter. Many of the parameter names used correspond to variable names used in the computer code of the model. Parentheses around a parameter indicate that the parameter is optional for that keyword. The default that is taken when an optional parameter is left blank is explained in the discussion for that keyword.

3.2 CONTROL PATHWAY INPUTS AND OPTIONS

The **CO**ntrol pathway contains the keywords that provide the overall control of the model run. These include the dispersion options, averaging time options, terrain height options, and others that are described below. The CO pathway must be the first pathway in the runstream input file.

3.2.1 Title Information

There are two keywords that allow the user to specify up to two lines of title information that will appear on each page of the main output file from the model. The first keyword, TITLEONE, is mandatory, while the second keyword, TITLETWO, is optional. The syntax and type for the keywords are summarized below:

Syntax:	CO TITLEONE Title1 CO TITLETWO Title2
Type:	TITLEONE - Mandatory, Non-repeatable TITLETWO - Optional, Non-repeatable

The parameters Title1 and Title2 are character parameters of length 68, which are read as a single field from columns 13 to 80 of the input record. The title information is taken as it appears in the runstream file without any conversion of lower case to upper case letters. If the TITLETWO keyword is not included in the runstream file, then the second line of the title in the output file will appear blank.

3.2.2 Dispersion Options

The dispersion options are controlled by the MODELOPT keyword on the CO pathway. The syntax, type, and order of the MODELOPT keyword are summarized below:

Syntax:	CO MODELOPT DFAULT CONC FLAT NOSTD NOCHKD NOWARN SCREEN TOXICS SCIM
Type:	Mandatory, Non-repeatable

where the secondary keyword parameters are described below (the order and spacing of these parameters is not critical):

DFAULT - Specifies that the regulatory default options will be used;

CONC - Specifies that concentration values will be calculated (note that deposition algorithms have not been implemented in AERMOD yet);

FLAT - Specifies that the non-default option of assuming flat terrain will be used;

NOSTD - Specifies that the non-default option of no stack-tip downwash will be used;

NOCHKD - Specifies that the non-default option of suspending date checking will be used for non-sequential meteorological data files;

NOWARN - Specifies that the option of suppressing the detailed listing of warning messages in the main output file will be used (the number of warning messages is still reported, and warning messages are still included in the error file controlled by the CO ERRORFIL card described in Section 3.2.14);

SCREEN - Specifies that the non-default option for running AERMOD in a screening mode will be used;

TOXICS - Specifies use of air toxics option(s), including SCIM and area source optimizations; and

SCIM - Sampled Chronological Input Model - used only with the ANNUAL average option to reduce runtime by sampling meteorology at a user-specified regular interval; SCIM sampling parameters must be specified on the ME pathway.

The regulatory default option in AERMOD includes the use of stack-tip downwash, incorporates the effects of elevated terrain, and includes the calms and missing data processing routines. The regulatory default option in AERMOD also forces the use of a 4-hour half life when modeling SO_2 in an urban source, and does not allow for exponential decay for other applications.

The missing data processing routines that are included in the AERMOD model allow the model to handle missing meteorological data in the processing of short term averages. The model treats missing meteorological data in the same way as the calms processing routine, i.e., it sets the concentration values to zero for that hour, and calculates the short term averages according to EPA's

calms policy, as set forth in the Guideline. Calms and missing values are tracked separately for the purpose of flagging the short term averages. An average that includes a calm hour is flagged with a 'c', an average that includes a missing hour is flagged with an 'm', and an average that includes both calm and missing hours is flagged with a 'b'. If the number of hours of missing meteorological data exceeds 10 percent of the total number of hours for a given model run, a cautionary message is written to the main output file, and the user is referred to Section 5.3.2 of "Meteorological Monitoring Guidance for Regulatory Modeling Applications" (EPA,).

The screening mode of AERMOD, which is controlled by the SCREEN keyword on the MODELOPT card, forces the model calculations to represent values for the plume centerline, regardless of the source-receptor-wind direction orientation. This option is included in AERMOD to facilitate the use of the model with a Windows-based AERMOD Screening Model interface (not yet developed) to estimate worst case impacts. Its use outside of that context is not recommended. Since the screening model is designed to be used with a non-sequential meteorological data file, representing a matrix of conditions, the SCREEN option also forces the use of the NOCHKD option described above, even if NOCHKD is not included on the MODELOPT card. The SCREEN option also restricts the averaging period options to 1-hour averages only on the AVERTIME card (see Section 3.2.3).

The AERMOD model includes the Sampled Chronological Input Model (SCIM) option for air toxics applications. In order to utilize this option, the user must include the TOXICS and SCIM keywords together on the CO MODELOPT card. Since the TOXICS option is a non-regulatory default option, the DFAULT keyword should not be included on the MODELOPT card. If the DFAULT keyword is present on the MODELOPT card, the DFAULT option will override the TOXICS option if it is present, and any other enhancements dependent on the TOXICS option. The SCIM approach associated with the TOXICS option is described below.

When the TOXICS option is specified, the area source integration routine is optimized to reduce model runtime. This is accomplished by incorporation of a three-tiered approach using the Romberg numerical integration, a 2-point Gaussian Quadrature routine for numerical integration, or

a point source approximation based on the location of the receptor relative to the source. In the regulatory default mode the Romberg numerical integration is utilized for all receptors.

If the non-default TOXICS option is specified, the user may also use the SCIM option to reduce model runtime. The SCIM option can only be used with the ANNUAL average option, and is primarily applicable to multi-year model simulations. The approach used by the SCIM option is to sample the meteorological data at a user-specified regular interval to approximate the long-term (i.e., ANNUAL) average impacts. Studies have shown that the uncertainty in modeled results introduced by use of the SCIM option is generally lower for area sources than for point sources.

When only the regular sampling is selected, hourly concentrations are calculated in the normal fashion for each sampled hour. The annual average concentration is then simply calculated by dividing the cumulative concentration for the sampled hours by the number of hours sampled (arithmetic average), i.e.,

$$C = \Sigma C_s / N_s$$

where:
C = Calculated concentration
ΣC_s = Cumulative impacts for the sampled hours
N_s = Number of sampled hours

To use the SCIM option, the user must include the SCIM and TOXICS keywords on the CO MODELOPT card, and also specify the SCIM sampling parameters on the ME SCIMBYHR card. The format and syntax of the ME SCIMBYHR keyword are described in Section 3.5.7.

3.2.3 Averaging Time Options

The averaging periods for AERMOD are selected using the AVERTIME keyword. The syntax and type of the AVERTIME keyword are summarized below:

Syntax:	CO AVERTIME Time1 Time2 Time3 Time4 MONTH PERIOD
Type:	Mandatory, Non-repeatable

where the parameters Time1 . . . Time4 refer to the user-specified short term averaging periods of 1, 2, 3, 4, 6, 8, 12, or 24 hours, the secondary keyword MONTH refers to monthly averages (for calendar months), and the secondary keyword PERIOD refers to the average for the entire data period. Any of the short term averaging periods listed above may be selected for a given run, as long as the total data storage needed by the model does not exceed the available computer memory. Since the monthly averages are treated as short term averages, the user can select appropriate output options, such as the second highest values by receptor, on the OUtput pathway.

The location of the PERIOD keyword in the parameter list is not critical. The order of the short term averaging periods (including MONTH) is also not critical, although it does control the order of the averaging period result tables in the main output file. Generally, it is recommended that the short term averaging periods be input in increasing order, unless there is a clear advantage in doing otherwise.

3.2.4 Urban Modeling Option

The AERMOD model allows the user to incorporate the effects of increased surface heating from an urban area on pollutant dispersion under stable atmospheric conditions. The user defines the input parameters for the urban area with the URBANOPT keyword on the CO pathway, and then identifies which sources are to be modeled with urban effects using the URBANSRC keyword on the SO pathway (see Section 3.3.4). The syntax and type of the URBANOPT keyword are summarized below:

Syntax:	CO URBANOPT UrbPop (UrbName) (UrbRoughness)
Type:	Optional, Non-repeatable

where the UrbPop parameter specifies the population of the urban area, the optional UrbName parameter may be used to identify the name of the urban area, and the optional UrbRoughness parameter may be used to specify the urban surface roughness length. Note the UrbName must be specified if the user wants to specify the urban roughness length. A default value of 1.0 meter will be used for the urban roughness length if the UrbRoughness parameter is omitted.

3.2.5 Specifying the Pollutant Type

The POLLUTID keyword is used to identify the type of pollutant being modeled for a particular run. The syntax, type, and order of the POLLUTID keyword are summarized below:

Syntax:	`CO POLLUTID Pollut`
Type:	`Mandatory, Non-repeatable`

where the Pollut parameter may be name of up to eight characters. Examples include SO2, NOX, CO, PM10, TSP, and OTHER. The only choice that currently has any impact on the results is the selection of PM10 (or PM-10) with the multi-year option for generating the high-sixth-high in five years. Otherwise, the pollutant ID currently has no effect on the calculations made in AERMOD.

3.2.6 Modeling With Exponential Decay

The model provides the option to use exponential decay of the pollutant being modeled. Two keywords are available for this purpose, the HALFLIFE and DCAYCOEF keywords. The syntax, type, and order of these keywords are summarized below:

Syntax:	`CO HALFLIFE Haflif` `CO DCAYCOEF Decay`
Type:	`Optional, Non-repeatable`

where the Haflif parameter is used to specify the half life for exponential decay in seconds, and the parameter Decay is used to specify the decay coefficient in units of s^{-1}. The relationship between these parameters is DECAY = 0.693/HAFLIF.

Only one of these keywords may be specified in a given run. If more than one is encountered, a non-fatal warning message is generated and the first specification is used in the modeling.

3.2.7 Flagpole Receptor Height Option

The FLAGPOLE keyword specifies that receptor heights above local ground level (i.e. flagpole receptors) are allowed on the REceptor pathway. The FLAGPOLE keyword may also be used to specify a default flagpole receptor height other than 0.0 meters. The syntax and type of the FLAGPOLE keyword are summarized below:

Syntax:	CO FLAGPOLE (Flagdf)
Type:	Optional, Non-repeatable

where Flagdf is an optional parameter to specify a default flagpole receptor height. If no parameter is provided, then a default flagpole receptor height of 0.0 meters is used. Any flagpole receptor heights that are entered on the Receptor pathway will override the default value, but are ignored if the FLAGPOLE keyword is not present on the Control pathway, and a non-fatal warning message is generated.

3.2.8 To Run or Not to Run - That is the Question

Because of the improved error handling and the "defensive programming" that has been employed in the design of the AERMOD model, it is intended that the model will read through all of the inputs in the runstream file regardless of any errors or warnings that may be encountered. If a fatal error occurs in processing of the runstream information, then further model calculations will be aborted. Otherwise, the model will attempt to run. Because of the great many options available in

the AERMOD model, and the potential for wasted resources if a large run is performed with some incorrect input data, the RUNORNOT keyword has been included on the Control pathway to allow the user to specify whether to RUN the model and perform all of the calculations, or NOT to run and only process the input runstream data and summarize the setup information. The syntax and type of the RUNORNOT keyword are summarized below:

Syntax:	CO RUNORNOT RUN or NOT
Type:	Mandatory, Non-repeatable

3.2.9 Generating an Input File for EVENT Processing

The AERMOD model contains the EVENTFIL keyword on the CO pathway to control whether or not the AERMOD model will generate an input file for EVENT processing. The syntax and type of the EVENTFIL keyword are summarized below:

Syntax:	CO EVENTFIL (Evfile) (Evopt)
Type:	Optional, Non-repeatable

where the optional Evfile parameter specifies the name of the EVENT input file to be generated (the maximum length of the file name is set by the ILEN_FLD parameter in MODULE MAIN1), and the optional parameter, Evopt, specifies the level of detail to be used in the EVENT output file. Valid inputs for the Evopt parameter are the secondary keywords of SOCONT and DETAIL (see the EVENTOUT keyword on the OUtput pathway, Section 3.7.2). The default filename used if no parameters are specified is EVENTS.INP, and the default for the level of detail is DETAIL. If only one parameter is present, then it is taken to be the Evfile, and the default will be used for Evopt.

The primary difference between routine AERMOD and EVENT processing is in the treatment of source group contributions. The AERMOD model treats the source groups independently. EVENT processing is designed to provide source contributions to particular events, such as the design concentrations determined from AERMOD, or user specified events. The user

may specify the "events" to process using the EVent pathway, which lists specific combinations of receptor location, source group, and averaging period. By specifying the EVENTFIL keyword, an input runstream file will be generated that can be used directly for EVENT processing. The events included in the generated EVENT processing input file are the design concentrations defined by the RECTABLE keyword and the threshold violations identified by the MAXIFILE keyword on the OU pathway.

3.2.10 The Model Re-start Capability

The AERMOD model has an optional capability to store intermediate results into an unformatted file, so that the model run can be continued later in case of a power failure or a user interrupt. This re-start option is controlled by the SAVEFILE and INITFILE keywords on the CO pathway. The syntax and type of these keywords are summarized below:

Syntax:	CO SAVEFILE (Savfil) (Dayinc) (Savfl2) CO INITFILE (Inifil)
Type:	Optional, Non-repeatable

The SAVEFILE keyword instructs the model to save the intermediate results to a file, and controls the save options. All three parameters for this keyword are optional. If the user specifies only the Savfil parameter, then the intermediate results are saved to the same file (and overwritten) each time. If the user specifies both the Savfil and the Savfl2 parameters, then the model alternates between the two files for storing intermediate results. The latter approach requires additional disk space to handle two storage files. However, selecting two files avoids the potential problem that the power failure or interrupt might occur while the temporary file is open and the intermediate results are being copied to it. In such a case, the temporary results file would be lost.

The optional Dayinc parameter allows the user to specify the number of days between successive dumps. The default is to dump values at the end of each day, i.e., Dayinc = 1. For larger modeling runs, where the SAVEFILE option is most useful, the additional execution time required

to implement this option is very small compared to the total runtime. To be most effective, it is recommended that results be saved at least every 5 days.

If no parameters are specified for the SAVEFILE keyword, then the model will store intermediate results at the end of each day using a default filename of TMP.FIL.

The INITFILE keyword works in conjunction with the SAVEFILE keyword, and instructs the model to initialize the results arrays from a previously saved file. The optional parameter, Inifil, identifies the unformatted file of intermediate results to use for initializing the model. If no Inifil parameter is specified, then the model assumes the default filename of TMP.FIL. If the file doesn't exist or if there are any errors encountered in opening the file, then a fatal error message is generated and processing is halted.

Note: It is important to note that if both the SAVEFILE and INITFILE keywords are used in a the same model run, then different filenames must be specified for the Savfil and Inifil parameters. Otherwise, the model will encounter an error in opening the files, and further processing will be halted.

3.2.11 Post-1997 PM_{10} Processing

A new NAAQS for modeling PM_{10} was promulgated in July 1997. This guidance utilizes the expected second high value of the 24-hour NAAQS replaced by a 3-year average of the 99th percentile value of the frequency distribution and a 3-year average of the annual mean. Since the Guideline on Air Quality Modeling precludes the use of a 3-year data set, a policy was established that uses unbiased estimates of the 3-year averages, utilizing all meteorological data (both single and multiple years of data) available. An unbiased estimate of the 99th percentile is the fourth highest concentration, if one year of meteorological data are input to the model, or the multi-year average of the fourth highest concentrations, if more than one year of meteorological data are input to the model. Similarly, an unbiased estimate of the 3-year average annual mean is simply the annual mean, if only one year of meteorological data are input to the model, or the multi-year average

annual mean if multiple years of meteorological data are used. Analogously to the original NAAQS situation, the entire area is in compliance when the highest fourth high (or highest average fourth high) and the highest annual mean (or the highest average annual mean) are less than or equal to the NAAQS.

AERMOD will process the 24-hour and annual averages for PM_{10} according to the new NAAQS if the pollutant ID specified on the CO POLLUTID card is PM10 or PM-10, and the CO MULTYEAR card is not present. In this case, the model will compute an average of the fourth highest concentrations at each receptor across the number of years of meteorological data being processed. For a single year of data, the model will report the fourth highest concentration at each receptor. For a five year period of data, the model will report the average of the five fourth-highest values at each receptor. Also, for multiple year data files, the annual average will first be calculated for each individual year of data, and the average of these across the number of years will be calculated. This processing of the annual average across multiple years may give slightly different results than the PERIOD average across the same time period, due to differences in the number of calms from year to year. In order to accommodate this difference, the new PM_{10} NAAQS makes use of the ANNUAL average keyword for specifying the long-term average.

Users should be aware of the following restrictions which are applied to the new PM_{10} NAAQS processing.

1. The averaging periods are limited to the 24-hour and ANNUAL averages. Use of the PERIOD average or a short-term average other than 24-hour will result in a fatal error message being generated.

2. Only the FOURTH (or 4TH) highest value may be requested on the RECTABLE card for 24-hour averages. Specifying another high value on the RECTABLE card will result in a fatal error message being generated.

3. The model will only process complete years of meteorological data, although there is no restriction on the start date for the data. If less than one complete year of data is processed, a fatal error message will be generated. If additional meteorological data remains after the end of the last complete year of data, the remaining data will be ignored, and a non-fatal warning message will be generated specifying the number of hours ignored.

4. The MULTYEAR card cannot be used with the new PM_{10} NAAQS. Multiple year analyses should be accomplished by including the multiple years of meteorology in a single data file.

5. Since the 24-hour average design values for post-1997 PM_{10} analyses may consist of averages over a multi-year period, they are incompatible with the EVENT processor. If the MAXIFILE option is used to output 24-hour average threshold violations, these may be used with the EVENT processor. Therefore, if the EVENTFIL option is used without the MAXIFILE option for post-1997 PM_{10} analyses, a non-fatal warning message will be generated, and the EVENTFIL option will be ignored.

3.2.12 Pre-1997 PM_{10} Processing

AERMOD may still be used to perform PM_{10} analyses according to the pre-1997 NAAQS. This may be accomplished as before by use of the MULTYEAR card on the CO pathway, except that the syntax for this keyword has been changed slightly. The syntax and type are now as follows:

Syntax:	CO MULTYEAR H6H Savfil (Inifil)
Type:	Optional, Non-repeatable

where H6H is a new secondary keyword that identifies this as a pre-1997 analysis, the Savfil parameter specifies the filename for saving the results arrays at the end of each year of processing, and the Inifil parameter specifies the filename to use for initializing the results arrays at the beginning of the current year. The Inifil parameter is optional, and should be left blank for the first

year in the multi-year series of runs. A non-fatal warning message will be generated if the MULTYEAR card is used for pre-1997 NAAQS analyses.

3.2.13 Debugging Output Option

The DEBUGOPT keyword on the CO pathway allows the user to request detailed files of intermediate calculation results for debugging purposes. The syntax and type of the DEBUGOPT keyword are summarized below:

Syntax:	CO DEBUGOPT MODEL (Dbgfil) and/or METEOR (Dbmfil)
Type:	Optional, Non-repeatable

where the MODEL and METEOR secondary keywords specify the type of debug information to be provided, and the Dbgfil and Dbmfil parameters specify the names of the detailed message files. This option allows for two types of debug output files. The MODEL secondary keyword specifies that intermediate calculations related to the model results for each source and receptor, e.g., dispersion parameters, plume heights, etc., are to be output. The METEOR secondary keyword specifies that the gridded profiles of meteorological variables for each hour of data are to be output. Use the DEBUGOPT keyword with **CAUTION**: it can produce very large files! The METEOR profiles are printed to a separate file from the MODEL information. The filenames for each type of output are optional, and if provided must immediately follow the appropriate secondary keyword. The default filenames used if none are specified by the user are MODEL.DBG and METEOR.DBG. The model will overwrite these files, without warning, if they already exist.

3.2.14 Detailed Error Listing File

The ERRORFIL keyword on the CO pathway allows the user to request a detailed listing file of all the messages generated by the model. This includes the error and warning messages that are listed as part of the message summaries provided in the main output file, and also any informational messages (such as occurrences of calm winds) and quality assurance messages that are generated. The syntax and type of the ERRORFIL keyword are summarized below:

Syntax:	CO ERRORFIL (Errfil)
Type:	Optional, Non-repeatable

where the Errfil parameter is the name of the detailed message file. If the optional Errfil parameter is left blank, then the model will use a default filename of ERRORS.LST. A complete description of the error and other types of messages generated by the model is provided in Appendix C.

3.3 SOURCE PATHWAY INPUTS AND OPTIONS

The **SO**urce pathway contains the keywords that define the source information for a particular model run. The model currently handles three source types, identified as point, volume or area sources. The input parameters vary depending on the source type. For point sources, the user can also identify building dimensions for nearby structure that cause aerodynamic downwash influences on the source. The user can also identify groups of sources for which the model will combine the results.

The LOCATION keyword, which identifies the source type and location, must be the first card entered for each source. The only other requirement for order of the keywords is that the SRCGROUP keyword must be the last keyword before the SO FINISHED card. The user may group all of the LOCATION cards together, then group the source parameter cards together, or they may want to group all input cards for a particular source together. All sources are given a source ID by the user, which is used to link the source parameter inputs to the correct source or sources. The source ID can be any alphanumeric string of up to eight characters.

As noted in Section 2.3, the number of sources is allocated dynamically at the time AERMOD is run. This value, in concert with the other dynamically allocated arrays and input requirements, is limited only by the amount of available memory.

3.3.1 Identifying Source Types and Locations

The LOCATION keyword is used to identify the source type and the location of each source to be modeled. The LOCATION card must be the first card entered for each source since it identifies the source type, and dictates which parameters are needed and/or accepted. The syntax, type and order of the LOCATION keyword are summarized below:

Syntax:	SO LOCATION Srcid Srctyp Xs Ys (Zs)
Type:	Mandatory, Repeatable
Order:	Must be first card for each source input

where the Srcid parameter is the alphanumeric source ID defined by the user (up to eight characters), Srctyp is the source type, which is identified by one of the secondary keywords - POINT, VOLUME, AREA, AREAPOLY, or AREACIRC - and Xs, Ys, and Zs are the x, y, and z coordinates of the source location in meters. All three of the area source types use the same numerical integration algorithm for estimating impacts from area sources, and are merely different options for specifying the shape of the area source. The AREA source keyword may be used to specify a rectangular-shaped area source with arbitrary orientation; the AREAPOLY source keyword may be used to specify an area source as an irregularly-shaped polygon of up to 20 sides; and the AREACIRC source keyword may be used to specify a circular-shaped area source (modeled as an equal-area polygon of 20 sides). Note that the source elevation, Zs, is an optional parameter. If the default option to include elevated terrain effects is used and the source elevation is omitted, a warning message will be generated and the source elevation will be given a value of 0.0. The source elevation is not used by the model if the non-default FLAT terrain option is used. While the default units of Zs are meters, the user may also specify source elevations to be in feet by adding the SO ELEVUNIT FEET card immediately following the SO STARTING card. The x (east-west) and y (north-south) coordinates are for the center of the source for POINT, VOLUME, and AREACIRC sources, and are for one of the vertices of the source for AREA and AREAPOLY sources. The source coordinates may be input as Universal Transverse Mercator (UTM) coordinates, or may be referenced to a user-defined origin.

Certain types of line sources can be handled in AERMOD using either a string of volume sources, or as an elongated area source. The volume source algorithms are most applicable to line sources with some initial plume depth, such as conveyor belts and rail lines. Section 1.2.2 of the ISC Model User's Guide - Volume II (EPA, 1995) provides technical information on how to model a line source with multiple volume sources. The use of the AERMOD area source algorithm for elongated rectangles would be most applicable to near ground level line sources, such as a viaduct.

The source ID entered on the LOCATION card identifies that source for the remainder of the SO pathway inputs. Since the model accepts alphanumeric strings of up to eight characters for the source ID, the sources can be identified with descriptive names, such as STACK1, STACK2, BOILER3, SLAGPILE, etc. This may also be useful if line sources are being modeled as multiple volume or areas, as discussed above. Since they are part of the same physical source, they can be given names that will identify them as being related, such as LINE1A, LINE1B, LINE1C, etc.

3.3.2 Specifying Source Release Parameters

The main source parameters are input on the SRCPARAM card, which is a mandatory keyword for each source being modeled. Since the input parameters vary depending on the source type, the different source types handled by the AERMOD model are discussed separately.

3.3.2.1 POINT Source Inputs.

The AERMOD POINT source algorithms are used to model releases from stacks and isolated vents, as well as other kinds of sources. The syntax, type and order for the SRCPARAM card for POINT sources are summarized below:

Syntax:	`SO SRCPARAM Srcid Ptemis Stkhgt Stktmp Stkvel Stkdia`
Type:	`Mandatory, Repeatable`
Order:	`Must follow the LOCATION card for each source input`

where the Srcid parameter is the same source ID that was entered on the LOCATION card for a particular source, and the other parameters are as follows:

Ptemis - point emission rate in g/s,

Stkhgt - release height above ground in meters,

Stktmp - stack gas exit temperature in degrees K,

Stkvel - stack gas exit velocity in m/s, and

Stkdia - stack inside diameter in meters.

An example of a valid SRCPARAM input card for a point source is given below:

```
SO SRCPARAM   STACK1   16.71   35.0   444.0   22.7   2.74
```

where the source ID is STACK1, the emission rate is 16.71 g/s, the release height is 35.0 m, the exit temperature is 444.0 K, the exit velocity is 22.7 m/s, and the inside stack diameter is 2.74 m. All of the parameters must be present on the input card.

If a value of 0.0 is input for the exit temperature, AERMOD will adjust the exit temperature for each hour to match the ambient temperature. This option allows the user to model a plume that is released at ambient temperature. The user may also model a plume with an exit temperature that exceeds the ambient temperature by a fixed amount by entering a negative value for exit temperature equal in magnitude to the temperature difference. The model will add the absolute value of a negative exit temperature to the ambient temperature for each hour to obtain the exit temperature used in computing the buoyancy flux of the plume. The AERMOD model does not include algorithms to model plumes that are released at temperatures below ambient temperature. Such releases should be modeled with a dense gas model.

Since the AERMOD model uses direction-specific building dimensions for all sources subject to building downwash, there are no building parameters entered on the SRCPARAM card.

Building dimensions are entered on the BUILDHGT, BUILDWID, BUILDLEN, XBADJ, and YBADJ cards described below in Section 3.3.3.

3.3.2.2 VOLUME Source Inputs.

The AERMOD VOLUME source algorithms are used to model releases from a variety of industrial sources, such as building roof monitors, multiple vents, and conveyor belts. The syntax, type and order for the SRCPARAM card for VOLUME sources are summarized below:

Syntax:	SO SRCPARAM Srcid Vlemis Relhgt Syinit Szinit
Type:	Mandatory, Repeatable
Order:	Must follow the LOCATION card for each source input

where the Srcid parameter is the same source ID that was entered on the LOCATION card for a particular source, and the other parameters are as follows:

Vlemis - volume emission rate in g/s,

Relhgt - release height (center of volume) above ground, in meters,

Syinit - initial lateral dimension of the volume in meters, and

Szinit - initial vertical dimension of the volume in meters.

The following table, which is explained in more detail in Section 1.2.2 of the ISC Model User's Guide - Volume II, summarizes the suggested procedures to be used for estimating the initial lateral and vertical dimensions for various types of volume and line sources.

TABLE 3-1.

SUMMARY OF SUGGESTED PROCEDURES FOR ESTIMATING

INITIAL LATERAL DIMENSIONS σ_{yo} AND

INITIAL VERTICAL DIMENSIONS σ_{zo} FOR VOLUME AND LINE SOURCES

Type of Source	Procedure for Obtaining Initial Dimension
(a) Initial Lateral Dimensions (σ_{yo})	
Single Volume Source	σ_{yo} = length of side divided by 4.3
Line Source Represented by Adjacent Volume Sources (see Figure 1-8(a) in EPA, 1995)	σ_{yo} = length of side divided by 2.15
Line Source Represented by Separated Volume Sources (see Figure 1-8(b) in EPA, 1995)	σ_{yo} = center to center distance divided by 2.15
(b) Initial Vertical Dimensions (σ_{zo})	
Surface-Based Source ($h_e \sim 0$)	σ_{zo} = vertical dimension of source divided by 2.15
Elevated Source ($h_e > 0$) on or Adjacent to a Building	σ_{zo} = building height divided by 2.15
Elevated Source ($h_e > 0$) not on or Adjacent to a Building	σ_{zo} = vertical dimension of source divided by 4.3

3.3.2.3 AREA Source Inputs

The AERMOD area source algorithm is used to model low level or ground level releases with no plume rise (e.g., storage piles, slag dumps, and lagoons). The AERMOD model uses a numerical integration approach for modeling impacts from area sources. When the TOXICS option is specified, the area source integration routine is optimized to reduce model runtime. This is accomplished by incorporation of a three-tiered approach using the Romberg numerical integration, a 2-point Gaussian Quadrature routine for numerical integration, or a point source approximation based on the location of the receptor relative to the source. In the regulatory default mode the Romberg numerical integration is utilized for all receptors.

The AERMOD model includes three options for specifying the shape of an area source: the AREA source type may be used to specify rectangular areas that may also have a rotation angle specified relative to a north-south orientation; the AREAPOLY source type may be used to specify an area source as an irregularly-shaped polygon of up to 20 sides; and the AREACIRC source keyword may be used to specify a circular-shaped area source (modeled as an equal-area polygon of 20 sides). The source parameter inputs for each of the area source types is described below.

AREA Source Type

The rotation angle for rectangular AREA sources is specified relative to the vertex used to define the source location on the SO LOCATION card (e.g., the southwest corner). The syntax, type and order for the SRCPARAM card for AREA sources are summarized below:

Syntax:	SO SRCPARAM Srcid Aremis Relhgt Xinit (Yinit) (Angle) (Szinit)
Type:	Mandatory, Repeatable
Order:	Must follow the LOCATION card for each source input

where the Srcid parameter is the same source ID that was entered on the LOCATION card for a particular source, and the other parameters are as follows:

Aremis - area emission rate in g/(s-m^2),

Relhgt - release height above ground in meters,

Xinit - length of X side of the area (in the east-west direction if Angle is 0 degrees) in meters,

Yinit - length of Y side of the area (in the north-south direction if Angle is 0 degrees) in meters (optional),

Angle - orientation angle for the rectangular area in degrees from North, measured positive in the clockwise direction (optional), and

Szinit - initial vertical dimension of the area source plume in meters (optional).

It should be noted that the emission rate for the area source is an emission rate per unit area, which is different from the point and volume source emission rates, which are total emissions for the source.

If the optional Yinit parameter is omitted, then the model assumes that the area is a square, i.e., Yinit = Xinit. If the optional Angle parameter is omitted, then the model assumes that the area is oriented in the north-south and east-west directions, i.e., Angle = 0.0. If the Angle parameter is input, and the value does not equal 0.0, then the model will rotate the area clockwise around the vertex defined on the SO LOCATION card for this source. Figure 3-1 illustrates the relationship between the Xinit, Yinit, and Angle parameters and the source location, (Xs,Ys), for a rotated rectangle. The Xinit dimension is measured from the side of the area that is counterclockwise along the perimeter from the vertex defined by (Xs,Ys), while the Yinit dimension is measured from the side of the area that is clockwise from (Xs,Ys). The Angle parameter is measured as the orientation relative to North of the side that is clockwise from (Xs,Ys), i.e. the side with length Yinit. The Angle parameter may be positive (for clockwise rotation) or negative (for counterclockwise rotation), and a warning message is generated if the absolute value of Angle is greater than 180 degrees. The selection of the vertex to use for the source location is not critical, as long as the relationship described above for the Xinit, Yinit, and Angle parameters is maintained.

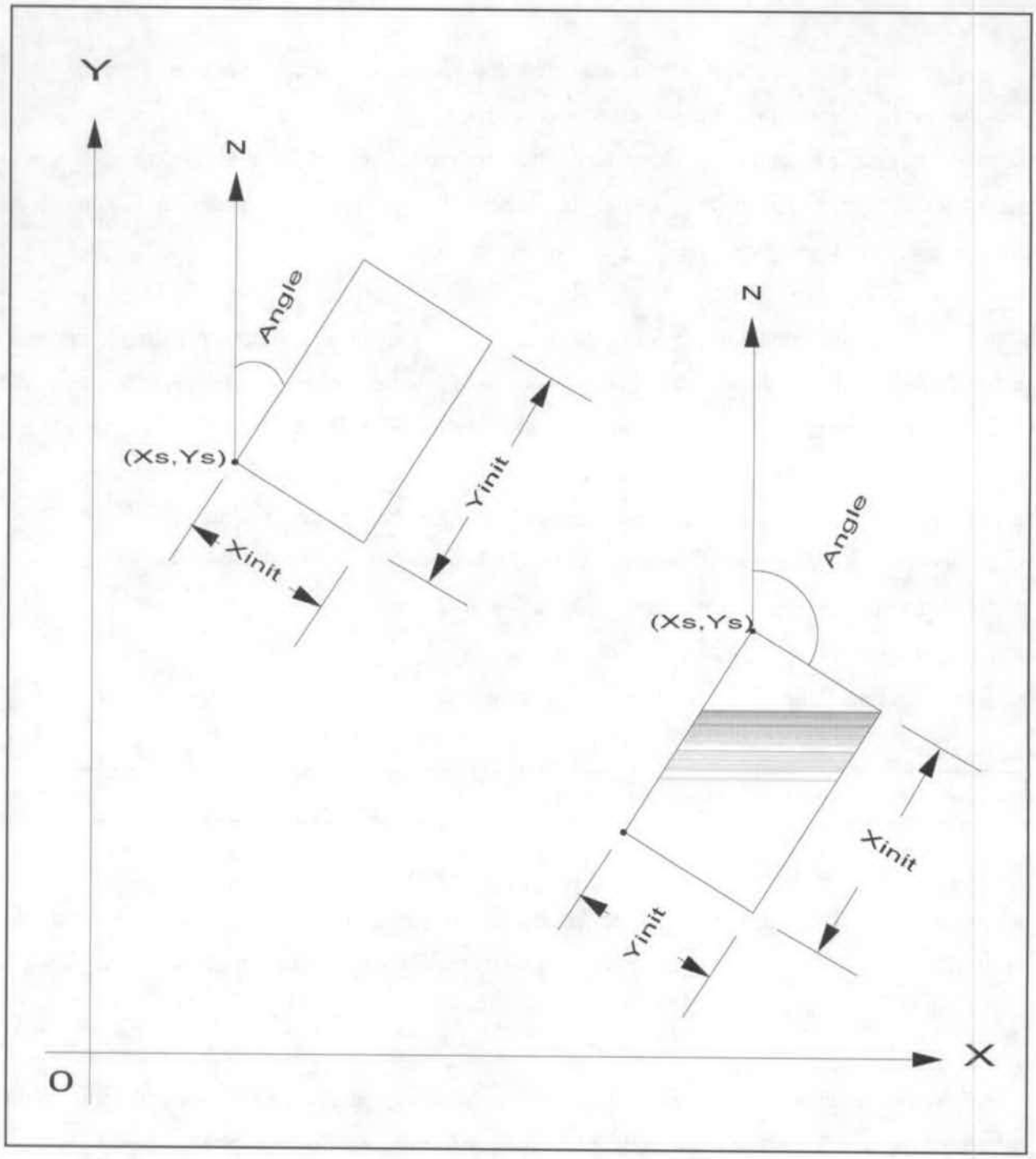


FIGURE 3-1. RELATIONSHIP OF AREA SOURCE PARAMETERS FOR ROTATED RECTANGLE

By making the Yinit and Angle parameters optional, the area source input data for the previous versions of the ISC2 model can be used with the AERMOD model. The aspect ratio (i.e., length/width) for area sources should generally be less than about 10 to 1. If this is exceeded, then the model will generate a non-fatal warning message, and the user should consider subdividing the area to achieve a 10 to 1 aspect ratio (or less) for all subareas.

The optional Szinit parameter may be used to specify an initial vertical dimension to the area source plume, similar to the use of the Szinit parameter for volume sources. This parameter may be important when the area source algorithm is used to model mechanically generated emission sources, such as mobile sources. In these cases, the emissions may be turbulently mixed near the source by the process that is generating the emissions, and therefore occupy some initial depth. For more passive area source emissions, such as evaporation or wind erosion, the Szinit parameter may be omitted, which is equivalent to using an initial sigma-z of zero.

An example of a valid SRCPARAM input card for a rectangular area source is given below:

```
SO SRCPARAM  SLAGPILE  0.0015  5.0  50.0  100.0  30.0
```

where the source ID is SLAGPILE, the emission rate is 0.0015 g/(s-m^2), the release height is 5.0 m, the X-dimension is 50.0 m, the Y-dimension is 100.0 m, and the orientation angle is 30.0 degrees clockwise from North.

Since the numerical integration algorithm can handle elongated areas with aspect ratios of up to 10 to 1, the AERMOD area source algorithm may be useful for modeling certain types of line sources. There are no restrictions on the placement of receptors relative to area sources for the AERMOD model. Receptors may be placed within the area and at the edge of an area. The AERMOD model will integrate over the portion of the area that is upwind of the receptor. However, since the numerical integration is not performed for portions of the area that are closer than 1.0 meter upwind of the receptor, caution should be used when placing receptors within or

adjacent to areas that are less than a few meters wide. More technical information about the application of the AERMOD area source algorithm is provided in Sections 1.2.3 and 2.2.3 of the ISC Model User's Guide - Volume II (EPA, 1995).

AREAPOLY Source Type

The AREAPOLY source type may be used to specify an area source as an arbitrarily-shaped polygon of between 3 and 20 sides (the number of sides allowed may be increased by modifying the NVMAX parameter in MODULE MAIN1). This source type option provides the user with considerable flexibility for specifying the shape of an area source. The syntax, type and order for the SRCPARAM card for AREAPOLY sources are summarized below:

Syntax:	SO SRCPARAM Srcid Aremis Relhgt Nverts (Szinit)
Type:	Mandatory, Repeatable
Order:	Must follow the LOCATION card for each source input

where the Srcid parameter is the same source ID that was entered on the LOCATION card for a particular source, and the other parameters are as follows:

Aremis - area emission rate in g/(s-m^2),

Relhgt - release height above ground in meters,

Nverts - number of vertices (or sides) of the area source polygon,

Szinit - initial vertical dimension of the area source plume in meters (optional).

As with AREA sources, the emission rate for the source is an emission rate per unit area, which is different from the point and volume source emission rates, which are total emissions for the source. The number of vertices (or sides) used to define the area source polygon may vary between 3 and 20. The locations of the vertices are specified by use of the AREAVERT keyword, which applies only to AREAPOLY sources. The syntax, type and order for the AREAVERT keyword used for AREAPOLY sources are summarized below:

Syntax:	SO AREAVERT Srcid Xv(1) Yv(1) Xv(2) Yv(2) ... Xv(i) Yv(i)
Type:	Mandatory for AREAPOLY sources, Repeatable
Order:	Must follow the LOCATION card for each source input

where the Xv(i) and Yv(i) are the x-coordinate and y-coordinate values of the vertices of the area source polygon. There must by Nverts pairs of coordinates for the area source, where Nverts in the number of vertices specified for that source on the SRCPARAM card. The first vertex, Xv(1) and Yv(1), must also match the coordinates given for the source location on the LOCATION card, Xs and Ys. The remaining vertices may be defined in either a clockwise or counter-clockwise order from the point used for defining the source location.

Since the numerical integration algorithm can handle elongated areas with aspect ratios of up to 10 to 1, the AERMOD area source algorithm may be useful for modeling certain types of line sources. There are no restrictions on the placement of receptors relative to area sources for the AERMOD model. Receptors may be placed within the area and at the edge of an area. The AERMOD model will integrate over the portion of the area that is upwind of the receptor. However, since the numerical integration is not performed for portions of the area that are closer than 1.0 meter upwind of the receptor, caution should be used when placing receptors within or adjacent to areas that are less than a few meters wide.

AREACIRC Source Type

The AREACIRC source type may be used to specify an area source as a circular shape. The model will automatically generate a regular polygon of up to 20 sides to approximate the circular area source. The polygon will have the same area as that specified for the circle. The syntax, type and order for the SRCPARAM card for AREACIRC sources are summarized below:

Syntax:	SO SRCPARAM Srcid Aremis Relhgt Radius (Nverts) (Szinit)
Type:	Mandatory, Repeatable
Order:	Must follow the LOCATION card for each source input

where the Srcid parameter is the same source ID that was entered on the LOCATION card for a particular source, and the other parameters are as follows:

Aremis - area emission rate in g/(s-m^2),

Relhgt - release height above ground in meters,

Radius - radius of the circular area in meters,

Nverts - number of vertices (or sides) of the area source polygon (optional, 20 sides will be used if omitted),

Szinit - initial vertical dimension of the area source plume in meters (optional).

As with AREA sources, the emission rate for the source is an emission rate per unit area, which is different from the point and volume source emission rates, which are total emissions for the source.

3.3.3 Specifying Building Downwash Information

As noted above, the AERMOD model include algorithms to model the effects of buildings downwash on emissions from nearby or adjacent point sources. The building downwash algorithms do not apply to volume or area sources. For a technical description of the building downwash algorithms in AERMOD, the user is referred to Schulman, et. al. (2000). The AERMOD model uses direction-specific information for all building downwash cases.

There are five keywords that are used to specify building downwash information: BUILDHGT, BUILDWID, BUILDLEN, XBADJ, YBADJ. The syntax, type and order for the BUILDHGT keyword, used to input direction specific building heights, are summarized below:

Syntax:	SO BUILDHGT Srcid (or Srcrng) Dsbh(i),i=1,36 (16 for LT)
Type:	Optional, Repeatable
Order:	Must follow the LOCATION card for each source input

where the Srcid parameter is the same source ID that was entered on the LOCATION card for a particular source. The user also has the option of specifying a range of sources (the Srcrng parameter) for which the building heights apply, instead of identifying a single source. This is accomplished by two source ID character strings separated by a dash, e.g., STACK1-STACK10. Since the model reads the source range as a single input field there must not be any spaces between the source IDs. The model then places the building heights that follow (the Dsbh(i) parameter) into the appropriate arrays for all Srcid's that fall within that range, including STACK1 and STACK10.

When comparing a source ID to the range limits for a Srcrng parameter, the model separates the source IDs into three parts: an initial alphabetical part, a numerical part, and then the remainder of the string. Each part is then compared to the corresponding parts of the source range, and all three parts must satisfy the respective ranges in order for the source ID to be included. If there is no numeric part, then the ID consists of only one alphabetical part. If the ID begins with a numeric character, then the initial alphabetical part defaults to a single blank. If there is no trailing alphabetical part, then the third part also defaults to a single blank part. If the trailing part consists of more than one alphabetical or numeric field, it is all lumped into one character field. For example, the source ID 'STACK2' consists of the parts 'STACK' plus '2' plus a single trailing blank, ' '. By comparing the separate parts of the source IDs, it can be seen that STACK2 falls between the range 'STACK1-STACK10.' For a three-part example, it can also be seen that VENT1B falls within the range of VENT1A-VENT1C. However, VENT2 does not fall within the range of VENT1A to VENT3B, since the third part of VENT2 is a single blank, which does not fall within the range of A to C. This is because a blank character will precede a normal alphabetical character. Normally, the source ranges will work as one would intuitively expect for simple source names. Most importantly, for names that are made up entirely of numeric characters, the source ranges will be based simply on the relative numerical values. The user is strongly encouraged to check the summary of model inputs to ensure that the source ranges were interpreted as expected, and also to avoid using complex source names in ranges, such as AA1B2C-AB3A3C. Since the order of keywords within the SO pathway is quite flexible, it is also important to note that the building heights will only be applied to those sources that have been defined previously in the input file.

Following the Srcid or the Srcrng parameter, the user inputs 36 direction-specific building heights (Dsbh parameter) in meters, beginning with the 10 degree flow vector (wind blowing toward 10 degrees from north), and incrementing by 10 degrees in a clockwise direction. Some examples of building height inputs are presented below:

```
SO BUILDHGT  STACK1  34. 34. 34. 34. 34. 34. 34. 34. 34. 34. 34. 34.
SO BUILDHGT  STACK1  34. 34. 34. 34. 34. 34. 34. 34. 34. 34. 34. 34.
SO BUILDHGT  STACK1  34. 34. 34. 34. 34. 34. 34. 34. 34. 34. 34. 34.

SO BUILDHGT  STACK1  36*34.0

SO BUILDHGT  STACK1-STACK10  33*34.0  3*0.0

SO BUILDHGT  STACK1  35.43 36.45 36.37 35.18 32.92 29.66 25.50 20.56
SO BUILDHGT  STACK1  15.00 20.56 25.50 29.66 32.92 35.18 36.37 36.45
SO BUILDHGT  STACK1  35.43 33.33 35.43 36.45  0.00 35.18 32.92 29.66
SO BUILDHGT  STACK1  25.50 20.56 15.00 20.56 25.50 29.66 32.92 35.18
SO BUILDHGT  STACK1  36.37 36.45 35.43 33.33
```

The first example illustrates the use of repeat cards if more than one card is needed to input all of the values. The values are processed in the order in which they appear in the input file, and are identified as being repeat cards by repeating the Srcid parameter. The first and second examples produce identical results within the model. The second one illustrates the use of a repeat value that can simplify numerical input in some cases. The field "36*34.0" is interpreted by the model as "repeat the value 34.0 a total of 36 times." This is also used in the third example where the building height is constant for directions of 10 degrees through 330 degrees, and then is set to 0.0 (e.g. the stack may be outside the region of downwash influence) for directions 340 through 360. The third example also uses a source range rather than a single source ID. The last example illustrates building heights which vary by direction, and shows that the number of values on each card need not be the same. For improved readability of the input file, the user may want to put the numerical inputs into "columns," but there are no special rules regarding the spacing of the parameters on this keyword.

The BUILDWID keyword is used to input direction-specific building widths for downwash analyses. The syntax for this keyword, which is very similar to the BUILDHGT keyword, is summarized below, along with the type and order information:

Syntax:	SO BUILDWID Srcid (or Srcrng) Dsbw(i),i=1,36 (16 for LT)
Type:	Optional, Repeatable
Order:	Must follow the LOCATION card for each source input

For a description of the Srcid and Srcrng parameters, and for a discussion and examples of the numeric input options, refer to the BUILDHGT keyword above. The Dsbw(i) parameter contains the 36 direction-specific building widths. The directions proceed in a clockwise direction, beginning with the 10 degree flow vector.

The BUILDLEN keyword is used to input direction-specific along-flow building lengths for downwash analyses. Figure 3-2 shows the relationship of the projected building to this dimension. The syntax for this keyword, which is very similar to the BUILDHGT keyword, is summarized below, along with the type and order information:

Syntax:	SO BUILDLEN Srcid (or Srcrng) Dsbl(i),i=1,36
Type:	Optional, Repeatable
Order:	Must follow the LOCATION card for each source input

For a description of the Srcid and Srcrng parameters, and for a discussion and examples of the numeric input options, refer to the BUILDHGT keyword above. The Dsbl(i) parameter contains the 36 direction-specific building lengths. The directions proceed in a clockwise direction, beginning with the 10 degree flow vector.

Figure 3-2 shows the relationship of the projected building to these distances.

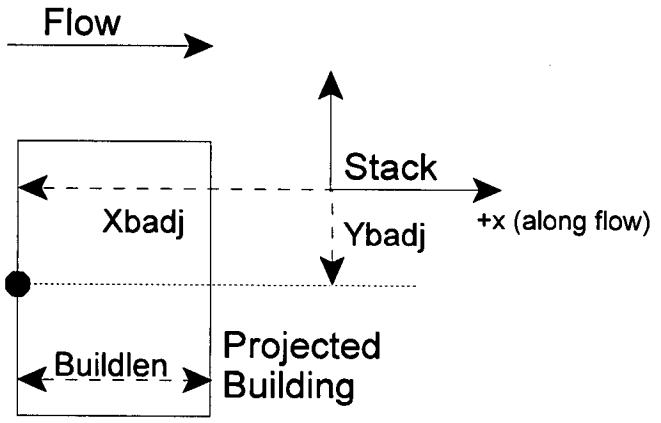


FIGURE 3-2. SCHEMATIC DIAGRAM IDENTIFYING NEW BUILDING DATA FOR PRIME DOWNWASH

The XBADJ and YBADJ keywords are used to input direction-specific along-flow and across-flow distances from the stack to the center of the upwind face of the projected building, respectively. Figure 3-2 shows the relationship of the projected building to these distances. The syntax for these keywords, which is very similar to the BUILDHGT keyword, are summarized below, along with the type and order information:

Syntax:	SO XBADJ Srcid (or Srcrng) Xbadj(i),i=1,36
Type:	Optional, Repeatable
Order:	Must follow the LOCATION card for each source input

Syntax:	SO YBADJ Srcid (or Srcrng) Ybadj(i),i=1,36
Type:	Optional, Repeatable
Order:	Must follow the LOCATION card for each source input

For a description of the Srcid and Srcrng parameters, refer to the BUILDHGT keyword above. The Xbadj(i) parameter contains the 36 direction-specific along-flow distances from the stack to the center of the upwind face and the Ybadj(i) parameter contains the 36 direction-specific across-flow distances from the stack to the center of the upwind face. The directions proceed in a clockwise direction, beginning with the 10 degree flow vector.

3.3.4 Specifying Urban Sources

As discussed in Section 3.2.4, the AERMOD model allows the user to incorporate the effects of increased surface heating from an urban area on pollutant dispersion under stable atmospheric conditions. The user specifies the parameters for the urban area on the CO URBANOPT card (see Section 3.2.4), and identifies which sources are to be modeled with urban effects using the SO URBANSRC card. If a source is not included on the URBANSRC card, it will be modeled without the urban effects. The syntax, type and order for the URBANSRC keyword are summarized below:

Syntax:	SO URBANSRC Srcid's and/or Srcrng's
Type:	Optional, Repeatable
Order:	Must follow the LOCATION card for each source input

where the Srcid's and Srcrng's are the individual source IDs and/or source ranges that are to be modeled with urban effects. Source ranges, which are described in more detail in the description of the BUILDHGT keyword (Section 3.3.3), are input as two source IDs separated by a dash, e.g.,

STACK1-STACK10. Individual source IDs and source ranges may be used on the same card. If more than one input card is needed to define the urban sources, then additional cards may be input.

3.3.5 Using Variable Emission Rates

The AERMOD model provide the option of specifying variable emission rate factors for individual sources or for groups of sources. The factors may vary on different time scales, such as by season, hour-of-day, etc. The EMISFACT keyword provides the user the option of specifying variable emission rate factors for sources modeled by the AERMOD model. The syntax, type and order of this keyword are summarized below:

Syntax:	SO EMISFACT Srcid (or Srcrng) Qflag Qfact(i),i=1,n
Type:	Optional, Repeatable
Order:	Must follow the LOCATION card for each source input

where the Srcid parameter is the same source ID that was entered on the LOCATION card for a particular source. The user also has the option of using the Srcrng parameter for specifying a range of sources for which the emission rate factors apply, instead of identifying a single source. This is accomplished by two source ID character strings separated by a dash, e.g., STACK1-STACK10. The use of the Srcrng parameter is explained in more detail in Section 3.3.3 above for the BUILDHGT keyword.

The parameter Qflag is the variable emission rate flag, and is one of the following secondary keywords:

SEASON - emission rates vary seasonally (n=4),

MONTH - emission rates vary monthly (n=12),

HROFDY - emission rates vary by hour-of-day (n=24),

WSPEED - emission rates vary by wind speed (n=6),

SEASHR- emission rates vary by season and hour-of-day (n=96),

SHRDOW - emission rates vary by season, hour-of-day, and day-of-week [M-F, Sat., Sun.] (n=288), and

SHRDOW7 - emission rates vary by season, hour-of-day, and the seven days of the week [M,Tu,W,Th,F,Sat.,Sun.] (n=672).

The Qfact array is the array of factors, where the number of factors is shown above for each Qflag option. The seasons are defined in the following order: Winter (Dec., Jan., Feb.), Spring (Mar., Apr., May), Summer (Jun., Jul., Aug.), and Fall (Sep., Oct., Nov.). The wind speed categories used with the WSPEED option may be defined using the ME WINDCATS keyword. If the WINDCATS keyword is not used, the default wind speed categories are defined by the upper bound of the first five categories as follows (the sixth category is assumed to have no upper bound): 1.54, 3.09, 5.14, 8.23, and 10.8 m/s. The EMISFACT card may be repeated as many times as necessary to input all of the factors, and repeat values may be used for the numerical inputs. An example of each of these options is presented below, with column headers to indicate the order in which values are to be to input:

```
**                          WINTER  SPRING  SUMMER  FALL
SO EMISFACT STACK1 SEASON    0.50    0.50    1.00   0.75

**                          JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
SO EMISFACT STACK1 MONTH    0.1 0.2 0.3 0.4 0.5 0.5 0.5 0.6 0.7 1.0 1.0 1.0

**                           1   2   3   4   5   6   7   8   9  10  11  12
SO EMISFACT STACK1 HROFDY   0.0 0.0 0.0 0.0 0.0 0.5 1.0 1.0 1.0 1.0 1.0 1.0

**                          13  14  15  16  17  18  19  20  21  22  23  24
SO EMISFACT STACK1 HROFDY   1.0 1.0 1.0 1.0 1.0 0.5 0.0 0.0 0.0 0.0 0.0 0.0


** or, equivalently:         1-5    6    7-17   18   19-24
SO EMISFACT STACK1 HROFDY   5*0.0  0.5  11*1.0  0.5  6*0.0

**        Wind Speed Cat.:    1      2      3      4      5      6
SO EMISFACT STACK1 WSPEED    0.5    0.6    0.7    0.8    0.9    1.0

SO EMISFACT STACK1 SEASHR   enter 24 hourly scalars for each of the four
                            seasons (winter, spring, summer, fall), e.g.,

**                            Winter     Spring     Summer     Fall
SO EMISFACT STACK1 SEASHR    24*0.50    24*0.50    24*1.00    24*0.75

SO EMISFACT STACK1 SHRDOW   enter 24 hourly scalars for each of the four
                            seasons (winter, spring, summer, fall), first
                            for Weekdays (Monday-Friday), then for Saturdays,
                            and finally for Sundays, e.g.,

** Weekdays:                 Winter     Spring     Summer     Fall
SO EMISFACT STACK1 SHRDOW    24*1.0     24*0.8     24*0.6     24*0.8
** Saturdays:
SO EMISFACT STACK1 SHRDOW    24*0.5     24*0.4     24*0.3     24*0.4
** Sundays:
SO EMISFACT STACK1 SHRDOW    24*0.25    24*0.2     24*0.15    24*0.2

SO EMISFACT STACK1 SHRDOW7  enter 24 hourly scalars for each of the four
                            seasons (winter, spring, summer, fall), first
                            for Mondays, then for Tuesdays, ..., then for Saturdays,
                            and finally for Sundays, e.g.,

** Mondays:                  Winter     Spring     Summer     Fall
SO EMISFACT STACK1 SHRDOW7   24*1.0     24*0.8     24*0.6     24*0.8
** Tuesdays:                 Winter     Spring     Summer     Fall
       .
       .
       .
** Saturdays:
SO EMISFACT STACK1 SHRDOW7   24*0.5     24*0.4     24*0.3     24*0.4
** Sundays:
SO EMISFACT STACK1 SHRDOW7   24*0.25    24*0.2     24*0.15    24*0.2
```

3.3.6 Adjusting the Emission Rate Units for Output

The default emission rate units for the AERMOD model are grams per second for point and volume sources, and grams per second per square meter for area sources. By default, the model converts these input units to output units of micrograms per cubic meter for concentration calculations. This is accomplished by applying a default emission rate unit factor of 1.0E06 for concentration.

The EMISUNIT keyword on the SO pathway allows the user to specify a different unit conversion factor, and to specify the appropriate label for the output units for either concentration calculations. The syntax and type of the EMISUNIT keyword are summarized below:

Syntax:	SO EMISUNIT Emifac Emilbl Conlbl
Type:	Optional, Non-repeatable

where the parameter Emifac is the emission rate unit factor, Emilbl is the label for the emission units (up to 40 characters), and Conlbl is the output unit label (up to 40 characters) for concentration calculations. For example, to produce output concentrations in milligrams per cubic meter, assuming input units of grams per sec, the following card could be input:

```
SO EMISUNIT  1.0E3  GRAMS/SEC   MILLIGRAMS/M**3
```

since there are 1.0E3 milligrams per gram. The emission rate unit factor applies to all sources for a given run. Since the model uses one or more spaces to separate different fields on the input runstream images, it is important that there not be any spaces within the label fields on this card. Thus, instead of entering 'GRAMS PER SECOND' for the emission label, a label of 'GRAMS/SECOND', or 'GRAMS-PER-SECOND' or an equivalent variation should be used.

3.3.7 Specifying Variables for Settling, Removal and Deposition Calculations

The current version of the AERMOD model does not include algorithms to handle the gravitational settling and removal by dry deposition of particulates.

3.3.8 Specifying Variables for Precipitation Scavenging and Wet Deposition Calculations

The current version of the AERMOD model does not include algorithms to handle the scavenging and removal by wet deposition (i.e., precipitation scavenging) of gases and particulates.

3.3.9 Specifying an Hourly Emission Rate File

The source (SO) pathway includes an option for inputting hourly emission rates for the AERMOD model, controlled by the HOUREMIS keyword. AERMOD currently allows for a single hourly emission file to be used with each model run. The syntax, type and order for this keyword are summarized below:

Syntax:	SO HOUREMIS Emifil Srcid's (and/or Srcrng's)
Type:	Optional, Repeatable
Order:	Must follow the LOCATION card for each source input

where the Emifil parameter specifies the filename (up to 40 characters) for the hourly emission file, and Srcid or Srcrng identify the source or sources for which hourly emission rates are included. Source ranges, which are described in more detail in the description of the BUILDHGT keyword (Section 3.3.3), are input as two source IDs separated by a dash, e.g., STACK1-STACK10. The user may include more than one HOUREMIS card in a runstream file, if needed to specify additional sources, but there can be only one hourly emissions file, and therefore the filename must be the same on all HOUREMIS cards.

The format of each record of the hourly emissions file includes a pathway and keyword (SO HOUREMIS), followed by the Year, Month, Day, Hour, Source ID, and emission rate (in the appropriate units). For point sources, the stack gas exit temperature (K), and stack gas exit velocity (m/s) are also specified. The hourly emissions file is processed using the same routines used to process the runstream input file, therefore each of the parameters must be separated by at least one space, but otherwise the format is flexible. It is also not necessary to include the SO HOUREMIS on each line, as long as the parameters (Year, Month, etc.) do not begin before column 13.

The data in the hourly emission file must include the exact same dates as are included in the meteorological input files, and the source IDs must correspond to the source IDs defined on the SO LOCATION cards and be in the same order. Multiple records are required to define the emissions for one hour if more than one source is referenced. The model will check for a date mismatch between the hourly emissions file and the meteorological data, and also for a source ID mismatch. However, it is not necessary to process the entire hourly emissions file on each model run, i.e., the correct emissions data will be read if the ME DAYRANGE or the ME STARTEND cards (see Section 3.5.4) are used, as long as all the dates (including those that are processed and those that are skipped) match the meteorological data files. An example of several lines from an hourly emissions file for two point sources is provided below:

```
SO HOUREMIS   88   8 16   1   STACK1   52.467   382.604   12.27
SO HOUREMIS   88   8 16   1   STACK2   44.327   432.326   22.17
SO HOUREMIS   88   8 16   2   STACK1   22.321   377.882   9.27
SO HOUREMIS   88   8 16   2   STACK2   42.166   437.682   19.67
SO HOUREMIS   88   8 16   3   STACK1   51.499   373.716   11.87
SO HOUREMIS   88   8 16   3   STACK2   41.349   437.276   18.77
SO HOUREMIS   88   8 16   4   STACK1   36.020   374.827   9.63
SO HOUREMIS   88   8 16   4   STACK2   43.672   437.682   18.23
```

The model will use the stack release height and stack inside diameter defined on the SO SRCPARAM card, but will use the emission rate, exit temperature and exit velocity from the hourly emission file. If the emission rate, exit temperature and exit velocity are not included for a particular hour, i.e, any or all of those fields are blank, the model will interpret emissions data for

that hour as missing and will set the parameters to zero. Since the emission rate will be zero, there will be no calculations made for that hour and that source.

3.3.10 Including Source Data From an External File

The user has the option of including source data from an external file by using the INCLUDED keyword on the source (SO) pathway. An SO INCLUDED card may be placed anywhere within the source pathway, after the STARTING card and before the FINISHED card (i.e., the SO STARTING and SO FINISHED cards cannot be included in the external file). The data in the included file will be processed as though it were part of the runstream file. The syntax and type of the INCLUDED keyword are summarized below:

Syntax:	SO INCLUDED Incfil
Type:	Optional, Repeatable

where the Incfil parameter is a character field of up to 40 characters that identifies the filename for the included file. The contents of the included file must be valid runstream images for the source pathway. If an error is generated during processing of the included file, the error message will report the line number of the included file (see Appendix C). If more than one INCLUDED file is specified for the source pathway, the user will first need to determine which file the error occurred in. If the starting column of the main runstream input file is shifted from column 1 (see Section 2.4.8), then the runstream images in the included file must be offset by the same amount.

3.3.11 Using Source Groups

The AERMOD model allows the user to group contributions from particular sources together. Several source groups may be setup in a single run, and they may, for example, be used to model impacts from the source being permitted, the group of increment consuming PSD sources, and the group of all sources for comparison to a NAAQS in a single run. There is always at least one source group in a run, which may consist of all sources, so the SRCGROUP keyword has been

made mandatory in the AERMOD model. The syntax, type and order of the SRCGROUP keyword are summarized below:

Syntax:	SO SRCGROUP Grpid Srcid's and/or Srcrng's
Type:	Mandatory, Repeatable
Order:	Must be the last keyword in the SO pathway before FINISHED

where the Grpid parameter is an alphanumeric string of up to eight characters that identifies the group name. The Srcid's and Srcrng's are the individual source IDs and/or source ranges that make up the group of sources. Source ranges, which are described in more detail in the description of the BUILDHGT keyword (Section 3.3.3), are input as two source IDs separated by a dash, e.g., STACK1-STACK10. Individual source IDs and source ranges may be used on the same card. If more than one input card is needed to define the sources for a particular group, then additional cards may be input, repeating the pathway, keyword and group ID.

A special group ID has been reserved for use in specifying the group of all sources. When Grpid = ALL, the model will automatically setup a source group called ALL that includes all sources modeled for that particular run. If desired, the user can setup a group of all sources with a different group ID by explicitly specifying all sources on the input card(s).

As noted in Section 2.3, the number of source groups is allocated dynamically at the time AERMOD is run. This value, in concert with the other dynamically allocated arrays and input requirements, is limited only by the amount of available memory.

As discussed in Sections 1.2.4.6 and 3.2.9, it is sometimes important for a user to know the contribution of a particular source to the total result for a group. These source contribution analyses are facilitated for short term averages by the use the EVENT processing capabilities in the AERMOD model. EVENT processing uses the same source groups that are identified by AERMOD (when the input file is generated using the CO EVENTFIL option), but the model is

structured in a way that it retains individual source results for particular events. Refer to the sections noted above for a more complete description of EVENT processing and its uses.

3.4 RECEPTOR PATHWAY INPUTS AND OPTIONS

The **RE**ceptor pathway contains keywords that define the receptor information for a particular model run. The RE pathway contains keywords that allow the user to define Cartesian grid receptor networks and/or polar grid receptor networks, with either uniform or non-uniform grid spacing, as well as discrete receptor locations referenced to a Cartesian or a polar system. As noted in Section 2.3, the number of receptors and receptor networks are allocated dynamically at the time AERMOD is run. This value, in combination with the other dynamically allocated arrays and input requirements, is limited only by the amount of available memory.

All of the receptor options in AERMOD allow the user to input terrain elevations and hill height scales for each receptor, both of which are needed when applying AERMOD in an elevated terrain situation. To facilitate the generation of hill height scales for AERMOD, a terrain preprocessor, called AERMAP, has been developed (EPA, 1998c). The AERMAP terrain preprocessor, which uses U.S. Geological Survey (USGS) Digital Elevation Model (DEM) data as an input, may also be used to generate the terrain elevations for the receptor locations. The AERMAP program generates an output file that contains the receptor pathway data for AERMOD in the format described below. This file may either be cut and pasted into the AERMOD runstream file, or may be included as an external file using the RE INCLUDED card (see Section 3.4.4).

The default units for receptor elevations for the AERMOD model are in meters, however, the user may specify receptor elevations to be in units of feet by adding the RE ELEVUNIT FEET card immediately after the RE STARTING card. Since the AERMAP terrain preprocessor outputs elevations in meters and includes the RE ELEVUNIT METERS card as the first record, the AERMAP data must be placed at the beginning of the receptor pathway.

3.4.1 Defining Networks of Gridded Receptors

Two types of receptor networks are allowed by the AERMOD model. A Cartesian grid network, defined through the GRIDCART keyword, includes an array of points identified by their x (east-west) and y (north-south) coordinates. A polar network, defined by the GRIDPOLR keyword, is an array of points identified by direction and distance from a user-defined origin. Each of these keywords has a series of secondary keywords associated with it that are used to define the network, including any receptor elevations for elevated terrain and flagpole receptor heights. The GRIDCART and GRIDPOLR keywords can be thought of as "sub-pathways," since their secondary keywords include a STArt and an END card to define the start and end of inputs for a particular network.

3.4.1.1 Cartesian Grid Receptor Networks.

Cartesian grid receptor networks are defined by use of the GRIDCART keyword. The GRIDCART keyword may be thought of as a "sub-pathway," in that there are a series of secondary keywords that are used to define the start and the end of the inputs for a particular network, and to select the options for defining the receptor locations that make up the network. The syntax and type of the GRIDCART keyword are summarized below:

Syntax:	RE GRIDCART Netid	STA							
		XYINC	Xinit	Xnum	Xdelta	Yinit	Ynum	Ydelta	
	or	XPNTS	Gridx1	Gridx2	Gridx3	....		Gridxn,	and
		YPNTS	Gridy1	Gridy2	Gridy3	....		Gridyn	
		ELEV	Row	Zelev1	Zelev2	Zelev3	...	Zelevn	
		HILL	Row	Zhill1	Zhill2	Zhill3	...	Zhilln	
		FLAG	Row	Zflag1	Zflag2	Zflag3	...	Zflagn	
		END							
Type:	Optional, Repeatable								

where the parameters are defined as follows:

Netid	Receptor network identification code (up to eight alphanumeric characters)
STA	Indicates the STArt of GRIDCART inputs for a particular network, repeated for each new Netid

XYINC	Keyword identifying uniform grid network generated from x and y increments
Xinit	Starting x-axis grid location in meters
Xnum	Number of x-axis receptors
Xdelta	Spacing in meters between x-axis receptors
Yinit	Starting y-axis grid location in meters
Ynum	Number of y-axis receptors
Ydelta	Spacing in meters between y-axis receptors
XPNTS	Keyword identifying grid network defined by a series of discrete x and y coordinates (used with YPNTS)
Gridx1	Value of first x-coordinate for Cartesian grid (m)
Gridxn	Value of 'nth' x-coordinate for Cartesian grid (m)
YPNTS	Keyword identifying grid network defined by a series of discrete x and y coordinates (used with XPNTS)
Gridy1	Value of first y-coordinate for Cartesian grid (m)
Gridyn	Value of 'nth' y-coordinate for Cartesian grid (m)
ELEV	Keyword to specify that receptor elevations follow (optional)
Row	Indicates which row (y-coordinate fixed) is being input (Row=1 means first, i.e., southmost row)
Zelev	An array of receptor terrain elevations (m) for a particular Row (default units of meters may be changed to feet by use of RE ELEVUNIT keyword), number of entries per row equals the number of x-coordinates for that network
HILL	Keyword to specify that hill height scales follow (optional)
Row	Indicates which row (y-coordinate fixed) is being input (Row=1 means first, i.e., southmost row)
Zelev	An array of hill height scales (m) for a particular Row (default units of meters may be changed to feet by use of RE ELEVUNIT keyword), number of entries per row equals the number of x-coordinates for that network
FLAG	Keyword to specify that flagpole receptor heights follow (optional)
Row	Indicates which row (y-coordinate fixed) is being input (Row=1 means first, i.e., southmost row)
Zflag	An array of receptor heights (m) above local terrain elevation for a particular Row (flagpole receptors), number of entries per row equals the number of x-coordinates for that network
END	Indicates the END of GRIDCART inputs for a particular network, repeated for each new Netid

The ELEV, HILL, and FLAG keywords are optional inputs, and are only needed if elevated terrain or flagpole receptor heights are to be used. If elevated terrain is being used, then both the ELEV and HILL inputs are needed for each receptor. If the ELEV and HILL keywords are used and the model is being run with the flat terrain option (see Section 3.2.2), then the elevated terrain height inputs will be ignored by the model, and a non-fatal warning message will be generated. If the elevated terrain option is selected, and no elevated terrain heights are entered, the elevations will default to 0.0 meters, and warning messages will also be generated. The model handles flagpole receptor height inputs in a similar manner.

The order of cards within the GRIDCART subpathway is not important, as long as all inputs for a particular network are contiguous and start with the STA secondary keyword and end with the END secondary keyword. It is not even required that all ELEV cards be contiguous, although the input file will be more readable if a logical order is followed. The network ID is also not required to appear on each runstream image (except for the STA card). The model will assume the previous ID if none is entered, similar to the use of continuation cards for pathway and keywords. Thus, the following two examples produce the same 8 X 4 Cartesian grid network:

```
RE GRIDCART CAR1 STA
RE GRIDCART CAR1 XPNTS  -500.  -400.  -200.  -100. 100.  200.  400.  500.
RE GRIDCART CAR1 YPNTS  -500.  -250.   250.  500.
RE GRIDCART CAR1 ELEV  1  10.  10.  10.  10.  10.  10. 10.  10.
RE GRIDCART CAR1 ELEV  2  20.  20.  20.  20.  20.  20. 20.  20.
RE GRIDCART CAR1 ELEV  3  30.  30.  30.  30.  30.  30. 30.  30.
RE GRIDCART CAR1 ELEV  4  40.  40.  40.  40.  40.  40. 40.  40.
RE GRIDCART CAR1 HILL  1  50.  50.  50.  50.  50.  50. 50.  50.
RE GRIDCART CAR1 HILL  2  60.  60.  60.  60.  60.  60. 60.  60.
RE GRIDCART CAR1 HILL  3  70.  70.  70.  70.  70.  70. 70.  70.
RE GRIDCART CAR1 HILL  4  80.  80.  80.  80.  80.  80. 80.  80.
RE GRIDCART CAR1 FLAG  1  10.  10.  10.  10.  10.  10. 10.  10.
RE GRIDCART CAR1 FLAG  2  20.  20.  20.  20.  20.  20. 20.  20.
RE GRIDCART CAR1 FLAG  3  30.  30.  30.  30.  30.  30. 30.  30.
RE GRIDCART CAR1 FLAG  4  40.  40.  40.  40.  40.  40. 40.  40.
RE GRIDCART CAR1 END
```

```
RE GRIDCART CAR1 STA
                 XPNTS  -500.  -400.  -200.  -100. 100.  200.  400.  500.
                 YPNTS  -500.  -250.   250.  500.
                 ELEV  1  8*10.
                 HILL  1  8*50.
                 FLAG  1  8*10.
                 ELEV  2  8*20.
                 HILL  2  8*60.
                 FLAG  2  8*20.
                 ELEV  3  8*30.
                 HILL  3  8*70.
                 FLAG  3  8*30.
                 ELEV  4  8*40.
                 HILL  4  8*80.
                 FLAG  4  8*40.
RE GRIDCART CAR1 END
```

The Row parameter on the ELEV, HILL, and FLAG inputs may be entered as either the row number, i.e., 1, 2, etc., or as the actual y-coordinate value, e.g., -500., -250., etc. in the example

above. The model sorts the inputs using Row as the index, so the result is the same. The above example could therefore be entered as follows, with the same result:

```
RE GRIDCART CAR1 STA
                 XPNTS  -500.  -400.  -200.  -100.  100.  200.  400.  500.
                 YPNTS  -500.  -250.   250.  500.
                 ELEV   -500.  8*10.
                 FLAG   -500.  8*10.
                 ELEV   -250.  8*20.
                 FLAG   -250.  8*20.
                 ELEV    250.  8*30.
                 FLAG    250.  8*30.
                 ELEV    500.  8*40.
                 FLAG    500.  8*40.
RE GRIDCART CAR1 END
```

Of course, one must use either the row number or y-coordinate value consistently within each network to have the desired result.

The following simple example illustrates the use of the XYINC secondary keyword to generate a uniformly spaced Cartesian grid network. The resulting grid is 11 x 11, with a uniform spacing of 1 kilometer (1000. meters), and is centered on the origin (0., 0.). No elevated terrain heights or flagpole receptor heights are included in this example.

```
RE GRIDCART CG1 STA
                 XYINC  -5000.  11  1000.  -5000.  11 1000.
RE GRIDCART CG1 END
```

3.4.1.2 Polar Grid Receptor Networks.

Polar receptor networks are defined by use of the GRIDPOLR keyword. The GRIDPOLR keyword may also be thought of as a "sub-pathway," in that there are a series of secondary keywords that are used to define the start and the end of the inputs for a particular network, and to select the options for defining the receptor locations that make up the network. The syntax and type of the GRIDPOLR keyword are summarized below:

Syntax:	RE GRIDPOLR Netid STA ORIG Xinit Yinit, or ORIG Srcid DIST Ring1 Ring2 Ring3 ... Ringn DDIR Dir1 Dir2 Dir3 ... Dirn, or GDIR Dirnum Dirini Dirinc ELEV Dir Zelev1 Zelev2 Zelev3 ... Zelevn HILL Dir Zhill1 Zhill2 Zhill3 ... Zhilln FLAG Dir Zflag1 Zflag2 Zflag3 ... Zflagn END
Type:	Optional, Repeatable

where the parameters are defined as follows:

Netid	Receptor network identification code (up to eight alphanumeric characters)
STA	Indicates STArt of GRIDPOLR inputs for a particular network, repeat for each new Netid
ORIG Xinit Yinit Srcid	Keyword to specify the origin of the polar network (optional) x-coordinate for origin of polar network y-coordinate for origin of polar network Source ID of source used as origin of polar network
DIST Ring1 Ringn	Keyword to specify distances for the polar network Distance to the first ring of polar coordinates Distance to the 'nth' ring of polar coordinates
DDIR Dir1 Dirn	Keyword to specify discrete direction radials for the polar network First direction radial in degrees (1 to 360) The 'nth' direction radial in degrees (1 to 360)
GDIR Dirnum Dirini Dirinc	Keyword to specify generated direction radials for the polar network Number of directions used to define the polar system Starting direction of the polar system Increment (in degrees) for defining directions
ELEV Dir Zelev	Keyword to specify that receptor elevations follow (optional) Indicates which direction is being input An array of receptor terrain elevations for a particular direction radial (default units of meters may be changed to feet by use of RE ELEVUNIT keyword), number of entries per radial equals the number of distances for that network
HILL Dir Zelev	Keyword to specify that hill height scales follow (optional) Indicates which direction is being input An array of receptor hill height scales for a particular direction radial (default units of meters may be changed to feet by use of RE ELEVUNIT keyword), number of entries per radial equals the number of distances for that network
FLAG Dir Zflag	Keyword to specify that flagpole receptor heights follow (optional) Indicates which direction is being input An array of receptor heights above local terrain elevation for a particular direction (flagpole receptors)
END	Indicates END of GRIDPOLR subpathway, repeat for each new Netid

The ORIG secondary keyword is optional for the GRIDPOLR inputs. If omitted, the model assumes a default origin of (0., 0.,) in x,y coordinates. The ELEV, HILL, and FLAG keywords are also optional inputs, and are only needed if elevated terrain or flagpole receptor heights are to be used. If elevated terrain is being used, then both the ELEV and HILL inputs are needed for each receptor. If the ELEV and HILL keywords are used and the model is being run with the flat terrain option (see Section 3.2.2), then the elevated terrain height inputs will be ignored by the model, and a non-fatal warning message will be generated. If the elevated terrain option is selected, and no elevated terrain heights are entered, the elevations will default to 0.0 meters, and warning messages will also be generated. The model handles flagpole receptor height inputs in a similar manner.

As with the GRIDCART keyword described above, the order of cards within the GRIDPOLR subpathway is not important, as long as all inputs for a particular network are contiguous and start with the STA secondary keyword and end with the END secondary keyword. It is not even required that all ELEV cards be contiguous, although the input file will be more readable if a logical order is followed. The network ID is also not required to appear on each runstream image (except for the STA card). The model will assume the previous ID if none is entered, similar to the use of continuation cards for pathway and keywords.

The following example of the GRIDPOLR keyword generates a receptor network consisting of 180 receptor points on five concentric distance rings centered on an assumed default origin of (0.,0.). The receptor locations are placed along 36 direction radials, beginning with 10. degrees and incrementing by 10. degrees in a clockwise fashion.

```
RE GRIDPOLR POL1 STA
                 DIST  100.  300.  500.  1000.  2000.
                 GDIR  36    10.   10.
RE GRIDPOLR POL1 END
```

Another example is provided illustrating the use of a non-zero origin, discrete direction radials and the specification of elevated terrain and flagpole receptor heights:

```
RE GRIDPOLR POL1 STA
                 ORIG  500.   500.
                 DIST  100.   300.   500.   1000.   2000.
                 DDIR  90.    180.   270.   360.
                 ELEV  90.    5. 10. 15. 20. 25.
                 ELEV  180.   5. 10. 15. 20. 25.
                 ELEV  270.   5. 10. 15. 20. 25.
                 ELEV  360.   5. 10. 15. 20. 25.
                 HILL  90.  50. 60. 75. 80. 95.
                 HILL  180. 50. 60. 75. 80. 95.
                 HILL  270. 50. 60. 75. 80. 95.
                 HILL  360. 50. 60. 75. 80. 95.
                 FLAG  90.    5. 10. 15. 20. 25.
                 FLAG  180.   5. 10. 15. 20. 25.
                 FLAG  270.   5. 10. 15. 20. 25.
                 FLAG  360.   5. 10. 15. 20. 25.
RE GRIDPOLR POL1 END
```

The user has the option of specifying the radial number (e.g. 1, 2, 3, etc.) on the ELEV, HILL, and FLAG inputs, or the actual direction associated with each radial.

For purposes of model calculations, all receptor locations, including those specified as polar, are stored in the model arrays as x, y and z coordinates and flagpole heights. For the purposes of reporting the results by receptor in the main print file, the tables are labeled with the polar inputs, i.e., directions and distances.

3.4.2 Using Multiple Receptor Networks

For some modeling applications, the user may need a fairly coarsely spaced network covering a large area to identify the area of significant impacts for a plant, and a denser network covering a smaller area to identify the maximum impacts. To accommodate this modeling need, the AERMOD model allows the user to specify multiple receptor networks in a single model run. The user can define either Cartesian grid networks or polar networks, or both. With the use of the ORIG option in the GRIDPOLR keyword, the user can easily place a receptor network centered on the facility being permitted, and also place a network centered on another background source known to be a significant contributor to high concentrations. Alternatively, the polar network may be centered on a receptor location of special concern, such as a nearby Class I area.

As noted in the introduction to this section (3.4), the model dynamically allocates array storage based on the number of receptors and receptor networks when the AERMOD model is run, up to the maximum amount of memory available on the computer.

3.4.3 Specifying Discrete Receptor Locations

In addition to the receptor networks defined by the GRIDCART and GRIDPOLR keywords described above, the user may also specify discrete receptor points for modeling impacts at specific locations of interest. This may be used to model critical receptors, such as the locations of schools or houses, nearby Class I areas, or locations identified as having high concentrations by previous modeling analyses. The discrete receptors may be input as either Cartesian x,y points (DISCCART keyword) or as polar distance and direction coordinates (DISCPOLR keyword). Both types of receptors may be identified in a single run. In addition, for discrete polar receptor points the user specifies the source whose location is used as the origin for the receptor.

3.4.3.1 Discrete Cartesian Receptors.

Discrete Cartesian receptors are defined by use of the DISCCART keyword. The syntax and type of this keyword are summarized below:

Syntax:	RE DISCCART Xcoord Ycoord (Zelev Zhill) (Zflag)
Type:	Optional, Repeatable

where the Xcoord and Ycoord parameters are the x-coordinate and y-coordinate (m), respectively, for the receptor location. The Zelev parameter is an optional terrain elevation (m) and Zhill is a corresponding hill height scale for the receptor for use in elevated terrain modeling. Both the Zelev and Zhill parameters must be specified for use with the elevated terrain algorithms, and are referenced to the same reference elevation (e.g., mean sea level) used for source elevations. The Zflag parameter is the optional receptor height above ground (m) for modeling flagpole receptors.

All of the parameters are in units of meters, except for Zelev and Zhill, which default to meters but may be specified in feet by use of the RE ELEVUNIT keyword.

If neither the elevated terrain option (Section 3.2.2) nor the flagpole receptor height option (Section 3.2.7) are used, then the optional parameters are ignored if present. If only the elevated terrain height option is used (no flagpoles), then the third parameter (the field after the Ycoord) is read as the Zelev parameter. If only the flagpole receptor height option is used (no elevated terrain), then the third parameter is read as the Zflag parameter. If both options are used, then the parameters are read in the order indicated for the syntax above. If the optional parameters are left blank, then default values will be used. The default value for Zelev is 0.0, and the default value for Zflag is defined by the CO FLAGPOLE card (see Section 3.2.7). Note: If both the elevated terrain and flagpole receptor height options are used, then the third parameter will always be used as Zelev, and it is not possible to use a default value for Zelev while entering a specific value for the Zflag parameter.

3.4.3.2 Discrete Polar Receptors.

Discrete polar receptors are defined by use of the DISCPOLR keyword. The syntax and type of this keyword are summarized below:

Syntax:	RE DISCPOLR Srcid Dist Direct (Zelev Zhill) (Zflag)
Type:	Optional, Repeatable

where the Srcid is the alphanumeric source identification for one of the sources defined on the SO pathway which will be used to define the origin for the polar receptor location. The Dist and Direct parameters are the distance in meters and direction in degrees for the discrete receptor location. Degrees are measured clockwise from north. The Zelev parameter is an optional terrain elevation for the receptor and Zhill is the corresponding hill top elevation (m) for use in elevated terrain modeling. Both the Zelev and Zhill parameters must be specified for use with the elevated terrain algorithms, and are referenced to the same reference elevation (e.g., mean sea level) used for source

elevations. The units of Zelev and Zhill are in meters, unless specified as feet by the RE ELEVUNIT keyword. The Zflag parameter is the optional receptor height above ground (meters) for modeling flagpole receptors.

If neither the elevated terrain option (Section 3.2.2) nor the flagpole receptor height option (Section 3.2.7) are used, then the optional parameters are ignored if present. If only the elevated terrain height option is used (no flagpoles), then the third parameter (the field after the Ycoord) is read as the Zelev parameter. If only the flagpole receptor height option is used (no elevated terrain), then the third parameter is read as the Zflag parameter. If both options are used, then the parameters are read in the order indicated for the syntax above. If the optional parameters are left blank, then default values will be used. The default value for Zelev is 0.0, and the default value for Zflag is defined by the CO FLAGPOLE card (see Section 3.2.7). Note: If both the elevated terrain and flagpole receptor height options are used, then fourth parameter will always be used as Zelev, and it is not possible to use a default value for Zelev while entering a specific value for the Zflag parameter.

3.4.3.3 Discrete Cartesian Receptors for EVALFILE Output.

The EVALCART keyword is used to define discrete Cartesian receptor locations, similar to the DISCCART keyword, but it also allows for grouping of receptors, e.g., along arcs. It is designed to be used with the EVALFILE option, described later for the output pathway, which outputs arc maxima values to a separate file for evaluation purposes. The EVALCART keyword can be used without the use of the EVALFILE option, in which case the receptor groupings are ignored. The syntax and type for the modified EVALCART keyword are summarized below:

Syntax:	RE EVALCART Xcoord Ycoord Zelev Zhill Zflag Arcid (Name)
Type:	Optional, Repeatable

where the Xcoord and Ycoord parameters are the x-coordinate and y-coordinate (m), respectively, for the receptor location. The Zelev parameter is the terrain elevation (m) for the receptor and Zhill is the corresponding hill top elevation (m) for use in elevated terrain modeling. Both the Zelev and Zhill parameters must be specified for use with the elevated terrain algorithms, and are referenced to the same reference elevation (e.g., mean sea level) used for source elevations. The Zflag parameter is the receptor height above ground (m) for modeling flagpole receptors. All of the parameters are in units of meters, except for Zelev and Zhill, which default to meters but may be specified in feet by use of the RE ELEVUNIT keyword. The Arcid parameter is the receptor grouping identification, which may be up to eight characters long, and may be used to group receptors by arc. The Name parameter is an optional name field that may be included to further identify a particular receptor location. The Name parameter is ignored by the model. Unlike the DISCCART keyword, all of the parameters (except for the Name) must be present on each card with the EVALCART keyword. The terrain height and flagpole height inputs are ignored if the appropriate options are not specified on the CO TERRHGHT and CO FLAGPOLE cards.

3.4.4 Including Receptor Data From an External File

The user has the option of including receptor data from an external file by using the INCLUDED keyword on the receptor pathway. An RE INCLUDED card may be placed anywhere within the source pathway, after the STARTING card and before the FINISHED card (i.e., the RE STARTING and RE FINISHED cards cannot be included in the external file). The data in the included file will be processed as though it were part of the runstream file. The syntax and type of the INCLUDED keyword are summarized below:

Syntax:	RE INCLUDED Incfil
Type:	Optional, Repeatable

where the Incfil parameter is a character field of up to 40 characters that identifies the filename for the included file. The contents of the included file must be valid runstream images for the receptor pathway. If an error is generated during processing of the included file, the error message will

report the line number of the included file (see Appendix C). If more than one INCLUDED file is specified for the receptor pathway, the user will first need to determine which file the error occurred in. If the starting column of the main runstream input file is shifted from column 1 (see Section 2.4.8), then the runstream images in the included file must be offset by the same amount. The INCLUDED option allows the user to include receptor data that have been generated by the AERMOD Terrain Preprocessor, AERMAP, in the runstream file without having to cut and paste the AERMAP output file. Since AERMAP generates terrain elevations in meters and includes the RE ELEVUNIT METERS card as the first record, an AERMAP file must be INCLUDED at the beginning of the receptor pathway, immediately following the RE STARTING card. If more than one AERMAP output file is INCLUDED on the receptor pathway, the RE ELEVUNIT METERS card must be deleted from all but the first one.

3.5 METEOROLOGY PATHWAY INPUTS AND OPTIONS

The **ME**teorology pathway contains keywords that define the input meteorological data for a particular model run.

3.5.1 Specifying the Input Data Files and Formats

The AERMOD model uses hourly meteorological data from separate surface and profile data files as one of the basic model inputs. These input meteorological data filenames for AERMOD are identified by the SURFFILE and PROFFILE keywords on the ME pathway. The syntax and type of these keywords are summarized below:

Syntax:	ME SURFFILE Sfcfil (Format) ME PROFFILE Profil (Format)
Type:	Mandatory, Non-repeatable

where the Srcfil and Profil parameters are character fields of up to 40 characters that identify the filenames for the input meteorological data files. For running the model on an IBM-compatible PC, the filename parameters may include the complete DOS pathname for the file, or will assume the

current directory if only the filename is given. The optional Format parameter specifies the format of the meteorological data files. The default formats for the surface and profile data files corresponds with the format of the files generated by the AERMET meteorological preprocessor program. The user also has the option of specifying the Fortran read format for each of these files. The contents of the meteorological data files are described below, and the file formats are documented in Appendix D.

The surface meteorological data file consists of a header record containing information on the meteorological station locations, and one record for each hour of data. These data are delimited by at least one space between each element, i.e., the data may be read as free format. The contents of the surface file are as follows:

Year
Month (1 - 12)
Day (1 -31)
Julian day (1 - 366)
Hour (1 - 24)
Sensible heat flux (W m^{-2})
Surface friction velocity, u_* (ms^{-1})
Convective velocity scale, w_* (ms^{-1})
Vertical potential temperature gradient in the 500 m layer above the planetary boundary layer
Height of the convectively-generated boundary layer (m)
Height of the mechanically-generated boundary layer (m)
Monin-Obukhov length, L (m)
Surface roughness length, z_0 (m)
Bowen ratio
Albedo
Wind speed (ms^{-1}) used in the computations
Wind direction (degrees) corresponding to the wind speed above
Height at which the wind above was measured (m)
Temperature (K) used in the computations
Height at which the temperature above was measured (m)

The sensible heat flux, Bowen ratio and albedo are not used by the AERMOD model, but are passed through by AERMET for information purposes only.

The profile meteorological data file consists of one or more records for each hour of data. As with the surface data file, the data are delimited by at least one space between each element and

may be read as Fortran free format. The contents of the profile meteorological data file are as follows:

Year
Month (1 - 12)
Day (1 -31)
Hour (1 - 24)
Measurement height (m)
Top flag = 1, if this is the last (highest) level for this hour,
0, otherwise
Wind direction for the current level (degrees)
Wind speed for the current level (ms^{-1})
Temperature at the current level (K)
Standard deviation of the wind direction, σ_θ (degrees)
Standard deviation of the vertical wind speed, σ_w (ms^{-1})

The data in this file include the on-site meteorological data that are processed by AERMET. Since AERMET was designed to be able to perform dispersion parameter calculations with NWS data only, i.e., no on-site data, the profile data may consist of a one-level "profile" based on the NWS winds and temperature.

3.5.2 Specifying Station Information

Three keywords are used to specify information about the meteorological stations, SURFDATA for the surface meteorological station, UAIRDATA for the upper air station, and the optional SITEDATA for any on-site meteorological data that may be used. The syntax and type of these keywords are summarized below:

Syntax:	ME SURFDATA Stanum Year (Name) (Xcoord) (Ycoord)
Syntax:	ME UAIRDATA Stanum Year (Name) (Xcoord) (Ycoord)
Syntax:	ME SITEDATA Stanum Year (Name) (Xcoord) (Ycoord)
Type:	Mandatory, Non-repeatable for SURFDATA and UAIRDATA Optional, Non-repeatable for SITEDATA

where Stanum is the station number, e.g. the 5-digit WBAN number for NWS stations, Year is the year of data being processed (either 2 or 4 digits), Name is an optional character field (up to 40 characters with no blanks) specifying the name of the station, and Xcoord and Ycoord are optional parameters for specifying the x and y coordinates for the location of the stations. At the present time, the station locations are not utilized in the model. Therefore, no units are specified for Xcoord and Ycoord at this time, although meters are suggested in order to be consistent with the source and receptor coordinates. The AERMOD model compares the station numbers input using these keywords with the numbers included in the header record of the surface meteorological data file, and issues non-fatal warning messages if there are any mismatches.

3.5.3 Specifying the Base Elevation for Potential Temperature Profile

The AERMOD model generates a gridded vertical profile of potential temperatures for use in the plume rise calculations. Since potential temperature is dependent on the elevation above mean sea level (MSL), the user must define the base elevation for the profile with the PROFBASE keyword. The syntax and type for the PROFBASE keyword are summarized below:

Syntax:	ME PROFBASE BaseElev (Units)
Type:	Mandatory, Non-repeatable

where the BaseElev parameter specifies the base elevation above MSL for the potential temperature profile, and the optional Units parameter specifies the units of BaseElev. Valid inputs of Units are the secondary keywords METERS or FEET. The default units for BaseElev are in meters if Units is left blank. The base elevation should correspond with the base elevation of the primary meteorological tower.

3.5.4 Specifying a Data Period to Process

There are two keywords that allow the user to specify particular days or ranges of days to process from the sequential meteorological file input for the AERMOD model. The STARTEND

keyword controls which period within the meteorological data file is read by the model, while the DAYRANGE keyword controls which days or ranges of days (of those that are read) for the model to process. The default for the model is to read the entire meteorological data file (up to a full year) and to process all days within that period.

The syntax and type for the STARTEND keyword are summarized below:

Syntax:	ME STARTEND Strtyr Strtmn Strtdy (Strthr) Endyr Endmn Enddy	(Endhr)
Type:	Optional, Non-repeatable	

where the Strtyr Strtmn Strtdy parameters specify the year, month and day of the first record to be read (e.g., 87 01 31 for January 31, 1987), and the parameters Endyr Endmn Enddy specify the year, month and day of the last record to be read. The Strthr and Endhr are optional parameters that may be used to specify the start and end hours for the data period to be read. If either Strthr or Endhr is to be specified, then both must be specified. Any records in the data file that occur before the start date are ignored, as are any records in the data file that occur after the end date. In fact, once the end date has been reached, the model does not read any more data from the meteorological file. If Strthr and Endhr are not specified, then processing begins with hour 1 of the start date, and ends with hour 24 of the end date, unless specific days are selected by the DAYRANGE card described below.

Any PERIOD averages calculated by the model will apply only to the period of data actually processed. Therefore, if someone wanted to calculate a six-month average, they could select PERIOD averages on the CO AVERTIME card, and then specify the period as follows:

```
ME STARTEND  87 01 01  87 06 30
```

for the period January 1, 1987 through June 30, 1987.

The syntax and type for the DAYRANGE keyword are summarized below:

Syntax:	ME DAYRANGE Range1 Range2 Range3 ... Rangen
Type:	Optional, Repeatable

where the Range parameters specify particular days or ranges of days to process. The days may be specified as individual days (e.g. 1 2 3 4 5) or as a range of days (e.g. 1-5). The user also has the option of specifying Julian day numbers, from 1 to 365 (366 for leap years), or specifying month and day (e.g., 1/31 for January 31). Any combination of these may also be used. For example the following card will tell the model to process the days from January 1 (Julian day 1) through January 31 (1/31):

```
ME DAYRANGE  1-1/31
```

The DAYRANGE keyword is also repeatable, so that as many cards as needed may be included in the ME pathway.

As with the STARTEND keyword, any PERIOD averages calculated by the model will apply only to the period of data actually processed. If the STARTEND keyword is also used, then only those days selected on the DAYRANGE cards that fall within the period from the start date to the end date will be processed. Thus, if the ME pathway included the following two cards:

```
ME STARTEND  87 02 01  87 12 31
ME DAYRANGE  1-31
```

then no data would be processed, since the days 1 through 31 fall outside the period 2/1 to 12/31.

3.5.5 Correcting Wind Direction Alignment Problems

The WDROTATE keyword allows the user to correct the input meteorological data for wind direction alignment problems. All input wind directions or flow vectors are rotated by a user-specified amount. Since the model results at particular receptor locations are often quite sensitive to the transport wind direction, this optional keyword should be used only with extreme caution and with clear justification.

The syntax and type of this keyword are summarized below:

Syntax:	ME WDROTATE Rotang
Type:	Optional, Non-repeatable

where the Rotang parameter specifies the angle in degrees to rotate the input wind direction measurements. The value of Rotang is subtracted from the wind direction measurements. It may be used to correct for known (and documented) calibration errors, or to adjust for the alignment of a valley if the meteorological station is located in a valley with a different alignment than the source location.

3.5.6 Specifying Wind Speed Categories

Variable emission rate factors may be input to the model that vary by wind speed category. The model uses six wind speed categories, and these are defined by the upper bound wind speed for the first five categories (the sixth category is assumed to have no upper bound). The default values for the wind speed categories are as follows: 1.54, 3.09, 5.14, 8.23, and 10.8 m/s. The syntax and type of the WINDCATS keyword, which may be used to specify different category boundaries, are summarized below:

Syntax:	ME WINDCATS Ws1 Ws2 Ws3 Ws4 Ws5
Type:	Optional, Non-repeatable

where the Ws1 through Ws5 parameters are the upper bound wind speeds of the first through fifth categories in meters per second. The upper bound values are inclusive, i.e., a wind speed equal to the value of Ws1 will be placed in the first wind speed category.

3.5.7 Specifying SCIM Parameters

The SCIM parameters on the SCIMBYHR card specify the starting hour and sampling interval for the regular sample and an optional file name. The syntax and type of the SCIMBYHR keyword are summarized below:

Syntax:	ME SCIMBYHR NRegStart NRegInt NwetStart NwetInt (SfcFilnam PflFilnam)
Type:	Optional, Non-repeatable

where the NRegStart and NRegInt parameters specify the first hour to be sampled and the sampling interval, respectively, when performing the regular sampling. The NWetStart and NWetInt parameters are used to specify the first wet hour (i.e., with non-zero precipitation) and the wet sampling interval for wet sampling. However, since the AERMOD model currently does not include wet deposition algorithms, the wet sampling option is not operational, and the user should enter a value of zero (0) for bot NWetStart and NWetInt. Optionally, the user can create output files containing the surface and profile meteorological data for the sampled hours by specifying the SfcFilnam and PflFilnam parameters. These output files are in the same format used in the summary of the first 24 hours of data included in the main output file.

In order to use the SCIM option, the user must specify the non-DFAULT TOXICS option on the CO MODELOPT card, and also specify SCIM on the MODELOPT card. Although the ME SCIMBYHR is an optional card, it is required when using the SCIM option. NRegStart is required to have a value from 1 through 24, i.e., the first sampled hour must be on the first day in the

meteorological data file. There are no restrictions for NRegInt; however, NRegInt would generally be greater than 1. For example, NRegInt could be based on the formula (24n+1), where "n" is the number of days to skip between samples, in order to ensure a regular diurnal cycle to the sampled hours (e.g., 25 or 49).

3.6 EVENT PATHWAY INPUTS AND OPTIONS

EVENT processing is specifically designed to facilitate analysis of source contributions to specific events for short term averages (less than or equal to 24 hours). These events may be design concentrations generated by the AERMOD model, occurrences of violations of an air quality standard, or user-specified events. These events are input to the AERMOD model through the **EV**ent pathway. Each event is defined by an averaging period and specific data period, a source group, and a receptor location. Since the locations are only of interest in combination with particular averaging and data periods, the REceptor pathway is not used with EVENT processing.

There are two keywords that are used to define the events on the EV pathway. The EVENTPER keyword defines the averaging period, data period and source group, while the EVENTLOC keyword defines the receptor location for the event. Each event is also given an alphanumeric name that links the two input cards for that event.

The syntax and type of the EVENTPER and EVENTLOC keywords are summarized below:

Syntax:	EV EVENTPER Evname Aveper Grpid Date
Syntax:	EV EVENTLOC Evname XR= Xr YR= Yr (Zelev) (Zflag) or Evname RNG= Rng DIR= Dir (Zelev) (Zflag)
Type:	Mandatory, Repeatable

where the parameters are as follows:

Evname - event name (an alphanumeric string of up to 8 characters),

Aveper - averaging period for the event (e.g. 1, 3, 8, 24 hr)

Grpid - source group ID for the event (must be defined on SO pathway),

Date - date for the event, input as an eight digit integer for the ending hour of the data period (YYMMDDHH), e.g. 84030324 defines a data period ending at hour 24 on March 3, 1984. The length of the period corresponds to Aveper.

XR= - X-coordinate (m) for the event location, referenced to a Cartesian coordinate system

YR= - Y-coordinate (m) for the event location, referenced to a Cartesian coordinate system

RNG= - distance range (m) for the event location, referenced to a polar coordinate system with an origin of (0., 0.)

DIR= - radial direction (deg.) for the event location, referenced to a polar coordinate system with an origin of (0., 0.)

Zelev - optional terrain elevation for the event location (m)

Zflag - optional receptor height above ground (flagpole receptor) for the event location (m)

Each event is defined by the two input cards EVENTPER and EVENTLOC, and these inputs are linked by the event name, which must be unique among the events being processed in a given run. There is no particular requirement for the order of cards on the EV pathway. Note that the location for the event may be specified by either Cartesian coordinates or by polar coordinates, however, the polar coordinates must be relative to an origin of (0,0).

3.6.1 Using Events Generated by the AERMOD Model

The AERMOD model has an option (CO EVENTFIL described in Section 3.2.9) to generate an input file for the AERMOD EVENT processing. When this option is used, the AERMOD model copies relevant inputs from the AERMOD runstream input file to the Event processing input file, and generates the inputs for the EVent pathway from the results of the modeling run. These events are the design concentrations identified by the OU RECTABLE keyword (see Section 3.8.1.1), such as the highest and high-second-high 24-hour averages, etc., and any threshold violations identified

by the OU MAXIFILE keyword (see Section 3.8.1.2). The inputs generated by the AERMOD model correspond to the syntax described above for the EVENTPER and EVENTLOC keywords. The locations for events generated by the AERMOD model are always provided as Cartesian coordinates.

To easily identify the events generated by the AERMOD model, and to provide a mechanism for the AERMOD model to manage the events generated from the model run, a naming convention is used for the EVNAME parameter. The following examples illustrate the event names used by the AERMOD model:

H1H01001 - High-first-high 1-hour average for source group number 1

H2H24003 - High-second-high 24-hour average for source group number 3

TH030010 - Threshold violation number 10 for 3-hour averages

TH240019 - Threshold violation number 19 for 24-hour averages

The high value design concentrations are listed first in the EVENT processing input file, followed by the threshold violations (grouped by averaging period). To make it easier for the user to review the EVENT processing input file generated by the AERMOD model, and determine which events are of most concern, the actual concentration value associated with the event is included as the last field on the EVENTPER card. This field is ignored by the AERMOD model, and is included only for informational purposes. The user should be aware that the same event may appear in the AERMOD model input file as both a design value and as a threshold violation, depending on the options selected and the actual results. Since the model processes the events by date sequence and outputs the results for each event as it is processed, the order of events in the output file will generally not follow the order of events in the input file, unless all of the events were generated by the MAXIFILE option.

3.6.2 Specifying Discrete Events

The user can specify discrete events by entering the EVENTPER and EVENTLOC cards as described above. The averaging period and source group selected for the event must be among those specified on the CO AVERTIME and SO SRCGROUP cards. If the EVENT processing input file was generated by the AERMOD model, the user may include additional events for those averaging periods and source groups used in the original AERMOD model run. They may also add averaging periods or define new source groups in the Event processing input file in order to define additional events.

3.6.3 Including Event Data From an External File

The user has the option of including event data from an external file by using the INCLUDED keyword on the source (EV) pathway. An EV INCLUDED card may be placed anywhere within the event pathway, after the STARTING card and before the FINISHED card (i.e., the EV STARTING and EV FINISHED cards cannot be included in the external file). The data in the included file will be processed as though it were part of the runstream file. The syntax and type of the INCLUDED keyword are summarized below:

Syntax:	EV INCLUDED Incfil
Type:	Optional, Repeatable

where the Incfil parameter is a character field of up to 40 characters that identifies the filename for the included file. The contents of the included file must be valid runstream images for the event pathway. If an error is generated during processing of the included file, the error message will report the line number of the included file (see Appendix C). If more than one INCLUDED file is specified for the event pathway, the user will first need to determine which file the error occurred in. If the starting column of the main runstream input file is shifted from column 1 (see Section 2.4.8), then the runstream images in the included file must be offset by the same amount.

3.7 OUTPUT PATHWAY INPUTS AND OPTIONS

The **OU**tput pathway contains keywords that define the output options for the model runs. The AERMOD model has three keywords that control different types of tabular output for the main output file of the model, and seven keywords that control separate output file options for specialized purposes. The user may select any combination of output option for a particular application.

3.7.1 Selecting Options for Tabular Printed Outputs.

The three tabular printed output options are controlled by the following keywords:

RECTABLE - Controls output option for high value summary tables by receptor;

MAXTABLE - Controls output option for overall maximum value summary tables; and

DAYTABLE - Controls output option for tables of concurrent values summarized by receptor for each day processed.

The keywords are described in more detail in the order listed above.

The syntax and type for the RECTABLE keyword are summarized below:

Syntax:	OU RECTABLE Aveper FIRST SECOND ... SIXTH or 1ST 2ND ... 6TH
Type:	Optional, Repeatable

where the Aveper parameter is the short term averaging period (e.g. 1, 3, 8 or 24 hr or MONTH) for which the receptor table is selected, and the secondary keywords, FIRST, SECOND, etc., indicate which high values are to be summarized by receptor for that averaging period. The RECTABLE card may be repeated for each averaging period. For cases where the user wants the same RECTABLE options for all short term averaging periods being modeled, the input may be simplified by entering the secondary keyword ALLAVE for the Aveper parameter. The following

example will select summaries of the highest, second highest and third highest values by receptor for all averaging periods:

```
OU RECTABLE  ALLAVE  FIRST  SECOND  THIRD
```

The model will also recognize a range of high values on the RECTABLE input card, and therefore the following card will have the effect:

```
OU RECTABLE  ALLAVE  FIRST-THIRD
```

The output file will include tables for only the high values selected. Tables for all source groups for a particular averaging period are grouped together, and the averaging periods are output in the order that they appear the CO AVERTIME card. For each averaging period and source group combination, the tables of high values for the receptor networks (if any) are printed first, followed by any discrete Cartesian receptors, and any discrete polar receptors.

If the CO EVENTFIL keyword has been used to generate an input file for EVENT processing, then the design values identified by the RECTABLE options, e.g., the high-second-high 24-hour average, are included in the events that are defined in the EVENT processing input file.

The syntax and type for the MAXTABLE keyword are summarized below:

Syntax:	OU MAXTABLE Aveper Maxnum
Type:	Optional, Repeatable

where the Aveper parameter is the short term averaging period (e.g. 1, 3, 8 or 24 hr or MONTH) for which the receptor table is selected, and the Maxnum parameter specifies the number of overall maximum values to be summarized for each averaging period. The MAXTABLE card may be

repeated for each averaging period. As with the RECTABLE keyword, for cases where the user wants the same MAXTABLE options for all short term averaging periods being modeled, the input may be simplified by entering the secondary keyword ALLAVE for the Aveper parameter. The following example will select the maximum 50 table for all averaging periods:

```
OU MAXTABLE  ALLAVE  50
```

A separate maximum overall value table is produced for each source group. The maximum value tables follow the RECTABLE outputs in the main print file. All source group tables for a particular averaging period are grouped together, and the averaging periods are output in the order that they appear on the CO AVERTIME card.

The syntax and type for the DAYTABLE keyword are summarized below:

Syntax:	OU DAYTABLE Avper1 Avper2 Avper3 . . .
Type:	Optional, Non-repeatable

where the Avpern parameters are the short term averaging periods (e.g. 1, 3, 8 or 24 hr or MONTH) for which the daily tables are selected. The DAYTABLE card is non-repeatable, but as with the RECTABLE and MAXTABLE keywords, for cases where the user wants daily tables for all short term averaging periods being modeled, the input may be simplified by entering the secondary keyword ALLAVE for the first parameter. The following example will select the daily tables for all averaging periods:

```
OU DAYTABLE  ALLAVE
```

For each averaging period for which the DAYTABLE option is selected, the model will print the concurrent averages for all receptors for each day of data processed. The receptor networks (if

any) are printed first, followed by any discrete Cartesian receptors, and any discrete polar receptors. Results for each source group are output. For example, if 1, 3, and 24-hour averages are calculated, and the OU DAYTABLE ALLAVE option is used, then for the first day of data processed, there will be 24 sets of tables of hourly averages (one for each hour in the day), eight sets of 3-hour averages (one for each 3-hour period in the day), and one set of 24-hour averages. The averages are printed as they are calculated by the model, but for hours where more than one averaging period is calculated (e.g., hour 24 is the end of an hourly average, a 3-hour average, and a 24-hour average), the order in which the averages are output will follow the order used on the CO AVERTIME card. Note: This option can produce very large output files, especially when used with a full year of data and very short period averages, such 1-hour and 3-hour. It should therefore be used with CAUTION.

3.7.2 Selecting Options for Special Purpose Output Files.

The AERMOD model provides options for seven types of output files for specialized purposes. These options are controlled by the following keywords:

MAXIFILE -	Produces file with occurrences of violations of user-specified threshold value;
POSTFILE -	Produces file of concurrent (raw) results at each receptor suitable for post-processing;
PLOTFILE -	Produces file of design values that can be imported into graphics software for plotting contours;
TOXXFILE -	Produces unformatted files of raw results above a threshold value with a special structure for use with the TOXX model component of TOXST;
RANKFILE -	Produces file of output values by rank for use in Q-Q (quantile) plots;
EVALFILE -	Produces file of output values, including arc-maximum normalized concentrations, suitable for model evaluation studies; and
SEASONHR -	Produces file of output values by season and hour-of-day.

The keywords are described in more detail in the order listed above.

The syntax and type for the MAXIFILE keyword are summarized below:

Syntax:	OU MAXIFILE Aveper Grpid Thresh Filnam (Funit)
Type:	Optional, Repeatable

where the Aveper parameter is the short term averaging period (e.g. 3, 8, 24 for 3, 8 and 24-hour averages, or MONTH for monthly averages) and Grpid is the source group ID for which the MAXIFILE option is selected. The Thresh parameter is the user-specified threshold value, and Filnam is the name of the file where the MAXIFILE results are to be written. The optional Funit parameter allows the user the option of specifying the Fortran logical file unit for the output file. The user-specified file unit must be in the range of 26-100, inclusive. By specifying the same filename and unit for more than one MAXIFILE card, results for different source groups and/or averaging periods may be combined into a single file. If the Funit parameter is omitted, then the model will dynamically allocate a unique file unit for this file (see Section 3.7.2).

The MAXIFILE card may be repeated for each combination of averaging period and source group, and a different filename should be used for each file. The resulting maximum value file will include several header records identifying the averaging period, source group and the threshold value for that file, and a listing of every occurrence where the result for that averaging period/source group equals or exceeds the threshold value. Each of these records includes the averaging period, source group ID, date for the threshold violation (ending hour of the averaging period), the x, y, z and flagpole receptor height for the receptor location where the violation occurred, and the concentration value.

Each of the threshold violations, except for monthly averages, identify events that may be modeled for source contribution information with EVENT processing by selecting the CO EVENTFIL option (see Sections 3.2.9 and 3.8). Each of the threshold violations is included as an event on the EV pathway, and is given a name of the form THxxyyyy, where xx is the averaging period, and yyyy is the violation number for that averaging period. For example, an event name of TH240019 identifies the 19th threshold violation for 24-hour averages. Monthly average threshold

violations are included in the file specified on the MAXIFILE card, but are not included in the EVENT processing input file since the AERMOD model currently handles only averaging periods of up to 24 hours.

The following examples illustrate the use of the MAXIFILE option:

```
OU MAXIFILE  24  ALL    364.0  MAX24ALL.OUT
OU MAXIFILE  24  PSD     91.0  MAXPSD.OUT    50
OU MAXIFILE   3  PSD    365.0  MAXPSD.OUT    50
OU MAXIFILE   3  PLANT  25.0  C:\OUTPUT\MAXI3HR.FIL
OU MAXIFILE MONTH  ALL  10.0  MAXMONTH.OUT
```

where the 3-hour example illustrates the use of a DOS pathname for the PC, and the last example illustrates the use of monthly averages. The FILNAM parameter may be up to 40 characters in length. It should also be noted that only one MAXIFILE card may be used for each averaging period/source group combination. Note: The MAXIFILE option may produce very large files for runs involving a large number of receptors if a significant percentage of the results exceed the threshold value.

The syntax and type for the POSTFILE keyword are summarized below:

Syntax:	OU POSTFILE Aveper Grpid Format Filnam (Funit)
Type:	Optional, Repeatable

where the Aveper parameter is the averaging period (e.g. 3, 8, 24 for 3, 8 and 24-hour averages, MONTH for monthly averages, PERIOD for period averages, or ANNUAL for annual averages) and Grpid is the source group ID for which the POSTFILE option is selected. The Format parameter specifies the format of the POSTFILE output, and may either be the secondary keyword UNFORM for unformatted concentration files, or the secondary keyword PLOT to obtain formatted files of receptor locations (x- and y-coordinates) and concentrations suitable for plotting contours of concurrent values. The Filnam parameter is the name of the file where the POSTFILE results are to

be written. The optional Funit parameter allows the user the option of specifying the Fortran logical file unit for the output file. The user-specified file unit must be in the range of 26-100, inclusive. By specifying the same filename and unit for more than one POSTFILE card, results for different source groups and/or averaging periods may be combined into a single file. If the Funit parameter is omitted, then the model will dynamically allocate a unique file unit for this file (see Section 3.8.2).

The POSTFILE card may be repeated for each combination of averaging period and source group, and a different filename should be used for each file. If UNFORM is specified for the Format parameter, then the resulting unformatted file includes a constant-length record for each of the selected averaging periods calculated during the model run. The first variable of each record is an integer variable (4 bytes) containing the ending date (YYMMDDHH) for the averages on that record. The second variable for each record is an integer variable (4 bytes) for the number of hours in the averaging period. The third variable for each record is a character variable of length eight containing the source group ID. The remaining variables of each record contain the calculated average concentration values for all receptors, in the order in which they were defined in the input runstream.

The following examples illustrate the use of the POSTFILE option:

```
OU POSTFILE   24   ALL     UNFORM    PST24ALL.BIN
OU POSTFILE   24   PSD     UNFORM    PST24PSD.BIN
OU POSTFILE    3   PLANT   UNFORM    C:\BINOUT\PST3HR.FIL
OU POSTFILE  MONTH ALL       PLOT    PSTMONTH.PLT
OU POSTFILE PERIOD ALL       PLOT    PSTANN.PLT
```

where the 3-hour example illustrates the use of a DOS pathname for the PC, and the last example illustrates the use of monthly averages. The Filnam parameter may be up to 40 characters in length. The use of separate files for each averaging period/source group combination allows the user flexibility to select only those results that are needed for post-processing for a particular run, and also makes the resulting unformatted files manageable. Note: The POSTFILE option can produce very large files, and should be used with some caution. For a file of hourly values for a full year

(8760 records) and 400 receptors, the resulting file will use about 14 megabytes of disk space. To estimate the size of the file (in bytes), use the following equation:

$$\text{File Size (bytes)} = \frac{\text{(\# of Hrs/Yr)}}{\text{(\# of Hrs/Ave)}} * \text{(\# of Rec + 4)} * 4$$

Divide the result by 1000 to estimate the number of kilobytes (KB) and divide by 1.0E6 to estimate the number of megabytes (MB).

The syntax and type for the PLOTFILE keyword are summarized below:

Syntax:	OU PLOTFILE Aveper Grpid Hivalu Filnam (Funit), or OU PLOTFILE PERIOD Grpid Filnam (Funit) OU PLOTFILE ANNUAL Grpid Filnam (Funit)
Type:	Optional, Repeatable

where the Aveper parameter is the averaging period (e.g. 3, 8, 24 for 3, 8 and 24-hour averages, MONTH for monthly averages, PERIOD for period averages, or ANNUAL for annual averages), Grpid is the source group ID for which the PLOTFILE option is selected, and Hivalu specifies which short term high values are to be output (FIRST for the first highest at each receptor, SECOND for the second highest at each receptor, etc.) Note that the Hivalu parameter is not specified for PERIOD or ANNUAL averages, since there is only one period or annual average for each receptor. The Filnam parameter is the name of the file where the PLOTFILE results are to be written. The optional Funit parameter allows the user the option of specifying the Fortran logical file unit for the output file. The user-specified file unit must be in the range of 26-100, inclusive. By specifying the same filename and unit for more than one PLOTFILE card, results for different source groups and/or averaging periods may be combined into a single file. If the Funit parameter is omitted, then the model will dynamically allocate a unique file unit for this file (see Section 3.8.2).

The PLOTFILE card may be repeated for each combination of averaging period, source group, and high value, and a different filename should be used for each file. The resulting formatted file includes several records with header information identifying the averaging period, source group

and high value number of the results, and then a record for each receptor which contains the x and y coordinates for the receptor location, the appropriate high value at that location, and the averaging period, source group and high value number. The data are written to the file in the order of x-coord, y-coord, concentration so that the file can easily be imported into a graphics package designed to generate contour plots. Many such programs will read the PLOTFILEs directly without any modification, ignoring the header records, and produce the desired plots.

The following examples illustrate the use of the PLOTFILE option:

```
OU PLOTFILE  24  ALL    FIRST  PLT24ALL.FST
OU PLOTFILE  24  ALL    SECOND PLT24ALL.SEC
OU PLOTFILE  24  PSD      2ND  PLTPSD.OUT      75
OU PLOTFILE   3  PSD      2ND  PLTPSD.OUT      75
OU PLOTFILE   3  PLANT    1ST  C:\PLOTS\PLT3HR.FIL
OU PLOTFILE MONTH ALL   THIRD  PLTMONTH.OUT
OU PLOTFILE PERIOD ALL         PSTANN.PLT
```

where the 3-hour example illustrates the use of a DOS pathname for the PC, and the last example illustrates the use of monthly averages. As illustrated by the second and third examples, the high value parameter may also be input as secondary keywords using the standard abbreviations of 1ST, 2ND, 3RD, . . . 10TH. The Filnam parameter may be up to 40 characters in length. The use of separate files for each averaging period, source group, high value combination allows the user flexibility to select only those results that are needed for plotting from a particular run.

The syntax and type for the TOXXFILE keyword are summarized below:

Syntax:	OU TOXXFILE Aveper Cutoff Filnam (Funit)
Type:	Optional, Repeatable

where the Aveper parameter is the short term averaging period (e.g. 1, 3, 8, 24 for 1, 3, 8 and 24-hour averages, or MONTH for monthly averages) for which the TOXXFILE option has been selected. The Cutoff (threshold) parameter is the user-specified threshold cutoff value in g/m^3, and

Filnam is the name of the file where the TOXXFILE results are to be written. It is important to note that the units of the Cutoff parameter are g/m^3, regardless of the input and output units selected with the SO EMISUNIT card. The optional Funit parameter allows the user the option of specifying the Fortran logical file unit for the output file. The user-specified file unit must be in the range of 26-100, inclusive. If the Funit parameter is omitted, then the model will dynamically allocate a unique file unit for this file (see Section 3.8.2). While the TOXXFILE option may be specified for any of the short term averaging periods that are identified on the CO AVERTIME card for a particular run, a non-fatal warning message will be generated if other than 1-hour averages are specified. This is because the TOXST model currently supports only 1-hour averages.

The TOXXFILE card may be repeated for each averaging period, but a different filename should be used for each file since the structure of the output file generated by the TOXXFILE option does not allow for a clear way to distinguish between results for different averaging periods. The resulting output file for the AERMOD model is an unformatted file with several header records identifying the title, averaging period, receptor information, and the threshold value for that file, followed by records listing every occurrence where the result for any source group for that averaging period equals or exceeds the threshold value. When one of the source groups exceeds the threshold value, the results for all source groups for that averaging period and receptor location are output. Each concentration that is output through the TOXXFILE option is paired with an integer ID variable that identifies the averaging period (hour number of the year), the source group number, and the receptor number corresponding to that value. The concentration values and corresponding ID variables are stored in buffer arrays, and the arrays are then written to the unformatted output file when full. The size of the arrays is controlled by the NPAIR PARAMETER defined in MODULE MAIN1, and is initially set at 100. At the end of the modeling run, any values remaining in the buffer arrays are written to the file, padded to the right with zeroes. The structure of the output file generated by the TOXXFILE option is described in more detail in Section 3.8.2 and in Appendix D. When using the TOXXFILE option, the user will normally place a single source in each source group. The user should refer to the user's guide for TOXST for further instructions on the application of the TOXXFILE option of the AERMOD model.

The following examples illustrate the use of the TOXXFILE option:

```
OU TOXXFILE   1  1.0E-5   TOXX1HR.BIN
OU TOXXFILE  24  2.5E-3   TOXX24HR.BIN    50
```

The Filnam parameter may be up to 40 characters in length. It should be noted that only one TOXXFILE card may be used for each averaging period. Note: The TOXXFILE option may produce very large files for runs involving a large number of receptors if a significant percentage of the results exceed the threshold value.

The RANKFILE keyword outputs values by rank for use in Q-Q (quantile) plots. The MAXTABLE option must be specified first in order to use the RANKFILE option for a particular averaging period. However, the RANKFILE output differs from the results in the MAXTABLE output in that duplicate date/hour occurrences are removed. The syntax and type for the RANKFILE keyword are summarized below:

Syntax:	OU RANKFILE Aveper Hinum Filnam (Funit)
Type:	Optional, Repeatable

where the Aveper parameter is the averaging period (e.g., 3, 8, 24 for 3, 8, and 24-hour averages, or MONTH for monthly averages), and Hinum is the number of high values to be ranked. The RANKFILE keyword cannot be used with PERIOD averages. As noted above, the MAXTABLE option must be specified first for the particular Aveper, and the Hinum parameter on the RANKFILE card must be less than or equal to the Maxnum parameter on the corresponding MAXTABLE card. Since duplicate dates are removed from the RANKFILE output, the output file may contain less than the number of requested high values. The NMAX parameter, which controls the maximum number of values that can be stored, has been set initially to 400. The Filnam parameter is the name of the file (up to 40 characters) where the RANKFILE results are to be written. The optional Funit parameter allows the user the option of specifying the Fortran logical

file unit for the output file. The user-specified file unit must be in the range of 26-100, inclusive. By specifying the same filename and unit for more than one RANKFILE card, results for different averaging periods may be combined into a single file. If the Funit parameter is omitted, the model will dynamically allocate a unique file unit for this file according to the following formula:

IRKUNT = 100 + IAVE

where IRKUNT is the Fortran unit number and IAVE is the averaging period number (the order of the averaging period as specified on the CO AVERTIME card).

The EVALFILE option is specifically designed for use in generating residuals for model evaluation studies. The EVALFILE output consists of the arc-maximum normalized concentration values for each hour of meteorology and for each source specified. The arc groupings of the receptors must be specified using the RE EVALCART keyword described above. The syntax and type for the EVALFILE keyword are summarized below:

Syntax:	OU EVALFILE Srcid Filnam (Funit)
Type:	Optional, Repeatable

where the Srcid parameter is the source ID for which EVALFILE results are requested, the Filnam parameter is the name of the file (up to 40 characters) where the EVALFILE results are to be written, and the optional Funit parameter allows the user the option of specifying the Fortran logical file unit for the output file. The user-specified file unit must be in the range of 26-100, inclusive. By specifying the same filename and unit for more than one EVALFILE card, results for different sources may be combined into a single file. If the Funit parameter is omitted, the model will dynamically allocate a unique file unit for this file according to the following formula:

IELUNT = 400 + ISRC*5

where IELUNT is the Fortran unit number and ISRC is the source number (the order of the source as specified on the SO pathway).

For each hour of meteorological data processed and for each receptor grouping (e.g., arc), the EVALFILE option outputs five records containing the source ID, date, arc ID, arc-maximum normalized concentration (χ/Q), emission rate, and other plume dispersion and meteorological variables associated with the arc-maximum. Since the EVALFILE option looks at receptor groupings, it must be used in conjunction with the EVALCART keyword described above for the RE pathway, and a fatal error is generated if no receptor groups are identified.

The SEASONHR option is used to output a file containing the average results by season and hour-of-day. To select this option, the user must include the SEASONHR keyword on the OU pathway. The syntax, type, and order for the SEASONHR keyword are summarized below:

Syntax:	`OU SEASONHR GroupID Filenam (FUnit)`
Type:	`Optional, Repeatable`

where the GroupID parameter specifies the source group to be output, FileName specifies the name of the output file, and the optional FileUnit parameter specifies an optional file unit and must be in the range 26-100, inclusive. If FileUnit is left blank, then the model will dynamically assign a file unit based on the formula 302+IGRP*10, where IGRP is the group index number. A sample from a SEASONHR output file is shown below:

```
* AERMOD (02222):  Example of SEASONHR Output File Option
* MODELING OPTIONS USED:
*  CONC                 WDEP   RURAL  FLAT          TOXICS
*         FILE OF SEASON/HOUR VALUES FOR SOURCE GROUP: ALL
*         FOR A TOTAL OF   216 RECEPTORS.
*         FORMAT: (4(1X,F13.5),1X,F8.2,2X,A8,2X,I4,2X,I4,2X,I4,2X,A8)
*        X             Y      AVERAGE CONC   ZELEV     GRP      NHRS  SEAS  HOUR  NET ID
*
     8.68241      49.24039       0.00000     0.00   ALL        87     1     1   POL1
    17.36482      98.48077       0.00000     0.00   ALL        87     1     1   POL1
    86.82409     492.40387       0.18098     0.00   ALL        87     1     1   POL1
   173.64818     984.80774       2.52520     0.00   ALL        87     1     1   POL1
   868.24091    4924.03857       2.07470     0.00   ALL        87     1     1   POL1
  1736.48181    9848.07715       0.93252     0.00   ALL        87     1     1   POL1
    17.10101      46.98463       0.00000     0.00   ALL        87     1     1   POL1
    34.20201      93.96926       0.00000     0.00   ALL        87     1     1   POL1
   171.01007     469.84631       0.15772     0.00   ALL        87     1     1   POL1
   342.02014     939.69263       2.48554     0.00   ALL        87     1     1   POL1
  1710.10071    4698.46289       6.09119     0.00   ALL        87     1     1   POL1
  3420.20142    9396.92578       4.49830     0.00   ALL        87     1     1   POL1
    25.00000      43.30127       0.00000     0.00   ALL        87     1     1   POL1
    50.00000      86.60254       0.00000     0.00   ALL        87     1     1   POL1
   250.00000     433.01270       0.10114     0.00   ALL        87     1     1   POL1
   500.00000     866.02539       2.12970     0.00   ALL        87     1     1   POL1
  2500.00000    4330.12695       2.79993     0.00   ALL        87     1     1   POL1
  5000.00000    8660.25391       1.97200     0.00   ALL        87     1     1   POL1
```

The NHRS column in the output file contains the number of non-calm and non-missing hours used to calculate the season-by-hour-of-day averages. The SEAS column is the season index, and is 1 for winter, 2 for spring, 3 for summer and 4 for fall. The records loop through hour-of-day first, and then through the seasons.

3.7.3 EVENT Processing Options

EVENT processing in the AERMOD model is designed specifically to perform source contribution analyses for short term average (less than or equal to 24-hour) events. The events may either be generated by the AERMOD model, or they may be user-specified events, or both. Because of this rather narrow focus of applications, the output options are limited to a single keyword. The EVENTOUT keyword controls the level of detail in the source contribution output from the EVENT model. The syntax and type of the EVENTOUT keyword are summarized below:

Syntax:	OU EVENTOUT SOCONT DETAIL
Type:	Mandatory, Non-repeatable

where the SOCONT secondary keyword specifies the option to produce only the source contribution information in the output file, and the DETAIL secondary keyword specifies the option to produce more detailed summaries in the output file. The SOCONT option provides the average concentration (or total deposition) value (i.e., the contribution) from each source for the period corresponding to the event for the source group. The basic source contribution information is also provided with the DETAIL option. In addition, the DETAIL option provides the hourly average concentration (or total deposition) values for each source for every hour in the averaging period, and a summary of the hourly meteorological data for the event period. In general, the DETAIL option produces a larger output file than the SOCONT file, especially if there are a large number of sources. There is no default setting for the EVENTOUT options.

3.8 CONTROLLING INPUT AND OUTPUT FILES

This section describes the various input and output files used by the AERMOD model, and discusses control of input and output (I/O) on the IBM-compatible PC environment. Much of this discussion also applies to operating the model in other environments.

3.8.1 Description of AERMOD Input Files

The two basic types of input files needed to run all of the AERMOD model are the input runstream file containing the modeling options, source data and receptor data, and the two input meteorological data files. Each of these is discussed below, as well as a special file that may be used to initialize the AERMOD model with intermediate results from a previous run.

3.8.1.1 Input Runstream File.

The input runstream file contains the user-specified options for running the various AERMOD model (called AERMOD.INP), includes the source parameter data and source group information, defines the receptor locations, specifies the location and parameters regarding the meteorological data, and specifies the output options. Details regarding the keywords and parameters used in the input runstream file are provided in Section 3, and Appendix B.

For the PC-executable version of the model available on the SCRAM website, the runstream file is explicitly opened by the model using a Fortran OPEN statement, and the integer variable, INUNIT, specifies the unit number for the file. The variable INUNIT is initialized to a value of 7 in a DATA statement in MODULE MAIN1, and is therefore available to all of the necessary subroutines.

3.8.1.2 Meteorological Data Files.

The input meteorological data is read into the AERMOD model from two separate data files, one corresponding to surface (scalar) parameters, and the other corresponding to multi-level profiles of data. The meteorological data filenames and format are specified within the input runstream file using the ME SURFFILE and PROFFILE keywords. The AERMOD model accepts meteorological data that has been preprocessed by the AERMET meteorological preprocessor program (EPA, 1998b). The data are read from formatted ASCII files of hourly sequential records.

The meteorological data files are explicitly opened by the model using Fortran OPEN statements, and the integer variables MFUNIT for the surface/scalar file and MPUNIT for the profile file are used to specify the unit numbers for the files. The variable MFUNIT is initialized to a value of 19 and MPUNIT is initialized to a value of 16 in a DATA statement in MODULE MAIN1, and are therefore available to all of the necessary subroutines.

3.8.1.3 Initialization File for Model Re-start.

The AERMOD model has an optional capability to store intermediate results to an unformatted (sometimes called binary) file for later re-starting of the model in the event of a power failure or user interrupt. This unformatted file may therefore be used as an input file to initialize the model. This option is controlled by the SAVEFILE (saves intermediate results to a file) and the INITFILE (initialize result arrays from a previously saved file) keywords on the CO pathway.

When initializing the model for the re-start option, the user specifies the name of the unformatted results file on the INITFILE keyword. The default filename used if no parameter is provided is TMP.FIL. The initialization file is explicitly opened by the AERMOD model, and the integer variable, IRSUNT, specifies the unit number for the file. The variable IRSUNT is initialized to a value of 15 in a DATA statement in MODULE MAIN1, and is therefore available to all of the necessary subroutines.

3.8.2 Description of AERMOD Output Files

The AERMOD model produce a variety of output files, including the main print file of model results, an unformatted file of intermediate results for later re-start of the model (AERMOD only), and several output data files for specialized purposes. These files are described in detail below.

3.8.2.1 Output Print File.

The AERMOD model produces a main output print file of model results called AERMOD.OUT. The contents and organization of this file were shown in Figure 2-5. This file includes an echo of the input runstream images at the beginning of the file (up until a NO ECHO input is encountered). A summary of runstream setup messages and a summary of the inputs follow the echo of inputs. The input summary includes a summary of modeling options, source data, receptor data, and meteorological data, following the same order as the pathways in the runstream file. If model calculations are performed, then the model results are summarized next. The content and order of the model result summaries depend on the output options selected and on the particular model being run. Following the detailed model results are summary tables of the high values for each averaging period and source group. The final portion of the main output print file is the summary of messages for the complete model run.

For the PC-executable version of the model available on the SCRAM website, the main print output file is explicitly opened by the model using a Fortran OPEN statement, and the integer variable, IOUNIT, specifies the unit number for the file. The variable IOUNIT is initialized to a value of 8 in a DATA statement in MODULE MAIN1, and is therefore available to all of the necessary subroutines.

By opening the printed output file explicitly, the outputs are not automatically formatted for the printer. This formatting is accomplished using the CARRIAGECONTROL specifier in the OPEN statement for the output file.

3.8.2.2 Detailed Error Message File.

The user may select an option for the model to save a separate file of detailed error and other messages, through use of the CO ERRORFIL keyword. The format and syntax of these messages is described in Appendix C. The order of messages within the file is the order in which they were generated by the model. The file includes all types of messages that were generated.

The error message file is explicitly opened by the model using a Fortran OPEN statement, and the integer variable, IERUNT, specifies the unit number for the file. The variable IERUNT is initialized to a value of 10 in a DATA statement in MODULE MAIN1, and is therefore available to all of the necessary subroutines.

3.8.2.3 Intermediate Results File for Model Re-start.

The AERMOD model has an optional capability to store intermediate results to an unformatted (sometimes called binary) file for later re-starting of the model in the event of a power failure or user interrupt. This unformatted file may therefore be used as an input file to initialize the model. This option is controlled by the SAVEFILE (saves intermediate results to a file) and the INITFILE (initialize result arrays from a previously saved file) keywords on the CO pathway.

When saving the intermediate results for the re-start option, the user specifies the name of the unformatted results file on the SAVEFILE keyword. The user has the option of specifying a single filename, two filenames (for alternate saves), or specifying no filename. The default filename used if no parameter is provided is TMP.FIL. If a single file is used, then the intermediate results file is overwritten on each successive dump, with the chance that the file will be lost if the interrupt occurs during the time that the file is opened. If two filenames are provided, then the model also saves to the second file on alternate dumps, so that the next most recent dump will always be available. The main save file is explicitly opened by the AERMOD model, and the integer variable, IDPUNT, specifies the unit number for the file. The variable IDPUNT is initialized to a value of 12 in a BLOCK DATA subprogram of the model. If a second save file is used, then it is also opened explicitly, and the integer variable IDPUN2, initialized to a value of 14, specifies the unit number.

3.8.2.4 Maximum Value/Threshold File.

The user may select an option for the AERMOD model to generate a file or files of concentration values exceeding a user-specified threshold. The OU MAXIFILE keyword controls this option. The user may select separate files for each averaging period and source group

combination for which a list of threshold violations may be needed. Each file includes several records with header information identifying the averaging period, source group and threshold value, and then a record for every occurrence where the result for that averaging period/source group equals or exceeds the threshold value. Each of these records includes the averaging period, source group ID, date for the threshold violation (ending hour of the averaging period), the x, y, z and flagpole receptor height for the receptor location where the violation occurred, and the concentration value.

The structure of the threshold violation file is described in more detail in Appendix D. Each of the files selected by the user is opened explicitly by the model as an formatted file. The filenames are provided on the input runstream image. The user may specify the file unit on the MAXIFILE card through the optional FUNIT parameter. User-specified units must be greater than or equal to 26, and are recommended to be less than or equal to 100. If no file unit is specified, then the file unit is determined internally according to the following formula:

$$IMXUNT = 100 + IGRP*10 + IAVE$$

where IMXUNT is the Fortran unit number, IGRP is the source group number (the order in which the group is defined in the runstream file), and IAVE is the averaging period number (the order of the averaging period as specified on the CO AVERTIME card). This formula will not cause any conflict with other file units used by the model for up to 9 source groups and up to 9 short term averaging periods.

3.8.2.5 Sequential Results File for Postprocessing.

The user may select an option for the AERMOD model to generate a file or files of concentration values suitable for postprocessing. The OU POSTFILE keyword controls this option. The user may select separate files for each averaging period and source group combination for which postprocessing may be needed. For each file requested, the user has the option of specifying whether to use unformatted files suitable for postprocessing or to use a plot format which could

allow for importing the x,y,conc files into a graphics package for plotting. For the unformatted file option, each file consists of sequential unformatted records of values at each receptor location for every averaging period calculated. For the plot file format option, each file consists of formatted records listing the x-coordinate, y-coordinate and concurrent concentration values for each receptor and for all averaging periods calculated. For certain applications, these files may become quite large, and should only be used when needed, especially when using the plot format.

The structure of both types of postprocessing file is described in more detail in Appendix D. Each of the postprocessing files selected by the user is opened explicitly by the model as either an unformatted or a formatted file, depending on the option selected. The filenames are provided on the input runstream image. The user may specify the file unit on the POSTFILE card through the optional FUNIT parameter. User-specified units must be greater than or equal to 26, and are recommended to be less than or equal to 100. If no file unit is specified, then the file unit is determined internally according to the following formulas:

IPSUNT = 200 + IGRP*10 + IAVE for short term averages
IAPUNT = 300 + IGRP*10 - 5 for PERIOD averages

where IPSUNT and IAPUNT are the Fortran unit numbers, IGRP is the source group number (the order in which the group is defined in the runstream file), and IAVE is the averaging period number (the order of the averaging period as specified on the CO AVERTIME card). This formula will not cause any conflict with other file units used by the model for up to 9 source groups and up to 9 short term averaging periods.

3.8.2.6 High Value Summary File for Plotting.

The user may select an option for the AERMOD model to generate a file or files of the highest concentration values at each receptor suitable for importing into a graphics package in order to generate contour plots. The OU PLOTFILE keyword controls this option. The user may select separate files for each averaging period, source group and high value combination for which a plot

file may be needed. Each file includes several records with header information identifying the averaging period, source group and high value number of the results, and then a record for each receptor which contains the x and y coordinates for the receptor location, the appropriate high value at that location, and the averaging period, source group and high value number.

The structure of the plot file is described in more detail in Appendix D. Each of the plot files selected by the user is opened explicitly by the model as an formatted file. The filenames are provided on the input runstream image. The user may specify the file unit on the PLOTFILE card through the optional FUNIT parameter. User-specified units must be greater than or equal to 26, and are recommended to be less than or equal to 100. If no file unit is specified, then the file unit is determined internally according to the following formulas:

IPLUNT = (IVAL+3)*100 + IGRP*10 + IAVE for short term aver.
IPPUNT = 300 + IGRP*10 for PERIOD averages

where IPLUNT and IPPUNT are the Fortran unit numbers, IVAL is the high value number (1 for FIRST highest, 2 for SECOND highest, etc.), IGRP is the source group number (the order in which the group is defined in the runstream file), and IAVE is the averaging period number (the order of the averaging period as specified on the CO AVERTIME card). This formula will not cause any conflict with other file units used by the model for up to 9 source groups and up to 9 short term averaging periods.

3.8.2.7 TOXX Model Input Files

The user may select an option for the AERMOD model to generate an unformatted file or files of concentration values exceeding a user-specified threshold for use with the TOXX model component of TOXST. The OU TOXXFILE keyword controls this option. The user may select separate files for each averaging period for which a threshold violation file may be needed. Each file includes several records with header information identifying the title, averaging period, threshold value, and receptor network information, and then records including every occurrence

where the result of any source group for that averaging period equals or exceeds the threshold value. Records are also output that identify the averaging period (hour number of the year), source group number and receptor number corresponding to the concentration values.

The structure of the threshold exceedance file for use with the TOXX model component of TOXST is described in more detail in Appendix D. Each of the files selected by the user is opened explicitly by the model as an unformatted file. The filenames are provided on the input runstream image. The user may specify the file unit on the TOXXFILE card through the optional Funit parameter. User-specified units must be greater than or equal to 26, and are recommended to be less than or equal to 100. If no file unit is specified, then the file unit is determined internally according to the following formula:

$$ITXUNT = 300 + IAVE$$

where ITXUNT is the Fortran unit number, and IAVE is the averaging period number (the order of the averaging period as specified on the CO AVERTIME card). This formula will not cause any conflict with other file units used by the model for up to 4 short term averaging periods.

The user may also select an option for the AERMOD model to generate an output for use with the RISK model component of TOXLT. The OU TOXXFILE keyword also controls this option. The user can specify a separate TOXXFILE for each long term averaging period and source group combination. The TOXXFILE option may also be used for PERIOD averages with the AERMOD model. The structure of the TOXXFILE output for AERMOD is very similar to the long term PLOTFILE output, except that results are output for each individual source in the specified source group. The structure of the long term TOXXFILE is described in more detail in Appendix D. Each of the files selected by the user is opened explicitly by the model as a formatted file. The filenames are provided on the input runstream image. The user may specify the file unit on the TOXXFILE card through the optional Funit parameter. User-specified units must be greater than or equal to 26, and are recommended to be less than or equal to 100. If no file unit is specified, then the file unit is determined internally according to the following formulas:

ITXUNT = 500 + IAVE*10 + IGRP for long term averages

IPXUNT = 700 + IGRP*10 for PERIOD averages

where ITXUNT and IPXUNT are the Fortran unit numbers, IAVE is the averaging period number (in the order of months, seasons or quarters, and annual), and IGRP is the source group number (in the order is which the groups are defined in the SO pathway). This formula will not cause any conflict with other file units used by the model for up to 9 source groups.

3.8.3 Control of File Inputs and Outputs (I/O)

3.8.3.1 Control of I/O on PCs.

The main input runstream file and the main output print file are specified internally by AERMOD as AERMOD.INP and AERMOD.OUT, respectively. Therefore, a standard command line to execute the AERMOD model might look something like this:

```
C:\>AERMOD
```

where the "DOS prompt" has been given as "C:\>", but may look different on different systems, or may include a subdirectory specification. The output file generated by the DOS version includes page feeds that are written directly to the file as part of the header for each page, rather than using the Fortran carriage control of '1'. This is accomplished by including a compiler-specific parameter to set CARRIAGECONTROL = 'Fortran' on the OPEN statement for the output file.

3.8.3.2 Controlling I/O on Other Computer Systems.

Since the main input runstream file and the main output print file are specified internally by AERMOD, control of I/O on other computer systems will be the same, with the possible exception of the compiler-specific option to set CARRIAGECONTROL = 'Fortran' on the OPEN statement for the output file.

4.0 COMPUTER NOTES

This section provides information regarding the computer aspects of the AERMOD model, including the minimum hardware requirements for executing the model on a PC, instructions regarding compiling and running the model on a PC, and information regarding porting the model to other computer systems.

4.1 MINIMUM HARDWARE REQUIREMENTS

The AERMOD model was developed on an IBM-compatible PC, and was designed to run on PCs with certain minimum hardware requirements. The basic requirements are as follows:

- 80386 processor or higher (e.g., 80386, 80486, Pentium, Pentium II, etc.)
- 2 MB of RAM
- Math coprocessor
- Hard Disk with sufficient storage space to handle the executable file, input data files, and output files (file sizes will vary, generally about 5 MB will be sufficient for routine applications)

4.2 COMPILING AND RUNNING THE MODEL ON A PC

As mentioned earlier, the AERMOD model was developed on an IBM-compatible PC, using the Compaq Visual Fortran Optimizing Compiler, Version 6.6. This section provides details regarding compiling and running the model on a PC.

4.2.1 Compaq Compiler Options

The batch file provided for compiling the AERMOD model (AERMOD.EXE) with the Compaq Visual Fortran Optimizing Compiler (CVFAERM.BAT) includes the following commands:

```
DF MODULES.FOR  /compile_only /optimize:4
DF AERMOD.FOR   /compile_only /optimize:4
DF SETUP.FOR    /compile_only /optimize:4
DF COSET.FOR    /compile_only /optimize:4
DF SOSET.FOR    /compile_only /optimize:4
DF RESET.FOR    /compile_only /optimize:4
DF MESET.FOR    /compile_only /optimize:4
DF TGSET.FOR    /compile_only /optimize:4
DF OUSET.FOR    /compile_only /optimize:4
DF INPSUM.FOR   /compile_only /optimize:4
DF METEXT.FOR   /compile_only /optimize:4
DF IBLVAL.FOR   /compile_only /optimize:4
DF SIGGRID.FOR  /compile_only /optimize:4
DF TEMPGRID.FOR /compile_only /optimize:4
DF WINDGRID.FOR /compile_only /optimize:4
DF CALC1.FOR    /compile_only /optimize:4
DF CALC2.FOR    /compile_only /optimize:4
DF PRISE.FOR    /compile_only /optimize:4
DF PRIME.FOR    /compile_only /optimize:4
DF SIGMAS.FOR   /compile_only /optimize:4
DF PITAREA.FOR  /compile_only /optimize:4
DF OUTPUT.FOR   /compile_only /optimize:4
DF EVSET.FOR    /compile_only /optimize:4
DF EVCALC.FOR   /compile_only /optimize:4
DF EVOUTPUT.FOR /compile_only /optimize:4
DF /exe:aermod.exe /optimize:4 @CVFAERM.LRF
```

where the following compiler options have been specified:

```
/compile_only - perform compilation only on the specified file and suppress linking
/optimize:4 - use optimization level 4 (the highest level of optimization)
```

The last command links the model using the CVFAERM.LRF link response file, which includes the following list of object files:

```
MODULES.OBJ AERMOD.OBJ SETUP.OBJ COSET.OBJ SOSET.OBJ RESET.OBJ MESET.OBJ
TGSET.OBJ OUSET.OBJ INPSUM.OBJ
METEXT.OBJ IBLVAL.OBJ SIGGRID.OBJ TEMPGRID.OBJ WINDGRID.OBJ CALC1.OBJ
CALC2.OBJ PRISE.OBJ PRIME.OBJ SIGMAS.OBJ
PITAREA.OBJ OUTPUT.OBJ EVSET.OBJ EVCALC.OBJ EVOUTPUT.OBJ
```

4.2.2 Lahey Compiler Options

Since earlier versions of AERMOD were compiled with the Lahey Fortran compiler, a batch file is also provided for compiling the AERMOD model (AERMOD.EXE) with the Lahey Fortran 95 compiler. The Lahey LF95 batch file (LF95AERM.BAT) includes the following commands:

```
LF95 MODULES.FOR  -c -nw -f95 -nchk -nstchk -o1 -tp -ndal -nsav -nwo -trace >comp.log
LF95 AERMOD.FOR   -c -nw -f95 -nchk -nstchk -o1 -tp -ndal -nsav -nwo -trace >>comp.log
LF95 SETUP.FOR    -c -nw -f95 -nchk -nstchk -o1 -tp -ndal -nsav -nwo -trace >>comp.log
LF95 COSET.FOR    -c -nw -f95 -nchk -nstchk -o1 -tp -ndal -nsav -nwo -trace >>comp.log
LF95 SOSET.FOR    -c -nw -f95 -nchk -nstchk -o1 -tp -ndal -nsav -nwo -trace >>comp.log
LF95 RESET.FOR    -c -nw -f95 -nchk -nstchk -o1 -tp -ndal -nsav -nwo -trace >>comp.log
LF95 MESET.FOR    -c -nw -f95 -nchk -nstchk -o1 -tp -ndal -nsav -nwo -trace >>comp.log
LF95 TGSET.FOR    -c -nw -f95 -nchk -nstchk -o1 -tp -ndal -nsav -nwo -trace >>comp.log
LF95 OUSET.FOR    -c -nw -f95 -nchk -nstchk -o1 -tp -ndal -nsav -nwo -trace >>comp.log
LF95 INPSUM.FOR   -c -nw -f95 -nchk -nstchk -o1 -tp -ndal -nsav -nwo -trace >>comp.log
LF95 METEXT.FOR   -c -nw -f95 -nchk -nstchk -o1 -tp -ndal -nsav -nwo -trace >>comp.log
LF95 IBLVAL.FOR   -c -nw -f95 -nchk -nstchk -o1 -tp -ndal -nsav -nwo -trace >>comp.log
LF95 SIGGRID.FOR  -c -nw -f95 -nchk -nstchk -o1 -tp -ndal -nsav -nwo -trace >>comp.log
LF95 TEMPGRID.FOR -c -nw -f95 -nchk -nstchk -o1 -tp -ndal -nsav -nwo -trace >>comp.log
LF95 WINDGRID.FOR -c -nw -f95 -nchk -nstchk -o1 -tp -ndal -nsav -nwo -trace >>comp.log
LF95 CALC1.FOR    -c -nw -f95 -nchk -nstchk -o1 -tp -ndal -nsav -nwo -trace >>comp.log
LF95 CALC2.FOR    -c -nw -f95 -nchk -nstchk -o1 -tp -ndal -nsav -nwo -trace >>comp.log
LF95 PRISE.FOR    -c -nw -f95 -nchk -nstchk -o1 -tp -ndal -nsav -nwo -trace >>comp.log
LF95 SIGMAS.FOR   -c -nw -f95 -nchk -nstchk -o1 -tp -ndal -nsav -nwo -trace >>comp.log
LF95 PITAREA.FOR  -c -nw -f95 -nchk -nstchk -o1 -tp -ndal -nsav -nwo -trace >>comp.log
LF95 PRIME.FOR    -c -nw -f95 -nchk -nstchk -o1 -tp -ndal -nsav -nwo -trace >>comp.log
LF95 OUTPUT.FOR   -c -nw -f95 -nchk -nstchk -o1 -tp -ndal -nsav -nwo -trace >>comp.log
LF95 EVSET.FOR    -c -nw -f95 -nchk -nstchk -o1 -tp -ndal -nsav -nwo -trace >>comp.log
LF95 EVCALC.FOR   -c -nw -f95 -nchk -nstchk -o1 -tp -ndal -nsav -nwo -trace >>comp.log
LF95 EVOUTPUT.FOR -c -nw -f95 -nchk -nstchk -o1 -tp -ndal -nsav -nwo -trace >>comp.log
LF95 @LF95AERM.LRF
```

where the following compiler options have been specified:

-c - suppress linking
-nw - suppresses display of warning messages
-f95 - generates Fortran 95 performance warnings
-nchk - do not check subscript and substring bounds
-nstchk - do not generate stack check code
-o1 - use classical optimizations
-tp - generate Pentium code
-ndal - do not deallocate allocated arrays
-nsav - do not save local variables
-nwo - do not warn if feature is obsolescent
-trace - enable runtime error traceback

The '>comp.log' at the end of the first line and '>>comp.log' at the end of subsequent lines will redirect compiler messages to a file called comp.log. The 'LF95 @LF95AERM.LRF' command links the model using the LF95AERM.LRF link response file, which includes the following command:

```
MODULES.OBJ AERMOD.OBJ SETUP.OBJ COSET.OBJ SOSET.OBJ RESET.OBJ MESET.OBJ
TGSET.OBJ OUSET.OBJ INPSUM.OBJ
METEXT.OBJ IBLVAL.OBJ SIGGRID.OBJ TEMPGRID.OBJ WINDGRID.OBJ CALC1.OBJ
CALC2.OBJ PRISE.OBJ SIGMAS.OBJ
PITAREA.OBJ OUTPUT.OBJ EVSET.OBJ EVCALC.OBJ EVOUTPUT.OBJ PRIME.OBJ -EXE
AERMOD.EXE
```

4.2.3 Storage Limits

As discussed in Section 2.3, the AERMOD model dynamically allocates data storage needs based on the number of sources, receptors, source groups, and other input requirements, up to the maximum amount of memory available on the computer being used. The minimum system requirements for this version of the model are a 386 or higher processor with a math coprocessor and at least 2 MB of extended memory.

AERMOD uses allocatable arrays to allocate data storage at model runtime rather than at compile time. The AERMOD model preprocesses the model runstream input file to determine the data storage requirements for a particular model run, and then allocates the input data arrays before processing the setup data. Once the setup processing is completed, the model allocates storage for the result arrays. When allocating data storage, the AERMOD model traps for errors, e.g., not enough memory available to allocate. If the allocation is unsuccessful, then an error message is generated by the model and further processing is prevented. If the CO RUNORNOT NOT option is selected, the model will still go through all array allocations so that the user can determine if sufficient memory is available to complete the run. Also, an estimate of the total amount of memory needed for a particular run is printed out as part of the first page of printed output.

The parameters that are established at model runtime are as follows:

NSRC = Number of Sources
NREC = Number of Receptors
NGRP = Number of Source Groups

NAVE	= Number of Short Term Averaging Periods
NVAL	= Number of High Values by Receptor (RECTABLE Keyword)
NTYP	= Number of Output Types (CONC, DEPOS, DDEP and WDEP)
NMAX	= Number of Overall Maximum Values (MAXTABLE Keyword)
NQF	= Number of Variable Emission Rate Factors Per Source
NPDMAX	= Number of Particle Diameter Categories Per Source
IXM	= Number of X-coord (Distance) Values Per Receptor Network
IYM	= Number of Y-coord (Direction) Values Per Receptor Network
NNET	= Number of Cartesian and/or Polar Receptor Networks
NARC	= Number of Receptor Arcs Used with EVALCART Keyword
NEVE	= Number of Events for EVENT processing

In the case of NPDMAX, if no particle information is present in the input runstream, then NPDMAX is set to 1, otherwise it is set to 20. Other parameters are set to the actual numbers required for a particular model run.

There are several static array limits defined in AERMOD. These limits are controlled by PARAMETER statements in the Fortran source code. The variable name, definition, and current value are:

NSEC	= Number of sectors for building dimensions (set to 36),
NWSCAT	= Number of wind speed categories (for use with the WSPEED option of EMISFACT) (set to 6),
NPAIR	= Number of pairs of TXCONC and ISCONC for TOXXFILE output (set to 100),
NHIANN	= Number of high period/annual averages to include in the summary page of the output file (set to 10),
NMXPM	= Number of high average H4H 24-hour averages to include in the summary table for post-1997 PM10 processing (set to 10),
MXPLVL	= Maximum number of levels in the observed profile file (set to 50),

MXGLVL = Maximum number of levels in the gridded profiles (0-4000 meters) (set to 87).

To modify the static array limits for the model, the user must first edit the appropriate PARAMETER values in MODULE MAIN1 in the MODULES.FOR file. Once the array limits have been customized to a particular application's needs, then the entire model must be recompiled and linked (see Section 4.2.1 above).

4.3 PORTING THE MODEL TO OTHER PLATFORMS

The PC-executable version of the model that is available on the SCRAM website includes a few features that may be compiler-specific or specific to operating the model in a PC environment. These include writing an update on the status of the processing to the computer screen and specifying CARRIAGECONTROL = 'Fortran' when opening the output file (AERMOD.OUT). In order to port the model to other PC compilers or to other hardware platforms, the compiler-specific or PC-specific Fortran code may need to be commented-out, or replaced with equivalent code relevant to that platform. The compiler-specific and PC-specific code is contained in the AERMOD.FOR source file, in subroutines HRLOOP and FILOPN.

5.0 REFERENCES

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APPENDIX A. ALPHABETICAL KEYWORD REFERENCE

This appendix provides an alphabetical listing of all of the keywords used by the AERMOD model. Each keyword is identified as to the pathway for which it applies, the keyword type (either mandatory or optional, and either repeatable or non-repeatable), and with a brief description of the function of the keyword. For a more complete description of the keywords, including a list of associated parameters, refer to the Detailed Keyword Reference in Section 3 or the Functional Keyword/Parameter Reference in Appendix B.

Keyword	Path	Type	Keyword Description
AREAVERT	SO	M - R	Specifies location of vertices for an AREAPOLY source type (mandatory if AREAPOLY source is used)
AVERTIME	CO	M - N	Averaging time(s) to process (up to NAVE short term plus PERIOD or ANNUAL averages)
BUILDHGT	SO	O - R	Building height values for each wind sector
BUILDWID	SO	O - R	Building width values for each wind sector
DAYRANGE	ME	O - R	Specifies days or ranges of days to process (default is to process all data read in)
DAYTABLE	OU	O - N	Option to provide summaries for each averaging period for each day processed.
DCAYCOEF	CO	O - N	Optional decay coefficient for exponential decay
DEBUGOPT	CO	O - N	Option to generate detailed result and meteorology files for debugging purposes
DISCCART	RE	O - R	Defines the discretely placed receptor locations referenced to a Cartesian system
DISCPOLR	RE	O - R	Defines the discretely placed receptor locations referenced to a polar system
ELEVUNIT	SO RE	O - N O - N	Defines input units for receptor elevations (RE path), or source elevations (SO path) (defaults to meters)
EMISFACT	SO	O - R	Optional input for variable emission rate factors
EMISUNIT	SO	O - N	Optional conversion factors for emission units and concentration units

Type: M - Mandatory N - Non-repeatable
O - Optional R - Repeatable

Keyword	Path	Type	Keyword Description
ERRORFIL	CO	O - N	Option to generate detailed error listing file (error file is mandatory for CO RUNORNOT NOT case)
EVALCART	RE	O - R	Defines discretely placed receptor locations referenced to a Cartesian system, grouped by arc for use with the EVALFILE output option
EVALFILE	OU	O - R	Option to output file of normalized arc maxima for model evaluation studies
EVENTFIL	CO	O - N	Specifies whether to generate an input file for EVENT model
EVENTLOC	EV	M - R	Describes receptor location for an event
EVENTOUT	OU	M - N	Specifies the level of output information provided by the EVENT model
EVENTPER	EV	M - R	Describes data and averaging period for an event
FINISHED	ALL	M - N	Identifies the end of inputs for a particular pathway
FLAGPOLE	CO	O - N	Specifies whether to accept receptor heights above local terrain (m) for use with flagpole receptors, and allows for a default flagpole height to be specified
GRIDCART	RE	O - R	Defines a Cartesian grid receptor network
GRIDPOLR	RE	O - R	Defines a polar receptor network
HALFLIFE	CO	O - N	Optional half life used for exponential decay
HOUREMIS	SO	O - R	Option for specifying hourly emission rates in a separate file
INCLUDED	SO, RE	O - R	Option to include input data from a separate file in the runstream for the SO and/or RE pathways
INITFILE	CO	O - N	Option to initialize model from file of intermediate results generated by SAVEFILE option
LOCATION	SO	M - R	Identifies coordinates for particular source location

Keyword	Path	Type	Keyword Description
MAXIFILE	OU	O - R	Option to list events exceeding a threshold value to file (if CO EVENTFIL option is used, these events are included in the input file generated for the EVENT model)
MAXTABLE	OU	O - R	Option to summarize the overall maximum values
MODELOPT	CO	M - N	Job control and dispersion options
MULTYEAR	CO	O - N	Specifies that run is part of a multi-year run, e.g., for PM-10 H6H in five years
PLOTFILE	OU	O - R	Option to write certain results to a storage file suitable for input to plotting routines
POLLUTID	CO	M - N	Identifies pollutant being modeled
POSTFILE	OU	O - R	Option to write results to a mass storage file for postprocessing
PROFBASE	ME	M - N	Specifies the base elevation (above MSL) for the potential temperature profile
PROFFILE	ME	M - N	Describes input profile meteorological data file
RANKFILE	OU	O - R	Option to produce output file of ranked values for Q-Q plots

Keyword	Path	Type	Keyword Description
RECTABLE	OU	O - R	Option to output value(s) by receptor
RUNORNOT	CO	M - N	Identifies whether to run model or process setup information only
SAVEFILE	CO	O - N	Option to store intermediate results for later restart of the model after user or system interrupt
SCIMBYHR	ME	O - N	Specifies sampling parameters for the SCIM option
SITEDATA	ME	O - N	Describes on-site meteorological station
SRCGROUP	SO	M - R	Identification of source groups
SRCPARAM	SO	M - R	Identifies source parameters for a particular source
STARTEND	ME	O - N	Specifies start and end dates to be read from input meteorological data file (default is to read entire file)
STARTING	ALL	M - N	Identifies the start of inputs for a particular pathway
SURFDATA	ME	M - N	Surface meteorological station
SURFFILE	ME	M - N	Describes input surface meteorological data file
TITLEONE	CO	M - N	First line of title for output
TITLETWO	CO	O - N	Optional second line of output title
TOXXFILE	OU	O - R	Creates output file formatted for use with TOXX model component of TOXST
UAIRDATA	ME	M - N	Upper air meteorological station
WDROTATE	ME	O - N	Wind direction rotation adjustment
WINDCATS	ME	O - N	Upper bound of wind speed categories

APPENDIX B. FUNCTIONAL KEYWORD/PARAMETER REFERENCE

This appendix provides a functional reference for the keywords and parameters used by the input runstream files for the AERMOD model. The keywords are organized by functional pathway, and within each pathway the order of the keywords is based on the function of the keyword within the model. The pathways used by the model are as follows, in the order in which they appear in the runstream file and in the tables that follow:

CO - for specifying overall job **CO**ntrol options;
SO - for specifying **SO**urce information;
RE - for specifying **RE**ceptor information;
ME - for specifying **ME**teorology information and options;
EV - for specifying **EV**ent information and options;
OU - for specifying **OU**tput options.

The pathways and keywords are presented in the same order as in the Detailed Keyword Reference in Section 3, and in the Quick Reference at the end of the manual.

Two types of tables are provided for each pathway. The first table lists all of the keywords for that pathway, identifies each keyword as to its type (either mandatory or optional and either repeatable or non-repeatable), and provides a brief description of the function of the keyword. The second type of table, which takes up more than one page for most pathways, presents the parameters for each keyword, in the order in which they should appear in the runstream file where order is important, and describes each parameter in detail.

The following convention is used for identifying the different types of input parameters. Parameters corresponding to secondary keywords which should be input "as is" are listed on the tables with all capital letters and are underlined. Other parameter names are given with an initial capital letter and are not input "as is." In all cases, the parameter names are intended to be descriptive of the input variable being represented, and they often correspond to the Fortran variable names used in the model code. Parentheses around a parameter indicate that the parameter is

optional for that keyword. The default that is taken when an optional parameter is left blank is explained in the discussion for that parameter.

TABLE B-1

DESCRIPTION OF CONTROL PATHWAY KEYWORDS

CO Keywords	Type	Keyword Description
STARTING	M - N	Identifies the start of CONTROL pathway inputs
TITLEONE	M - N	First line of title for output
TITLETWO	O - N	Optional second line of title for output
MODELOPT	M - N	Job control and dispersion options
AVERTIME	M - N	Averaging time(s) to process
URBANOPT	O - N	Specifies parameters for urban dispersion option
POLLUTID	M - N	Identifies type of pollutant being modeled
HALFLIFE	O - N[1]	Optional half life used for exponential decay
DCAYCOEF	O - N[1]	Optional decay coefficient
FLAGPOLE	O - N	Specifies whether to accept receptor heights above local terrain (m) for use with flagpole receptors, and allows for default flagpole height to be specified
RUNORNOT	M - N	Identifies whether to run model or process setup information only
EVENTFIL[2]	O - N	Specifies whether to generate an input file for EVENT model
SAVEFILE[3]	O - N	Option to store intermediate results for later restart of the model after user or system interrupt
INITFILE[3]	O - N	Option to initialize model from file of intermediate results generated by SAVEFILE option
MULTYEAR[3]	O - N	Option to process multiple years of meteorological data (one year per run) and accumulate high short term values across years
DEBUGOPT	O - N	Option to generate detailed result and meteorology files for debugging purposes
ERRORFIL	O - N	Option to generate detailed error listing file
FINISHED	M - N	Identifies the end of CONTROL pathway inputs

Type: M - Mandatory N - Non-Repeatable
O - Optional R - Repeatable

1) Either HALFLIFE or DCAYCOEF may be specified. If both cards appear a warning message will be issued and the first value entered will be used in calculations. Default assumes a half life of 4 hours for SO_2 modeled in urban mode.

2) The EVENTFIL keyword controls whether or not to generate an input file for EVENT processing. The primary difference between AERMOD regular processing and EVENT processing by AERMOD is in the treatment of source group contributions. The AERMOD model treats the source groups independently, whereas EVENT processing determines individual source contributions to particular events, such as the design concentrations determined from AERMOD, or user-specified events. By specifying the EVENTFIL keyword, an input runstream file will be generated that can be used directly for EVENT processing. The events included in the generated EVENT processing input file are defined by the RECTABLE and MAXIFILE keywords on the OU pathway, and are placed in the EVent pathway.

3) The SAVEFILE and INITFILE keywords work together to implement the model's re-start capabilities. Since the MULTYEAR option utilizes the re-start features in a special way to accumulate high short term values from year to year, it cannot be used together with the SAVEFILE or INITFILE keyword in the same model run.

TABLE B-2

DESCRIPTION OF CONTROL PATHWAY KEYWORDS AND PARAMETERS

Keyword	Parameters	
TITLEONE	Title1	
where:	Title1	First line of title for output, character string of up to 68 characters
TITLETWO	Title2	
where:	Title2	Optional second line of title for output, character string of up to 68 characters
MODELOPT	DFAULT CONC FLAT NOSTD NOCHKD NOWARN SCREEN TOXICS SCIM	
where:	DFAULT	Specifies use of regulatory default options (stack tip downwash, elevated terrain effects), overrides the presence of FLAT, NOSTD, NOCHKD, and SCREEN keywords
	CONC	Specifies calculation of concentration values (deposition algorithm has not been implemented yet)
	FLAT	Option to assume flat terrain
	NOSTD	Option to use no stack-tip downwash
	NOCHKD	Option to by-pass date checking for non-sequential meteorological data file (for evaluation and screening purposes only)
	NOWARN	Option to suppress printing of warning messages in the main output file
	SCREEN	Option to run AERMOD in a screening mode (makes centerline calculations, sets NOCHKD option on, limits averaging period to 1-hour)
	TOXICS	Option to use air toxics option(s): SCIM
	SCIM	Sampled Chronological Input Model; parameters must be specified on the ME pathway
AVERTIME	Time1 Time2 Time3 Time4 MONTH PERIOD	
where:	TimeN	Nth optional averaging time (1, 2, 3, 4, 6, 8, 12, 24-hr; number of periods limited by NAVE parameter)
	MONTH	Option to calculate MONTHly averages (counts toward NAVE limit)
	PERIOD	Option to calculate averages for the entire data PERIOD

TABLE B-2 (CONT.)

DESCRIPTION OF CONTROL PATHWAY KEYWORDS AND PARAMETERS

URBANOPT	Urbpop (Urbname) (UrbRoughness)	
where:	UrbPop	Specifies the population of the urban area
	UrbName	Specifies the name of the urban area (optional)
	UrbRoughness	Specifies the urban surface roughness length, meters (optional, defaults to 1.0m)
POLLUTID	Pollut	
where:	Pollut	Identifies type of pollutant being modeled. Any name of up to eight characters may be used, e.g., SO2, NOX, CO, PM10, TSP or OTHER. Use of PM10, PM-10 or OTHER allows for the use of the MULTYEAR option.
HALFLIFE	Haflif	
where:	Haflif	Half life used for exponential decay (s)
DCAYCOEF	Decay	
where:	Decay	Decay coefficient for exponential decay (s^{-1}) = 0.693/HAFLIF
FLAGPOLE	(Flagdf)	
where:	Flagdf	Default value for height of (flagpole) receptors above local ground level, a default value of 0.0 m is used if this optional parameter is omitted

TABLE B-2 (CONT.)

DESCRIPTION OF CONTROL PATHWAY KEYWORDS AND PARAMETERS

RUNORNOT	RUN or NOT	
where:	RUN NOT	Indicates to run full model calculations Indicates to process setup data and report errors, but to not run full model calculations
EVENTFIL	(Evfile) (Evopt)	
where:	Evfile Evopt	Identifies the filename to be used to generate a file for input to EVENT model (Default=EVENTFIL.INP) Optional parameter to specify the level of output detail selected for the EVENT model: either SOCONT or DETAIL (default is DETAIL if this parameter is omitted)
SAVEFILE	(Savfil) (Dayinc) (Savfl2)	
where:	Savfil Dayinc Savfl2	Specifies name of disk file to be used for storing intermediate results (default = TMP.FIL) file is overwritten after each dump) Number of days between dumps (optional: default is 1) Optional second disk filename to be used on alternate dumps - eliminates risk of system crash during the dump. If blank, file is overwritten each time.
INITFILE	(Inifil)	
where:	Inifil	Specifies name of disk file of intermediate results to be used for initializing run (default = TMP.FIL)
MULTYEAR	H6H Savfil (Inifil)	
where:	H6H Savfil Inifil	Specifies the High-Sixth-High is being calculated for use in pre-1997 PM10 processing Specifies name of disk file to be used for storing results at end of the year Optional name of disk file used for initializing the results arrays from previous year(s). The Inifil parameter is not used for the first year in the multi-year run.
DEBUGOPT	MODEL (Dbgfil) and/or METEOR (Dbmfil)	
where:	MODEL (Dbgfil) METEOR (Dbmfil)	Specifies that MODEL debugging output will be generated Optional filename for the model calculation debug file Specifies that METEORological profile data file will be generated Optional filename for the meteorological profile data file
ERRORFIL	(Errfil)	
where:	Errfil	Specifies name of detailed error listing file (default = ERRORS.LST)

TABLE B-3

DESCRIPTION OF SOURCE PATHWAY KEYWORDS

SO Keywords	Type	Keyword Description
STARTING	M - N	Identifies the start of SOURCE pathway inputs
ELEVUNIT	O - N	Defines input units for source elevations (defaults to meters), must be first keyword after SO STARTING if used.
LOCATION	M - R	Identifies coordinates for particular source
SRCPARAM	M - R	Identifies source parameters for a particular source
BUILDHGT	O - R	Building height values for each wind sector
BUILDWID	O - R	Building width values for each wind sector
XBADJ	O - R	Along-flow distances from the stack to the center of the upwind face of the projected building
YBADJ	O - R	Across-flow distances from the stack to the center of the upwind face of the projected building
AREAVERT	M - R	Specifies location of vertices for an AREAPOLY source type (mandatory if AREAPOLY source is used)
URBANSRC	O - R	Identifies which sources to model with urban effects
EMISFACT	O - R	Optional input for variable emission rate factors
EMISUNIT	O - N	Optional unit conversion factors for emissions, concentrations
HOUREMIS	O - R	Option for specifying hourly emission rates in a separate file
INCLUDED	O - R	Option to include data from a separate file in the runstream
SRCGROUP[1]	M - R	Identification of source groups
FINISHED	M - N	Identifies the end of SOURCE pathway inputs

1) Source groups are treated independently for AERMOD.

TABLE B-4

DESCRIPTION OF SOURCE PATHWAY KEYWORDS AND PARAMETERS

Keyword	Parameters	
ELEVUNIT	METERS or FEET	
where:	METERS	Specifies input units for source elevations of meters
	FEET	Specifies input units for source elevations of feet Note: This keyword applies to source elevations only.
LOCATION	Srcid Srctyp Xs Ys (Zs)	
where:	Srcid	Source identification code (alphanumeric string of up to eight characters)
	Srctyp	Source type: POINT, VOLUME, AREA, AREAPOLY, AREACIRC
	Xs	x-coord of source location, SW corner for AREA (in m)
	Ys	y-coord of source location, SW corner for AREA (in m)
	Zs	Optional z-coord of source location (elevation above mean sea level, defaults to 0.0 if omitted)
SRCPARAM	Srcid Ptemis Stkhgt Stktmp Stkvel Stkdia	(POINT source)
	Vlemis Relhgt Syinit Szinit	(VOLUME source)
	Aremis Relhgt Xinit (Yinit) (Angle) (Szinit)	(AREA source)
	Aremis Relhgt Nverts (Szinit)	(AREAPOLY source)
	Aremis Relhgt Radius (Nverts) (Szinit)	(AREACIRC source)
where:	Srcid	Source identification code
	__Emis	Source emission rate: in g/s for Ptemis or Vlemis, g/(s-m^2) for Aremis for concentration
	___Hgt	Source physical release height above ground (center of height for VOLUME)
	Stktmp	Stack gas exit temperature (K)
	Stkvel	Stack gas exit velocity (m/s)
	Stkdia	Stack inside diameter (m)
	Syinit	Initial lateral dimension of VOLUME source (m)
	Szinit	Initial vertical dimension of VOLUME or AREA source (m)
	Xinit	Length of side of AREA source in X-direction (m)
	Yinit	Length of side of AREA source in Y-direction (m) (optional parameter, assumed to be equal to Xinit if omitted)
	Angle	Orientation angle of AREA source relative to North (degrees), measured positive clockwise, rotated around the source location, (Xs,Ys) (optional parameter, assumed to be 0.0 if omitted)
	Nverts	Number of vertices used for AREAPOLY or AREACIRC source (between 3 and 20, optional for AREACIRC sources)
	Radius	Radius of circular area for AREACIRC source (m)
BUILDHGT	Srcid (or Srcrng) Dsbh(i), i=1,36	
where:	Srcid	Source identification code
	Srcrng	Range of sources (inclusive) for which building dimensions apply, entered as two alphanumeric strings separated by a '-'
	Dsbh	Array of direction-specific building heights (m) beginning with 10 degree flow vector and incrementing by 10 degrees clockwise
BUILDWID	Srcid (or Srcrng) Dsbw(i), i=1,36	
where:	Srcid	Source identification code
	Srcrng	Range of sources (inclusive) for which building dimensions apply
	Dsbw	Array of direction-specific building widths (m) beginning with 10 degree flow vector and incrementing by 10 degrees clockwise

TABLE B-4 (CONT.)

DESCRIPTION OF SOURCE PATHWAY KEYWORDS AND PARAMETERS

XBADJ	Srcid (or Srcrng) Xbadj(i), i=1,36	
where:	Srcid	Source identification code
	Srcrng	Range of sources (inclusive) for which XBADJ distances apply
	Xbadj(i)	Array of direction-specific along-wind distances beginning with 10 degree flow vector and incrementing by 10 degrees clockwise
YBADJ	Srcid (or Srcrng) Ybadj(i), i=1,36	
where:	Srcid	Source identification code
	Srcrng	Range of sources (inclusive) for which YBADJ distances apply
	Ybadj(i)	Array of direction-specific across-wind distances beginning with 10 degree flow vector and incrementing by 10 degrees clockwise
AREAVERT	Srcid Xv(1) Yv(1) Xv(2) Yv(2) ... Xv(i) Yv(i)	
where:	Srcid	Source identification code
	Xv(1)	X-coordinate of the first vertex of an AREAPOLY source (must be the same as the value of Xs for that source defined on the SO LOCATION card)
	Yv(1)	Y-coordinate of the first vertex of an AREAPOLY source (must be the same as the value of Ys for that source defined on the SO LOCATION card)
	Xv(i)	X-coordinate for the ith vertex of an AREAPOLY source
	Yv(i)	Y-coordinate for the ith vertex of an AREAPOLY source
URBANSRC	Srcid's and/or Srcrng's	
where:	Srcid	Specifies which source(s) will be modeled with urban effects
	Srcrng	Specifies a range of sources that will be modeled with urban effects
EMISFACT	Srcid (or Srcrng) Qflag Qfact(i), i=1,n	
where:	Srcid	Source identification code
	Srcrng	Range of sources (inclusive) for which emission rate factors apply
	Qflag	Variable emission rate flag: SEASON for seasonal; MONTH for monthly; HROFDY for hour-of-day; WSPEED for wind speed category; SEASHR for season-by-hour; SHRDOW for season by hour-of-day by day-of-week (M-F,Sat,Sun); and SHRDOW7 for season by hour-of-day by day-of-week (M,Tu,W,Th,F,Sat,Sun)
	Qfact	Array of scalar emission rate factors, for: SEASON, n=4; MONTH, n=12; HROFDY, n=24; WSPEED, n=6; SEASHR, n=96; SHRDOW, n=288; SHRDOW7, n=672
EMISUNIT	Emifac Emilbl Conlbl	
where:	Emifac	Emission rate factor used to adjust units of output (default value is 1.0 E06 for CONC for grams to micrograms)
	Emilbl	Label to use for emission units (default is grams/sec)
	Conlbl	Label to use for concentrations (default is micrograms/m^3)
HOUREMIS	Emifil Srcid's Srcrng's	
where:	Emifil	Specifies name of the hourly emission rate file
	Srcid's	Discrete source IDs that are included in the hourly emission file
	Srcrng's	Source ID ranges that are included in the hourly emission file
INCLUDED	Incfil	
where:	Incfil	Specifies name of the file to be included in the runstream data
SRCGROUP	Grpid Srcid's Srcrng's	
where:	Grpid	Group ID (Grpid = ALL specifies group including all sources), number of source groups limited by NGRP parameter in the computer code
	Srcid's	Discrete source IDs to be included in group
	Srcrng's	Source ID ranges to be included in group Note: Card may be repeated with same Grpid if more space is needed to specify sources

TABLE B-5

DESCRIPTION OF RECEPTOR PATHWAY KEYWORDS

RE Keywords	Type	Keyword Description
STARTING	M - N	Identifies the start of RECEPTOR pathway inputs
ELEVUNIT	O - N	Defines input units for receptor elevations (defaults to meters), must be first keyword after RE STARTING if used.
GRIDCART	O - R[1]	Defines a Cartesian grid receptor network
GRIDPOLR	O - R[1]	Defines a polar receptor network
DISCCART	O - R[1]	Defines the discretely placed receptor locations referenced to a Cartesian system
DISCPOLR	O - R[1]	Defines the discretely placed receptor locations referenced to a polar system
EVALCART	O - R[1]	Defines discrete Cartesian receptor locations for use with EVALFILE output option
INCLUDED	O - R	Option to include data from a separate file in the runstream
FINISHED	M - N	Identifies the end of RECEPTOR pathway inputs

1) At least one of the following must be present: GRIDCART, GRIDPOLR, DISCCART, DISCPOLR, or EVALCART. Multiple receptor networks can be specified in a single run, including both Cartesian and polar, up to an overall maximum controlled by the NREC parameter.

TABLE B-6

DESCRIPTION OF RECEPTOR PATHWAY KEYWORDS AND PARAMETERS

Keyword	Parameters	
ELEVUNIT	METERS or FEET	
where:	METERS	Specifies input units for receptor elevations of meters
	FEET	Specifies input units for receptor elevations of feet Note: This keyword applies to receptor elevations only.
GRIDCART	Netid STA XYINC Xinit Xnum Xdelta Yinit Ynum Ydelta or XPNTS Gridx1 Gridx2 Gridx3 .... GridxN, and YPNTS Gridy1 Gridy2 Gridy3 .... GridyN ELEV Row Zelev1 Zelev2 Zelev3 ... ZelevN HILL Row Zhill1 Zhill2 Zhill3 ... ZhillN FLAG Row Zflag1 Zflag2 Zflag3 ... ZflagN END	
where:	Netid	Receptor network identification code (up to eight alphanumeric characters)
	STA	Indicates STArt of GRIDCART subpathway, repeat for each new Netid
	XYINC	Keyword identifying grid network generated from x and y increments
	Xinit	Starting x-axis grid location in meters
	Xnum	Number of x-axis receptors
	Xdelta	Spacing in meters between x-axis receptors
	Yinit	Starting y-axis grid location in meters
	Ynum	Number of y-axis receptors
	Ydelta	Spacing in meters between y-axis receptors
	XPNTS	Keyword identifying grid network defined by a series of x and y coordinates
	Gridx1	Value of first x-coordinate for Cartesian grid
	GridxN	Value of 'nth' x-coordinate for Cartesian grid
	YPNTS	Keyword identifying grid network defined by a series of x and y coordinates
	Gridy1	Value of first y-coordinate for Cartesian grid
	GridyN	Value of 'nth' y-coordinate for Cartesian grid
	ELEV	Keyword to specify that receptor elevations follow
	Row	Indicates which row (y-coordinate fixed) is being input
	Zelev	An array of receptor terrain elevations for a particular Row
	HILL	Keyword to specify that hill height scales follow
	Row	Indicates which row (y-coordinate fixed) is being input
	Zhill	An array of receptor hill height scales for a particular Row
	FLAG	Keyword to specify that flagpole receptor heights follow
	Row	Indicates which row (y-coordinate fixed) is being input
	Zflag	An array of receptor heights above local terrain elevation for a particular Row (flagpole receptors)
	END	Indicates END of GRIDCART subpathway, repeat for each new Netid

TABLE B-6 (CONT.)

DESCRIPTION OF RECEPTOR PATHWAY KEYWORDS AND PARAMETERS

GRIDPOLR	Netid STA ORIG Xinit Yinit, or ORIG Srcid DIST Ring1 Ring2 Ring3 ... RingN DDIR Dir1 Dir2 Dir3 ... DirN, or GDIR Dirnum Dirini Dirinc ELEV Dir Zelev1 Zelev2 Zelev3 ... ZelevN HILL Dir Zhill1 Zhill2 Zhill3 ... ZhillN FLAG Dir Zflag1 Zflag2 Zflag3 ... ZflagN END	
where:	Netid	Receptor network identification code (up to eight alphanumeric characters)
	STA	Indicates STArt of GRIDPOLR subpathway, repeat for each new Netid
	ORIG	Optional keyword to specify the origin of the polar network (assumed to be at x=0, y=0 if omitted)
	Xinit	x-coordinate for origin of polar network
	Yinit	y-coordinate for origin of polar network
	Srcid	Source ID of source used as origin of polar network
	DIST	Keyword to specify distances for the polar network
	Ring1	Distance to the first ring of polar coordinates
	RingN	Distance to the 'nth' ring of polar coordinates
	DDIR	Keyword to specify discrete direction radials for the polar network
	Dir1	First direction radial in degrees (1 to 360)
	DirN	The 'nth' direction radial in degrees (1 to 360)
	GDIR	Keyword to specify generated direction radials for the polar network
	Dirnum	Number of directions used to define the polar system
	Dirini	Starting direction of the polar system
	Dirinc	Increment (in degrees) for defining directions
	ELEV	Keyword to specify that receptor elevations follow
	Dir	Indicates which direction is being input
	Zelev	An array of receptor terrain elevations for a particular direction radial
	HILL	Keyword to specify that hill height scales follow
	Dir	Indicates which direction is being input
	Zhill	An array of receptor hill height scales for a particular direction radial
	FLAG	Keyword to specify that flagpole receptor heights follow
	Dir	Indicates which direction is being input
	Zflag	An array of receptor heights above local terrain elevation for a particular direction (flagpole receptors)
	END	Indicates END of GRIDPOLR subpathway, repeat for each new Netid

TABLE B-6 (CONT.)

DESCRIPTION OF RECEPTOR PATHWAY KEYWORDS AND PARAMETERS

DISCCART	Xcoord Ycoord (Zelev Zhill) (Zflag)	
where:	Xcoord	x-coordinate for discrete receptor location
	Ycoord	y-coordinate for discrete receptor location
	Zelev	Elevation above sea level for discrete receptor location (optional), used only for ELEV terrain
	Zhill	Hill height scale corresponding with a discrete receptor location (optional), used only for ELEV terrain
	Zflag	Receptor height (flagpole) above local terrain (optional), used only with FLAGPOLE keyword
DISCPOLR	Srcid Dist Direct (Zelev Zhill) (Zflag)	
where:	Srcid	Specifies source identification for which discrete polar receptor locations apply (used to define the origin for the discrete polar receptor)
	Dist	Downwind distance to receptor location
	Direct	Direction to receptor location, in degrees clockwise from North
	Zelev	Elevation above sea level for receptor location (optional), used only for ELEV terrain
	Zhill	Hill height scale corresponding with a discrete receptor location (optional), used only for ELEV terrain
	Zflag	Receptor height (flagpole) above local terrain (optional), used only with FLAGPOLE keyword
EVALCART	Xcoord Ycoord Zelev Zhill Zflag Arcid (Name)	
where:	Xcoord	x-coordinate for discrete receptor location
	Ycoord	y-coordinate for discrete receptor location
	Zelev	Elevation above sea level for discrete receptor location (optional), used only for ELEV terrain
	Zhill	Hill height scale corresponding with a discrete receptor location (optional), used only for ELEV terrain
	Zflag	Receptor height (flagpole) above local terrain (optional), used only with FLAGPOLE keyword
	Arcid	Receptor arc ID used to group receptors along an arc or other grouping (up to eight characters)
	(Name)	Optional name for receptor (up to eight characters)
INCLUDED	Incfil	
where:	Incfil	Specifies name of the file to be included in the runstream data

TABLE B-7

DESCRIPTION OF METEOROLOGY PATHWAY KEYWORDS

ME Keywords	Type	Keyword Description
STARTING	M - N	Identifies the start of METEOROLOGY pathway inputs
SURFFILE	M - N	Describes input meteorological surface data file
PROFFILE	M - N	Describes input meteorological profile data file
SURFDATA	M - N	Describes surface meteorological station
UAIRDATA	M - N	Describes upper air meteorological station
SITEDATA	O - N	Describes on-site meteorological station
PROFBASE	M - N	Specifies the base elevation for the potential temperature profile
STARTEND	O - N	Specifies start and end dates to be read from input meteorological data file (default is to read entire file)
DAYRANGE	O - R	Specifies days or ranges of days to process (default is to process all data read in)
SCIMBYHR	O - N	Specifies the parameters for the SCIM (Sampled Chronological Input Model) option (see CO MODELOPT)
WDROTATE	O - N	May be used to correct for alignment problems of wind direction measurements, or to convert wind direction from to flow vector
WINDCATS	O - N	Input upper bounds of wind speed categories, five values input - sixth category is assumed to have no upper bound
FINISHED	M - N	Identifies the end of METEOROLOGY pathway inputs

TABLE B-8

DESCRIPTION OF METEOROLOGY PATHWAY KEYWORDS AND PARAMETERS

Keyword	Parameters	
SURFFILE	Sfcfil (Format)	
where:	Sfcfil	Specify filename for surface meteorological input file
	Format	Specify format for input file
PROFFILE	Profil (Format)	
where:	Profil	Specify filename for profile meteorological input file
	Format	Specify format for input file
SURFDATA	Stanum Year (Name) (Xcoord Ycoord)	
where:	Stanum	Station number, e.g. 5-digit WBAN number for NWS surface station
	Year	Year of data being processed (four digits)
	Name	Station name (optional)
	Xcoord	x-coordinate of station location (m) (optional)
	Ycoord	y-coordinate of station location (m) (optional)
UAIRDATA	Stanum Year (Name) (Xcoord Ycoord)	
where:	Stanum	Station number, e.g. 5-digit WBAN number for NWS upper air station
	Year	Year of data being processed (four digits)
	Name	Station name (optional)
	Xcoord	x-coordinate of station location (m) (optional)
	Ycoord	y-coordinate of station location (m) (optional)
SITEDATA	Stanum Year (Name) (Xcoord Ycoord)	
where:	Stanum	Station number for on-site meteorological data station
	Year	Year of data being processed (four digits)
	Name	Station name (optional)
	Xcoord	x-coordinate of station location (m) (optional)
	Ycoord	y-coordinate of station location (m) (optional)
PROFBASE	BaseElev (Units)	
where:	BaseElev	Base elevation (above MSL) for the potential temperature profile
	Units	Units of BaseElev: METERS or FEET (default is METERS)
STARTEND	Strtyr Strtmn Strtdy (Strthr) Endyr Endmn Enddy (Endhr)	
where:	Strtyr	Year of first record to be read
	Strtmn	Month of first record to be read
	Strtdy	Day of first record to be read
	Strthr	Hour of first record to be read (optional)
	Endyr	Year of last record to be read
	Endmn	Month of last record to be read
	Enddy	Day of last record to be read
	Endhr	Hour of last record to be read (optional) Note: File read begins with hour 1 of the start date and ends with hour 24 of the end date if Stahr and Endhr are omitted.

TABLE B-8 (CONT.)

DESCRIPTION OF METEOROLOGY PATHWAY KEYWORDS AND PARAMETERS

DAYRANGE	Range1 Range2 Range3 ... RangeN	
where:	Range1	First range of days to process, either as individual day (XXX) or as range (XXX-YYY); days may be input as Julian dates (XXX) or as month and day (XX/YY)
	RangeN	The 'nth' range of days to process
SCIMBYHR	NRegStart NRegInt NWetStart NWetInt (SfcFilnam PflFilnam)	
where:	NRegStart	Specifies the first hour to be sampled with the SCIM option; required to have a value from 1 to 24
	NregInt	Specifies the sampling interval, in hours
	NWetStart	Specifies the first wet hour to be sampled with the SCIM option (not currently used in AERMOD, should set to 0)
	NWetInt	Specifies the wet sampling interval, in hours (not currently used in AERMOD, should be set to 0)
	SfcFilnam	Optional output file name to list the surface meteorological data for the sampled hours
	PflFilnam	Optional output file name to list the profile meteorological data for the sampled hours
WDROTATE	Rotang	
where:	Rotang	Specifies angle (in degrees) to rotate wind direction measurements to correct for alignment problems; value of Rotang is subtracted from WD measurements, i.e., rotation is counterclockwise
WINDCATS	Ws1 Ws2 Ws3 Ws4 Ws5	
where:	Ws1	Upper bound of first wind speed category (m/s)
	Ws2	Upper bound of second wind speed category (m/s)
	Ws3	Upper bound of third wind speed category (m/s)
	Ws4	Upper bound of fourth wind speed category (m/s)
	Ws5	Upper bound of fifth wind speed category (m/s) (sixth category is assumed to have no upper bound)

TABLE B-9

DESCRIPTION OF EVENT PATHWAY KEYWORDS

EV Keywords	Type	Keyword Description
STARTING	M - N	Identifies the start of EVENT pathway inputs
EVENTPER	M - R	Describes data and averaging period for an event
EVENTLOC	M - R	Describes receptor location for an event
FINISHED	M - N	Identifies the end of EVENT pathway inputs

TABLE B-10

DESCRIPTION OF EVENT PATHWAY KEYWORDS AND PARAMETERS

Keyword	Parameters	
EVENTPER	Evname Aveper Grpid Date	
where:	Name	Specify name of event to be processed (e.g. H2H24ALL), (up to eight alphanumeric characters)
	Grpid	Specify source group ID for event
	Aveper	Specify averaging period for event
	Date	Specify data period for event (ending YYMMDDHH for averaging period)
EVENTLOC	Evname	XR= Xr YR= Yr (Zelev) (Zflag) or RNG= Rng DIR= Dir (Zelev) (Zflag)
where:	Evname	Specify name of event to be processed (e.g. H2H24ALL), (up to eight alphanumeric characters)
	XR=	X-coordinate for event (discrete Cartesian receptor)
	YR=	Y-coordinate for event (discrete Cartesian receptor)
	RNG=	Distance range for event (discrete polar receptor)
	DIR=	Radial direction for event (discrete polar receptor)
	Zelev	Terrain elevation for event (optional)
	Zflag	Receptor height above ground for event (optional)

Note: EVENT locations can be input as either discrete Cartesian receptors (XR=, YR=) or as discrete polar receptors (RNG=, DIR=). Events that are specified in the file generated by the AERMOD model (CO EVENTFIL card) are always given as discrete Cartesian coordinates. Discrete polar receptors are assumed to be relative to an origin of (0,0).

TABLE B-11

DESCRIPTION OF OUTPUT PATHWAY KEYWORDS

OU Keywords	Type	Keyword Description
STARTING	M - N	Identifies the start of OUTPUT pathway inputs
RECTABLE	O - R	Option to specify value(s) by receptor for output
MAXTABLE	O - R	Option to summarize the overall maximum values
DAYTABLE	O - N	Option to print summaries for each averaging period for each day processed.
MAXIFILE	O - R	Option to list events exceeding a threshold value to file (if CO EVENTFIL option is used, these events are included in the input file generated for the EVENT model).
POSTFILE[1]	O - R	Option to write results to a mass storage file for postprocessing.
PLOTFILE[1]	O - R	Option to write certain results to a storage file suitable for input to plotting routines
TOXXFILE	O - R	Option to write results to a storage file suitable for input to the TOXX model component of TOXST or the RISK
RANKFILE	O - R	Option to output file of ranked values for Q-Q plots (must be used with the MAXTABLE keyword)
EVALFILE	O - R	Option to output file of normalized arc maxima from EVALCART receptors for model evaluation studies
EVENTOUT	M - N	Specifies the level of output information provided for EVENT processing
FINISHED	M - N	Identifies the end of OUTPUT pathway inputs

1) POSTFILE is used to output concurrent concentration values for particular source groups and averaging times across the receptor network, suitable for postprocessing, such as might be done for implementing the intermediate terrain policy. PLOTFILE is used to output specific design values, such as second high concentrations, across the receptor network, suitable for plotting concentration contours.

TABLE B-12

DESCRIPTION OF OUTPUT PATHWAY KEYWORDS AND PARAMETERS

Keyword	Parameters	
RECTABLE	Aveper FIRST SECOND . . . SIXTH or Aveper 1ST 2ND . . . 6TH	
where:	Aveper	Averaging period to summarize with high values (keyword ALLAVE specifies all averaging periods)
	FIRST	Select summaries of FIRST highest values by receptor
	SECOND	Select summaries of SECOND highest values by receptor
	SIXTH	Select summaries of SIXTH highest values by receptor
	1ST	Select summaries of 1ST highest values by receptor
	2ND	Select summaries of 2ND highest values by receptor
	6TH	Select summaries of 6TH highest values by receptor
		Note: If two keywords are input separated by a dash (e.g. FIRST-THIRD), then summaries of all high values in that range are provided. The number of high values allowed is controlled by the NVAL parameter in the computer code (initially set at 3). Also, if the CO EVENTFIL keyword is exercised, then the events generated by the RECTABLE keyword are included in the input file for EVENT model.
MAXTABLE	Aveper Maxnum	
where:	Aveper	Averaging period to summarize with maximum values (keyword ALLAVE specifies all averaging periods)
	Maxnum	Specifies number of overall maximum values to summarize (number of maximum values permitted is limited by the NMAX parameter in the computer code, initially set at 50)
DAYTABLE	Avper1 Avper2 Avper3 . . .	
where:	Avper1	Averaging period to summarize with values by receptor for each day of data processed (keyword ALLAVE for first parameter specifies all averaging periods) Averaging period to summarize with maximum values (keyword ALLAVE specifies all averaging periods) Specifies number of overall maximum values to summarize (number of maximum values permitted is limited by the NMAX parameter in the computer code, initially set at 50)

TABLE B-12 (CONT.)

DESCRIPTION OF OUTPUT PATHWAY KEYWORDS AND PARAMETERS

MAXIFILE	Aveper Grpid Thresh Filnam (Funit)	
where:	Aveper	Specifies averaging period for list of values equal to or exceeding a threshold value
	Grpid	Specifies source group to be output to file
	Thresh	Threshold value (e.g. NAAQS) for list of exceedances
	Filnam	Name of disk file to store maximum values
	Funit	Optional parameter to specify the file unit Note: If the CO EVENTFIL keyword is exercised, then the events generated by the MAXIFILE keyword are included in the input file for EVENT processing.
POSTFILE	Aveper Grpid Format Filnam (Funit)	
where:	Aveper	Specifies averaging period to be output to file, e.g., 24 for 24-hr averages, PERIOD for period averages
	Grpid	Specifies source group to be output to file
	Format	Specifies format of file, either UNFORM for unformatted files or PLOT for formatted files for plotting
	Filnam	Specifies filename for output file
	Funit	Optional parameter to specify the file unit
PLOTFILE	Aveper Grpid Hivalu Filnam (Funit) (Short Term values) Aveper Grpid Filnam (Funit) (PERIOD or ANNUAL averages)	
where:	Aveper	Specifies averaging period to be output to file, e.g., 24 for 24-hr averages, PERIOD for period averages, WINTER for winter averages, etc.
	Grpid	Specifies source group to be output to file
	Hivalu	Specifies high value summary (e.g. FIRST, SECOND, 1ST, 2ND, etc.) to be output to file (must be selected on a RECTABLE card)
	Filnam	Specifies filename for output file
	Funit	Optional parameter to specify the file unit
TOXXFILE	Aveper Cutoff Filnam (Funit)	
where:	Aveper	Specifies averaging period to be output to file, e.g., 1 for 1-hr averages.
	Cutoff	Specifies cutoff (threshold) value in g/m^3 for outputting results for AERMOD model
	Filnam	Specifies filename for output file
	Funit	Optional parameter to specify the file unit
RANKFILE	Aveper Hinum Filnam (Funit)	
where:	Aveper	Specifies averaging period to be output to file, e.g., 24 for 24-hr averages
	Hinum	Specifies the number of high values to be ranked
	Filnam	Specifies filename for output file
	Funit	Optional parameter to specify the file unit
EVALFILE	Srcid Filnam (Funit)	
where:	Srcid	Specifies the source ID to be output to file
	Filnam	Specifies filename for output file
	Funit	Optional parameter to specify the file unit
EVENTOUT	SOCONT or DETAIL	
where:	SOCONT	Provide source contribution information only in the event output
	DETAIL	Include hourly concentrations for each source and hourly meteorological data in the event output

APPENDIX C. EXPLANATION OF ERROR MESSAGE CODES

C.1 INTRODUCTION

The AERMOD input runstream is checked to identify parameters that are missing or potentially in error, and the input source and meteorological data are checked and flagged for possible erroneous values.

The AERMOD model uses a "defensive programming" approach to eliminate as much as possible of the user's work in debugging the input runstream file. Also, a great deal of effort has been made to eliminate the possibility of run time errors, such as "divide by zero," and to point out questionable input data. Error messages are reported to the user in two ways. A summary of messages is provided in the main output result file, and the user can also request a detailed message listing file.

Message Summary: Whether the user selects a detailed error listing file or not, the AERMOD model output a summary of messages within the output result file. This message table gives the number of messages of each type, together with a detailed list of all the fatal errors and warning messages. During setup processing, if no errors or warnings are generated, then the model simply reports to the user that "SETUP Finishes Successfully."

Detailed Message Listing File: The AERMOD model provide the option of saving a detailed list of all messages generated by the model in a separate output file. The user can select this option by specifying the keyword "ERRORFIL" followed by a filename inside the COntrol pathway. For example, the following statements will save all the error messages to an ASCII text file named "errormsg.out":

```
CO STARTING
   ERRORFIL errormsg.out
CO FINISHED
```

C.2 THE OUTPUT MESSAGE SUMMARY

There are two message summaries provided in the standard output file of the AERMOD model. The first one is located after the echo of input runstream file images and before the input data summary. This summary will take one of two forms, depending on whether any fatal error or non-fatal warning messages were generated, and also depending on whether the option to RUN or NOT to run was selected on the CO RUNORNOT card. If there are no errors or warnings generated during the setup processing, and the RUN option was selected, then the model simply reports that "SETUP Finishes Successfully." If any fatal errors or warning messages were generated during the setup processing, or if the option NOT to run was selected, then a more detailed summary is provided. This summary provides a message count for each type of message, and a detailed listing of each fatal error and warning message generated. The second message summary table is located at the very end of the standard output result file, and it sums up the messages generated by the complete model run - both setup processing and run-time processing.

An example of a setup processing message summary is shown in Figure C-1.

```
*** Message Summary For The AERMOD Model Setup ***

 --------- Summary of Total Messages ---------

A Total of           0 Fatal Error Message(s)
A Total of           0 Warning Message(s)
A Total of           0 Information Message(s)


   ******** FATAL ERROR MESSAGES ********
                *** NONE ***

   ********   WARNING MESSAGES   ********
                *** NONE ***

   ***********************************
   *** SETUP Finishes Successfully ***
   ***********************************
```

FIGURE C-1. EXAMPLE OF AN AERMOD MESSAGE SUMMARY

C.3 DESCRIPTION OF THE MESSAGE LAYOUT

Three types of messages can be produced by the model during the processing of input runstream images and during model calculations. These are described briefly below:

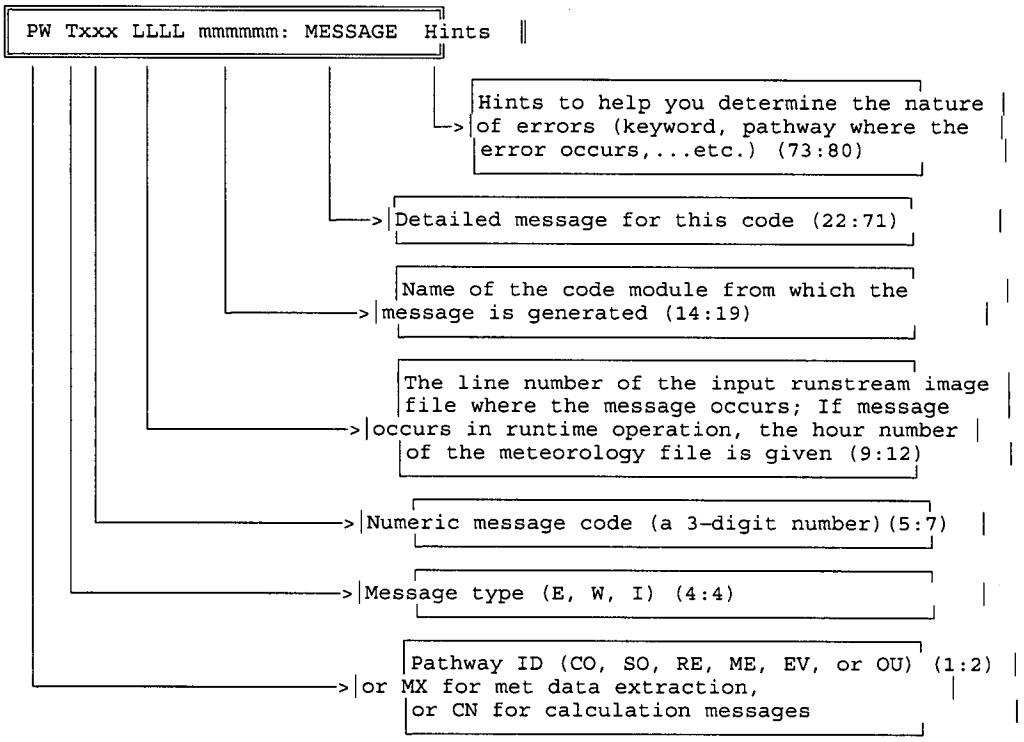
- Errors that will halt any further processing, except to identify additional error conditions (type E);
- Warnings that do not halt processing but indicate possible errors or suspect conditions (type W); and
- Informational messages that may be of interest to the user but have no direct bearing on the validity of the results (type I).

The messages have a consistent structure which contains the pathway ID, indicating which pathway the messages are generated from; the message type followed by a three-digit message number; the line number of the input runstream image file for setup messages (or the meteorology hour number for runtime messages); the name of the module (e.g. the subroutine name) from which the message is generated; a detailed message corresponding to the message code; and an 8-character simple hint to help the user spot the possible source of the problem.

The following is an example of a detailed message generated from the CO pathway:

```
CO E100     8 EXPATH: Invalid Pathway Specified. The Troubled Pathway is FF
```

The message syntax is explained in more detail below (values in parentheses give the column numbers within the message line for each element):



If an error occurs during processing of an included file (either SO INCLUDED or RE INCLUDED), the line number will represent the line number of the included file. The line number of the runstream file is saved before processing the included data, and then restored when processing returns to the main runstream file.

The three message types are identified with the letters E (for errors), W (for warnings), and I (for informational messages). The 3-digit message codes are grouped into general categories corresponding to the different stages of the processing. Theses categories are:

100 - 199 Input Runstream Image Structure Processing

200 - 299 Parameter Setup Processing

300 - 399 Data and Quality Assurance Processing

400 - 499 Run Time Message Processing

500 - 599 Input/Output Message Processing

A detailed description of each of the message codes currently used in the model is provided in the next section.

C.4 DETAILED DESCRIPTION OF THE ERROR/MESSAGE CODES

INPUT RUNSTREAM IMAGE STRUCTURE PROCESSING, 100-199

This type of message indicates problems with the basic syntax and/or structure of the input runstream image. Typical messages include errors like "Missing mandatory keyword", "Illegal Keyword", ..., etc. If a fatal error of this kind is detected in a runstream image, a fatal error message is written to the message file and any attempt to process data is prohibited, although the remainder of the runstream file is examined for other possible errors. If a warning occurs, data may still be processed, although the inputs should be checked carefully to be sure that the condition causing the warning does not indicate an error.

100 Invalid Pathway Specified. The pathway ID should be a 2 character string. It should be one of the following: CO for control pathway, SO for source pathway, RE for receptor pathway (or EV for event pathway for EVENT processing), ME for meteorology data setting pathway, and OU for output format pathway. Its position is normally confined to columns 1 and 2 (1:2) of the input runstream file. However, the model does allow for a shift of the entire input runstream file of up to 3 columns. If the inputs are shifted, then all input records must be shifted by the same amount. The invalid pathway is repeated at the end of the message.

105 Invalid Keyword Specified. The keyword ID should be an 8-character string. Its position is normally confined to columns 4 to 11 (4:11) of the input runstream file. However, the model does allow for a shift of the entire input runstream file of up to 3 columns. If the inputs are shifted, then all input records must be shifted by the same

amount. There should be a space between keyword ID and any other data fields. For a list of valid keywords, refer to Appendix A or Appendix B. The invalid keyword is repeated at the end of the message.

110 Keyword is Not Valid for This Pathway. The input keyword is a valid 8-character string, but it is not valid for the particular pathway. Refer to Appendix A, Appendix B or Section 3 for the correct usage of the keyword. The invalid keyword is repeated at the end of the message.

115 Starting and Finishing Statements do not match. Only One STARTING and one FINISHED statement,respectively, is allowed at the very beginning and the very end of each pathway block. Check the position and frequency to make sure the input runstream file meets the format requirement. The pathway during which the error occurs is included at the end of the message.

120 Pathway is Out of Sequence. The pathways are not input in the correct order. The correct order is CO, SO, RE, ME, and OU for the AERMOD and AERMOD model, and CO, SO, ME, EV, and OU for EVENT processing. The offending pathway is given as a hint.

125 Missing FINISHED Statement - Runstream file is incomplete. One or more FINISHED statements are missing. A 5-digit status variable is given as a hint. Each digit corresponds to a pathway in the appropriate order, and is a '1' if the pathway is complete and a '0' if the FINISHED is missing. For example, a status of '10111' indicates that the SO pathway was missing a FINISHED statement. Normally such an error will generate additional messages as well.

130 Missing Mandatory Keyword. To run the model, certain mandatory keywords must present in the input runstream file. For a list of mandatory keywords, see Appendix A or Appendix B. For more detailed information on keyword setup, see the description of message code 105. The missing keyword is included with the message.

135 Duplicate Non-repeatable Keyword Encountered. More than one instance of a non-repeatable keyword is encountered. For a list of non-repeatable keywords, see Appendix A or Appendix B. The repeated keyword is included with the message.

140 Invalid Placement of Keyword. A keyword has been placed out of the acceptable order, or a STARTING or FINISHED keyword has been placed in an INCLUDED file. The order for most keywords is not critical, but the relative order of a few keywords is important for the proper interpretation of the input data. The keyword reference in Section 3 identifies any requirements for the order of keywords. The keyword that was improperly placed is included with the message.

145 Conflicting Options: MULTYEAR and Re-Start Option. The multiple year option for processing PM-10 values makes use of the re-start routines in the model with some

slight changes to handle the period averages from year to year. As a result, the MULTYEAR keyword cannot be specified with either the SAVEFILE or INITFILE keywords.

150 Conflicting Options: MULTYEAR for Wrong Pollutant. The multiple year option is provided specifically for the processing of PM-10 values to obtain the "high-sixth-high in five years" design value. Its treatment of the high short term values for multiple year periods is not consistent with existing air quality standards for other pollutants. To use the MULTYEAR option, the user must specify a pollutant type (on the CO POLLUTID card) of PM-10, PM10, or OTHER.

152 ELEVUNIT card must be first for this pathway. The ELEVUNIT card must be the first non-commented card after STARTING when used on the SO or RE pathway. This requirement is made in order to simplify reviewing runstream files to determine the elevation units used for sources and receptors.

154 Conflicting Options: SCIM option cannot be used with the specified option, causing a fatal error.

155 Conflicting Decay Keyword. The AERMOD model allows for the user to specify the rate of exponential decay either in terms of the half-life (HALFLIFE keyword) or the decay coefficient (DCAYCOEF keyword). If both keywords are specified, then only the first one will be used, and inputs for the second one will be ignored.

156 Option ignored - not valid with SCIM. The specified option is not valid with the SCIM option and is ignored. This is not a fatal error.

157 Wet SCIM option is not operational yet and the input is ignored. Since the model does not include wet deposition algorithms yet, the wet SCIM option is not operational.

158 Wet SCIM option is not operational yet and the input is ignored. Since the model does not include wet deposition algorithms yet, the wet SCIM option is not operational.

160 Duplicate ORIG Secondary Keyword for GRIDPOLR. Only one origin card may be specified for each grid of polar receptors. The network ID for the effected grid is included with the message.

170 Invalid Secondary Key for Receptor GRID. The network ID for the effected grid is included with this message. Refer to Appendix B for the correct syntax of secondary keywords.

175 Missing Secondary Keyword END for Receptor Grid. The END secondary keyword is required for each grid of receptors input by the user (keywords GRIDCART and GRIDPOLR). It signals the end of inputs and triggers the processing of data for that particular network.

180 Conflicting Secondary Keyword for Receptor Grid. Two incompatible secondary keywords have been input for the same grid of receptors, e.g. GDIR and DDIR for the keyword GRIDPOLR, where GDIR specifies to generate directions with uniform spacing, and DDIR specifies that discrete, non-uniform directions are being specified.

185 Missing Receptor Keywords. No Receptors Specified. Since none of the RE pathway keywords are mandatory, a separate error check is made to determine if any of the RE keywords are specified. At least one of the following keywords must be present: GRIDCART, GRIDPOLR, DISCCART, DISCPOLR, or EVALCART.

190 No Keywords for OU Pathway and No PERIOD or ANNUAL Averages. All of the OU pathway keywords are optional, and in fact the model will run if no keywords are specified on the OU pathway as long as PERIOD or ANNUAL averages are being calculated. However, if there are no OU keywords and no PERIOD or ANNUAL averages, then there will be no output generated by the model, and this fatal error message will be generated.

195 Incompatible Option Used With SAVEFILE or INITFILE. Either a non-fatal message to warn the user that DAYTABLE results will be overwritten if the model run is re-started, or a fatal error message generated if the TOXXFILE option is selected with either the SAVEFILE or INITFILE options.

197 Post-1997 PM_{10} processing option without the MAXIFILE option is incompatible with the EVENTFIL option. Threshold violations generated through the MAXIFILE option are the only events that are compatible with post-1997 PM_{10} processing for EVENT processing.

198 The non-default TOXICS option is required in order to use the specified option, such as the SCIM option.

PARAMETER SETUP PROCESSING, 200-299

This type of message indicates problems with processing of the parameter fields for the runstream images. Some messages are specific to certain keywords, while others indicate general problems, such as an invalid numeric data field. If a fatal error of this kind is detected in a runstream image, a fatal error message is written to the message file and any attempt to process data is prohibited, although the remainder of the runstream file is examined for other possible errors. If a warning occurs, data may still be processed, although the inputs should be checked carefully to be sure that the condition causing the warning does not indicate an error.

200 Missing Parameter(s). No options were selected for the indicated keyword. Check Appendix B for the list of parameters for the keyword in question.

201 Not Enough Parameters Specified For The Keyword. Check if there are any missing parameters following the indicated keyword. See Appendix B for the required keyword parameters.

202 Too Many Parameters Specified For The Keyword. Refer to Appendix B or Section 3 for the list of acceptable parameters.

203 Invalid Parameter Specified. The inputs for a particular parameter are not valid for some reason. Refer to Appendix B or Section 3. The invalid parameter is included with the message.

204 Option Parameters Conflict. Forced by Default to: Some parameters under the indicated keyword conflict with the other model parameters setting. Refer to Appendix B or Section 3 for the correct parameter usage. The default setting is specified with the message.

205 No Option Parameter Setting. Forced by Default to: No setting was specified for a particular parameter. Refer to Appendix B or Section 3 for the correct parameter usage. The default setting is specified with the message.

206 Regulatory DFAULT Specified With Non-default Option. The DFAULT option on the CO MODELOPT card always overrides the specified non-default option, and a warning message is generated.

207 No Parameters Specified. Default Values Used For. The keyword for which no parameters are specified is included with the message. Refer to Appendix B or Section 3 for a discussion of the default condition.

208 Illegal Numerical Field Encountered. The model may have encountered a non-numerical character for a numerical input, or the numerical value may exceed the limit on the size of the exponent, which could potentially cause an underflow or an overflow error.

209 Negative Value Appears For A Non-negative Variable. The effected variable name is provided with the message.

210 Number of Short Term Averages Exceeds Maximum. The user has specified more short term averages on the CO AVERTIME card than the model array limits allow. This array limit is dynamically allocated at model runtime based on model inputs, and is stored in the NAVE variable. While the model still performs this test, this message should never occur.

211 Duplicate Parameter(s) Specified for Keyword. A duplicate parameter or set of parameters has been specified for the indicated keyword. For example, if more than one POSTFILE keyword is included for the same averaging period and source group, then this error message will be generated.

212 END Encountered Without (X,Y) Points Properly Set. This error occurs during setting up the grid of receptors for a Cartesian Network. This message may occur for example if X-coordinate points have been specified without any Y-coordinate points for a particular network ID.

213 ELEV Inputs Inconsistent With Option: Input Ignored. This happens when the user inputs elevated terrain heights for receptors when the FLAT option is specified. The input terrain heights are ignored and the model proceeds with FLAT terrain modeling.

214 ELEV Inputs Inconsistent With Option: Defaults Used. This happens when the user does not input elevated terrain heights for receptors when the default option of incorporating elevated terrain effects is used. The model assumes that the missing terrain heights are at 0.0 meters for those receptors and proceeds with ELEV terrain modeling.

215 FLAG Inputs Inconsistent With Option: Input Ignored. This happens when the user inputs receptor heights above ground for flagpole receptors when the FLAGPOLE keyword option has not been specified. The input flagpole heights are ignored in the model calculations.

216 FLAG Inputs Inconsistent With Option: Defaults Used. This happens when the user does not input receptor heights above ground for flagpole receptors when the FLAGPOLE keyword option has been specified. The model assumes that the missing flagpole heights are equal to the default value specified on the CO FLAGPOLE card. If no default height is specified on the FLAGPOLE card, then a default of 0.0 meters is assumed.

217 More Than One Delimiter In A Field. For example, 12//34 is an illegal input data item for the DAYRANGE card, and STACK1--STACK-20 is an illegal specification for a range of sources.

218 Number of (X,Y) Points Not Match With Number Of ELEV Or FLAG. Check the number of elevated terrain heights or flagpole receptor heights for the gridded network associated with the indicated line number in the runstream file.

219 Number Of Receptors Specified Exceeds Maximum. The user has specified more receptors on the RE pathway than the model array limits allow. This array limit is dynamically allocated at model runtime based on model inputs, and is stored in the NREC variable. While the model still performs this test, this message should never occur.

220 Missing Origin (Use Default = 0,0) In GRIDPOLR. This is a non-fatal warning message to indicate that the ORIG secondary keyword has not been specified for a particular grid of polar receptors. The model will assume a default origin of (X=0, Y=0).

221 Missing Distance Setting In Polar Network. No distances have been provided (secondary keyword DIST) for the specified grid of polar receptors.

222 Missing Degree Or Distance Setting In Polar Network. Missing a secondary keyword for the specified grid of polar receptors.

223 Missing Distance or Degree Field. No data fields have been specified for the indicated secondary keyword.

224 Number of Receptor Networks Exceeds Maximum. The user has specified more receptor networks of gridded receptors on the RE pathway than the model array limits allow. This array limit is dynamically allocated at model runtime based on model inputs, and is stored in the NNET variable. While the model still performs this test, this message should never occur.

225 Number of X-Coords Specified Exceeds Maximum. The user has specified more X-coordinate values for a particular grid of receptors than the model array limits allow. This array limit is dynamically allocated at model runtime based on model inputs, and is stored in the IXM variable. While the model still performs this test, this message should never occur.

226 Number of Y-Coords Specified Exceeds Maximum. The user has specified more Y-coordinate values for a particular grid of receptors than the model array limits allow. This array limit is dynamically allocated at model runtime based on model inputs, and is stored in the IYM variable. While the model still performs this test, this message should never occur.

227 No Receptors Were Defined on the RE Pathway. Either through lack of inputs or through errors on the inputs, no receptors have been defined.

228 Default(s) Used for Missing Parameters on Keyword. Either an elevated terrain height or a flagpole receptor height or both are missing for a discrete receptor location. Default value(s) will be used for the missing parameter(s).

229 Too Many Parameters - Inputs Ignored on Keyword. Either an elevated terrain height or a flagpole receptor height or both are provided when the corresponding option has not been specified. The unneeded inputs are ignored.

231 Too Many Numerical Values Specified. Too many values have been specified for the type of input indicated.

232 Number Of Specified Sources Exceeds Maximum. The user has specified more sources than the model array limits allow. This array limit is dynamically allocated at model runtime based on model inputs, and is stored in the NSRC variable. While the model still performs this test, this message should never occur.

233 Building Dimensions Specified for a Non-POINT Source. Building dimensions can only be specified for a POINT source, since the VOLUME and AREA source algorithms do not include building downwash.

234 Too Many Sectors Input. For example, the user may have input too many building heights or widths for a particular source.

235 Number of Source Groups Specified Exceeds Maximum. The user has specified more source groups than the model array limits allow. This array limit is dynamically allocated at model runtime based on model inputs, and is stored in the NGRP variable. While the model still performs this test, this message should never occur.

236 Not Enough BUILDHGTs Specified for a Source ID. There should be 36 building heights.

237 Not Enough BUILDWIDs Specified for a Source ID. There should be 36 building widths.

239 Not Enough QFACTs Specified for a Source ID. The number of variable emission rate factors specified for a particular source is less than the model expects based on the variable emission rate flag. Check the EMISFACT keyword on the SO pathway in Appendix B of Section 3 for the appropriate number.

241 Not Enough BUILDLENs Specified for a Source ID. There should be 36 building lengths specified.

246 Not Enough XBADJs Specified for a Source ID. There should be 36 along-flow distances from the stack to the center of the upwind face of building specified.

247 Not Enough YBADJs Specified for a Source ID. There should be 36 across-flow distances from the stack to the center of the upwind face of building specified.

248 No Sources Were Defined on the SO Pathway. There must be at least one LOCATION card and one SRCPARAM card to define at least one source on the SO pathway. Either no cards were input or there were errors on the inputs.

250 Duplicate XPNT/DIST or YPNT/DIR Specified for GRID. One of the grid inputs, either an X-coordinate, Y-coordinate, polar distance range or polar direction, has been specified more than once for the same grid of receptors. This generates a non-fatal warning message.

252 Duplicate Receptor Network ID Specified. A network ID for a grid of receptors (GRIDCART or GRIDPOLR keyword) has been used for more that one network.

254 Number of Receptor Arcs Exceeds Maximum. This array limit is dynamically allocated at model runtime based on model inputs, and is stored in the NARC variable. While the model still performs this test, this message should never occur.

256 EVALFILE Option Used Without EVALCART Receptors. The EVALFILE output option provides model results designed for model evaluation purposes based on receptors grouped by arc. Such receptors must be identified using the EVALCART keyword. If EVALFILE is selected without any EVALCART receptors, this fatal error message will be generated.

260 Number of Emission Factors Exceeds Maximum. The user has selected an option for variable emission rate factors that exceeds the array storage limit for emission rate factors. This array limit is dynamically allocated at model runtime based on model inputs, and is stored in the NQF variable. While the model still performs this test, this message should never occur.

262 First Vertex Does Not Match LOCATION for AREAPOLY Source. The coordinates of the first vertex defined for an AREAPOLY source must match the source location coordinates provided on the SO LOCATION card.

264 Too Many Vertices Specified for an AREAPOLY Source. The number of vertices specified on the AREAVERT cards must match the number given on the SRCPARAM card for that source.

265 Not Enough Vertices Specified for an AREAPOLY Source. The number of vertices specified on the AREAVERT cards must match the number given on the SRCPARAM card for that source.

270 Number of High Values Specified Exceeds Maximum. The user has selected a high short term value on the OU RECTABLE card that exceeds the array storage limit for high values by receptor. This array limit is dynamically allocated at model runtime based on model inputs, and is stored in the NVAL variable. While the model still performs this test, this message should never occur.

280 Number of Maximum Values Specified Exceeds Maximum. The user has selected a value for the number of overall maximum values on the OU MAXTABLE card that exceeds the array storage limit for overall maximum values. This array limit is dynamically allocated at model runtime based on model inputs, and is stored in the NMAX variable. While the model still performs this test, this message should never occur.

294 PERIOD and ANNUAL averages are both selected on the AVERTIME card. The user can only specify one long-term averaging option, either PERIOD or ANNUAL average.

295 Invalid Averaging Period Specified for the SCREEN Mode. The SCREEN mode of AERMOD can only be used with 1-hour averages.

298 Error Allocating Storage for Setup Arrays. An error occurred while allocating storage for the setup arrays, indicating that there is insufficient memory available on the computer for the model to run. Try closing other applications and/or reducing the size of the run. An estimate of memory requirements is provided on the first page of the output file.

299 Error Allocating Storage for Result Arrays. An error occurred while allocating storage for the result arrays, indicating that there is insufficient memory available on the computer for the model to run. Try closing other applications and/or reducing the size of the run. An estimate of memory requirements is provided on the first page of the output file.

SETUP DATA AND QUALITY ASSURANCE PROCESSING, 300-399

This type of message indicates problems with the actual values of the parameter data on the input runstream image. The basic structure and syntax of the input card is correct, but one or more of the inputs is invalid or suspicious. These messages include quality assurance checks on various model inputs. Typical messages will tell the consistency of parameters and data for the setup and run of the model. If a fatal error of this kind is detected in a runstream image, a fatal error message is written to the message file and any attempt to process data is prohibited. If a warning occurs, data may or may not be processed, depending on the processing requirements specified within the run stream input data.

300 Specified Source ID Has Not Been Defined Yet. The message indicates that the user attempts to use a source ID on a keyword before defining this source ID on a SO LOCATION card. It could indicate an error in specifying the source ID, an omission of a LOCATION card, or an error in the order of inputs.

310 Attempt to Define Duplicate LOCATION Card for Source. There can be only one LOCATION card for each source ID specified. The source ID is included with the message.

313 Attempt to Define Duplicate EVENTPER Card for the specified EVENT. There can be only one EVENTPER card for each EVENT specified. The EVENT name is included with the message.

315 Attempt to Define Duplicate SRCPARAM Card for Source. There can be only one SRCPARAM card for each source ID specified. The source ID is included with the message.

319 No Sources Included in the Specified Source Group. This is a non-fatal warning message indicating that a source group has been defined that does not include any sources. The source group ID is provided.

320 Source Parameter May Be Out-of-Range for Parameter. The value of one of the source parameters may be either too large or too small. The name of the parameter is provided with the message. Use the line number provided to locate the card in question.

325 Negative Exit Velocity (Set=1.0E-5) for Source ID. The exit velocity for the specified source ID was input as a negative value. Since the model currently cannot handle sources with downward momentum, the exit velocity is set to a very small value (1.0E-5 m/s) and modeling proceeds. This non-fatal message is generated to warn the user that the input may be in error.

330 Mass Fraction Parameters Do Not Sum to 1. (within +/- 2 percent) for a particular source.

332 Mass Fraction Parameter Out-of-Range for a particular source. Must be between 0.0 and 1.0, inclusive.

334 Particle Density Out-of-Range for a particular source. Must be greater than 0.0.

340 Possible error in the PROFBASE input. The value input as the base elevation (above MSL) for the potential temperature file is less than zero.

342 Source ID Mismatch in the Hourly Emissions File. The source ID read from the hourly emissions file does not match what is expected based on the SO HOUREMIS card. A source ID and/or date may be out of order or missing in the hourly emissions file. The source ID read from the file is provided with the error message.

344 Hourly Emission Rate is Zero. The emission rate read from the hourly emission file is zero for the specified date. This is written as an informational message, and does not halt processing of the data.

350 Julian Day Out Of Range. This error occurs if the Julian Day selected is less than zero or greater than 366. Check ME setup to ensure the Julian Day selection.

352 Missing Field on MULTYEAR Card for Pre-1997 PM10. When using the MULTYEAR card for pre-1997 PM10 processing, the keyword 'H6H' must be specified.

353 MULTYEAR Card for PM10 Processing Applies Only for Pre-1997 Applications. Use High-Fourth-High for Post-1997 PM10 Processing.

354 High-Fourth-High Only Required for Post-1997 PM10 Processing with the RECTABLE Card.

360 2-digit Year Specified. Valid for the range 1950-2049. Four-digit years are valid for the entire range of Gregorian dates, but two digit years are accepted.

363 24-Hr and ANNUAL Averages Only are Allowed for Post-1997 PM10 Processing on the AVERTIME Card.

365 Year Input is Greater than 2147. A four-digit year greater than 2147 has been input to the model, which will cause an integer overflow.

370 Invalid Date: 2/29 In a Non-leap Year. The year has been identified as a non-leap year, and a date of 2/29 (February 29) has been specified on the DAYRANGE card. Check the year and/or the date specification.

380 This Input Variable is Out-of-Range. The indicated value may be too large or too small. Use the line number to locate the card in question, and check the variable for a possible error.

381 Latitude in the Surface File is Not Valid. The latitude is read from the header record of the surface/scalar meteorological data file. If the value is not within the valid range of 0 to 90 degrees, then this error message is generated.

382 Error Decoding Latitude in the Surface File. The latitude is read from the header record of the surface/scalar meteorological data file. An error occurred trying to decode the latitude indicating a potential problem with the surface file.

385 Averaging period does not equal 1-hour averages for the TOXXFILE option for the AERMOD model. The AERMOD model will generate TOXXFILE outputs for other averaging periods, but the TOXX model component of TOXST currently supports only the 1-hour averages. This is a non-fatal warning message.

390 Averaging period specified on the EVENTPER card for EVENT processing must be less than or equal to 24.

391 Aspect ratio (length/width) of an area source is greater than 10. The area source algorithm in the AERMOD model allows for specifying area sources as elongated

rectangles, however, if the aspect ratio exceeds 10 a warning message will be printed out. The user should subdivide the area so that each subarea has an aspect ratio of less than 10.

392 Error Decoding Latitude. The latitude is read from the header record of the surface/scalar meteorological data file. The value of the latitude should be followed by an 'N' or an 'S' for the northern or southern hemispheres. If the value cannot be decoded properly, then this error message is generate.

395 Met. Data Error; Incompatible Version of AERMET. Based on the version date given in the header record of the surface meteorological data file, the meteorological data were generated by an older, incompatible version of AERMET.

396 Met. Data Generated by Older Version of AERMET. Based on the version date given in the header record of the surface meteorological data file, the meteorological data were generated by an older version of AERMET. The data may be compatible with the current version of AERMOD, but should be updated with the current version of AERMET.

RUNTIME MESSAGE PROCESSING, 400-499

This type of message is generated during the model run. Setup processing has been completed successfully, and the message is generated during the performance of model calculations. Typical messages will tell the information and error during the model run. If a fatal error of this kind is detected during model execution, a fatal error message is written to the message file and any further processing of the data is prohibited. The rest of the meteorological data file will be read and quality assurance checked to identify additional errors. If a warning occurs, data may or may not be processed, depending on the processing requirements specified within the run stream input data.

405 The Value of PHEE Exceeds 1.0. If the value of PHEE, the fraction of the plume material below Hcrit, is greater than 1.0, then this informational message is generated. The value of PHEE is then set to 1.0 for the specified date.

406 Increase NVMAX for complex AREAPOLY source. The number of vertices for an AREAPOLY source exceeds the value of NVMAX, initially set to 20.

410 Flow Vector Out-of-Range. The flow vector must be between 0 and 360 degrees, inclusive. The date of occurrence is provided with the message (in the form of year, month, day, hour as YYMMDDHH)

413 Number of Threshold Violation Events > 9999 for the Specified Averaging Period. This will result in duplicate event names being written to the EVENTFIL file. The duplicate events will have to be segregated before running the model in the EVENT processing mode.

420 Wind Speed Out-of-Range. The wind speed value may be either too large or too small. An error is generated if the speed is less than 0.0, and a warning is generated if the speed is greater than 30.0 m/s. The date of occurrence is provided with the message (in the form of year, month, day, hour as YYMMDDHH).

430 Ambient Temperature Data Out-of-Range. The ambient temperature value may be either too large or too small. A warning is generated if the temperature is less than 220.0 K or greater than 330 K. The date of occurrence is provided with the message (in the form of year, month, day, hour as YYMMDDHH).

432 Surface Friction Velocity Out-of-Range. The surface friction velocity may by too large. A warning is generated if the surface friction velocity is greater than 1.5 m/s. The date of occurrence is provided with the message (in the form of year, month, day, hour as YYMMDDHH).

435 Surface Roughness Length Out-of-Range. A warning is generated if the surface friction velocity is less than 0.001 meters, and the value is set to 0.001 meters to avoid a divide by zero. The date of occurrence is provided with the message (in the form of year, month, day, hour as YYMMDDHH).

438 Convective Velocity Scale Out-of-Range. The convective velocity scale may by too large. A warning is generated if the convective velocity scale is greater than 3.0 m/s. The date of occurrence is provided with the message (in the form of year, month, day, hour as YYMMDDHH).

440 Calm Hour Identified in Meteorology Data File. This message is generated if a calm hour is identified, and provides the date of occurrence (in the form of year, month, day, hour as YYMMDDHH). A calm hour is identified by a reference wind speed of 0.0 m/s in the surface meteorological data file.

450 Error in Meteorology File - Record Out of Sequence. There is an error in the sequence of the hourly meteorological data file. The message also provides the date of occurrence (in the form of year, month, day, hour as YYMMDDHH).

455 Date/Time Mismatch on Hourly Emission File. There is mismatch in the date/time field between the meteorological data file and the hourly emission file. The message also provides the date of the occurrence from the surface/scalar file (in the form of year, month, day, hour as YYMMDDHH).

456 Date/Time Mismatch on Scalar and Profile Data. There is mismatch in the date/time field between the surface/scalar and the profile meteorological data files. The message also provides the date of the occurrence from the surface/scalar file (in the form of year, month, day, hour as YYMMDDHH).

460 Missing Hour Identified in Meteorology Data File. At least one of the meteorological variables is missing or invalid for the hour specified (in the form of year, month, day, hour as YYMMDDHH). If the missing data processing option is not used, then this message will be generated and any further calculations with the data will be aborted. The model will continue to read through the meteorological data file and check the data.

465 Number of Profile Levels Exceeds the Maximum. The profile meteorological data file includes more than the maximum number of levels, specified by the MXPLVL PARAMETER in MODULE MAIN1. The value of MXPLVL is provided with the message.

470 Mixing Height Value is Less Than or Equal to 0.0. This is an informational message that may indicate an error in the meteorological data file. The message includes the hour of occurrence (in the form of year, month, day, hour as YYMMDDHH).

475 The Reference Height is Higher than 100 m. The reference height is read from the surface/scalar meteorological data file. This warning message is generated if the reference height is higher than 100 meters. Since data for the reference height are used in surface layer similarity profiles, the reference height should be within the surface layer (between about 7 and 100 times the surface roughness length).

480 Less Than 1 Year Found for ANNUAL Averages. The input meteorological data file consists of less than a full year of data. The ANNUAL average requires that a full year of data or multiple years be available.

485 Data Remaining After End of Year. The ANNUAL average requires full years of input data (not necessarily calendar years), and there are data remaining after the end of the year. The number of hours remaining is specified.

487 User-specified Start Date on STARTEND card is Earlier Than Start Date of Data File with the ANNUAL average or post-1997 PM10 processing option.

INPUT/OUTPUT MESSAGE PROCESSING, 500-599

This type of message is generated during the model input and output. Typical messages will tell the type of I/O operation (e.g., opening, reading or writing to a file), and the type of file. If a fatal error of this kind is detected in a runstream image, a fatal error message is written to the message file and any attempt to process data is prohibited. If a warning occurs, data may

or may not be processed, depending on the processing requirements specified within the run stream input data.

500 Fatal Error Occurs During Opening of the Data File. The file specified can not be opened properly. This may be the runstream file itself, the meteorological data file, or one of the special purpose output files. This may happen when the file called is not in the specified path, or an illegal filename is specified. If no errors are found in the filename specification, then this message may also indicate that there is not enough memory available to run the program, since opening a file causes a buffer to be opened which takes up additional memory in RAM. For the special purpose output files, the hint field includes character string identifying the type of file and the file unit number, e.g., 'PLTFL312'.

510 Fatal Error Occurs During Reading of the File. File is missing, incorrect file type, or illegal data field encountered. Check the indicated file for possible problems. As with error number 500, this message may also indicate that there is not enough memory available to run the program if no other source of the problem can be identified.

520 Fatal Error Occurs During Writing to the File. Similar to message 510, except that it occurs during a write operation.

530 CAUTION! Met. Station ID Mismatch with SURFFILE for SURFDATA, UAIRDATA or SITEDATA. The surface, upper air, or optional on-site station ID numbers specified on the ME pathway do not agree with the values on the first record of the surface meteorological data file. This is a non-fatal warning message, but the input data should be checked carefully to ensure that the correct data file has been used.

540 No RECTABLE/MAXTABLE/DAYTABLE for Averaging Period. No printed output options selected for a particular averaging period. This is a non-fatal warning condition for the AERMOD model.

550 File Unit/Name Conflict for the Output Option. This error indicates that a problem exists with the filename and file unit specification for one of the special purpose output files. The associated keyword is provided as a hint. The same filename may have been used for more than one file unit, or vice versa.

560 User Specified File Unit Less Than or Equal to 25 for OU Keyword. A file unit of less than or equal to 25 has been specified for the indicated special purpose output files. This is a fatal error condition. File units of less than or equal to 25 are reserved for system files. Specify a unit number in the range of 26 to 100.

565 Possible conflict With Dynamically Allocated FUNIT. A file unit specified for the indicated special purpose output files is in the range > 100, and may therefore conflict

with file units dynamically allocated for special purpose files by the model. This is typically a non-fatal warning condition.

570 Problem Reading Temporary Event File for Event. The AERMOD model stores high value events in a temporary file that is used to create the input file for EVENT processing, if requested, and also to store the high values for the summary tables at the end of the printed output file. A problem has been encountered reading this file, possibly because the concentration value was too large and overflowed the fixed format field of F14.5.

580 End-of-File Reached Trying to Read a Data File. The AERMOD model has encountered an end-of-file trying the read the indicated file. This may appear when trying to "re-start" a model run with the CO INITFILE card if there is an error with the initialization file. Check the data file for the correct filename.

APPENDIX D. DESCRIPTION OF FILE FORMATS

D.1 AERMET METEOROLOGICAL DATA

Two files are produced for input to the AERMOD dispersion model by the AERMET meteorological preprocessor. The surface OUTPUT contains observed and calculated surface variables, one record per hour. The PROFILE file contains the observations made at each level of an on-site tower, or the one level observations taken from NWS data, one record per level per hour. The contents and format of each of these files is described below:

SURFACE OUTPUT

Header record:

READ( ) *latitude, longitude, UA identifier, SF identifier, OS identifier, Version*

FORMAT (2(2X,A8),8X,' UA_ID: ',A8,' SF_ID: ',A8,' OS_ID: ',A8,
5X,'VERSION: ',I5)

where	*latitude*	=	latitude specified in Stage 3 of AERMET
	longitude	=	longitude specified in Stage 3 of AERMET
	UA identifier	=	station identifier for upper air data; usually the WBAN number used to extract the data from an archive data set
	SF identifier	=	station identifier for hourly surface observations; usually the WBAN number used in extracting the data
	OS identifier	=	on-site identifier
	Version	=	version date of AERMET used to generate file

Data records:

READ( ) *year, month, day, j_day, hour, H,* u_*, w_*, *VPTG,* Z_{ic}, Z_{im}, *L,* z_o, B_o, *r,* W_s, W_d, z_{ref}, *temp,* z_{temp}

FORMAT (3(I2,1X), I3,1X, I2,1X, F6.1,1X, 2(F6.3,1X), F5.0,1X, F8.1,1X, F5.2,1X, 2(F6.2,1X), F7.2,1X, F5.0, 3(1X,F6.1))

where *j_day* = Julian date

H = sensible heat flux (W/m^2)

u_* = surface friction velocity (m/s)

w_* = convective velocity scale (m/s)

VPTG = vertical potential temperature gradient in the 500 m layer above PBL

Z_{ic} = height of convectively-generated boundary layer (m)

Z_{im} = height of mechanically-generated boundary layer (m)

L = Monin-Obukhov length (m)

z_o = surface roughness length (m)

B_o = Bowen ratio

r = Albedo

W_s = wind speed (m/s)

W_d = wind direction (degrees)

z_{ref} = reference height for W_s and W_d (m)

temp = temperature (K)

z_{temp} = reference height for *temp* (m)

The sensible heat flux, Bowen ratio and albedo are not used by AERMOD, but are passed through by AERMET for information purposes only.

PROFILE

READ( ) *year, month, day , hour, height, top,* WD*nn*, WS*nn*, TT*nn*, SA*nn*, SW*nn*

FORMAT (4(I2,1X), F6.1,1X, I1,1X, F5.0,1X, F7.2,1X, F7.1, 1X,F6.1, 1X,F7.2)

where *height* = measurement height (m)

top = 1, if this is the last (highest) level for this *hour*, or 0 otherwise

WD*nn* = wind direction at the current level (degrees)

WS*nn* = wind speed at the current level (m/s)

TT*nn* = temperature at the current level (°C)

SA*nn* = σ_θ (degrees)

SW*nn* = σ_w (m/s)

D.2 THRESHOLD VIOLATION FILES (MAXIFILE OPTION)

The OU MAXIFILE card for the AERMOD model allows the user the option to generate a file or files of threshold violations for specific source group and averaging period combinations. The file consists of several header records, each identified with an asterisk (*) in column one. The header information includes the model name and version number, the first line of the title information for the run, the list of modeling option keywords applicable to the results, the averaging period and source group included in the file, and the threshold value. Any value equal to or exceeding the threshold value will be included in the file. The header also includes the format used for writing the data records, and column headers for the variables included in the file. The variables provided on each data record include the averaging period, the source group ID, the date (YYMMDDHH) for the end of averaging period, the X and Y coordinates of the receptor location, receptor terrain elevation, hill height scale, flagpole receptor height, and the concentration value that violated the threshold. The following example from a threshold file identifies the contents of the MAXIFILE:

```
* AERMOD (02222): A Simple Example Problem for the AERMOD Model with PRIME
* MODELING OPTIONS USED:
*  CONC                                FLAT
*         MAXI-FILE FOR  3-HR VALUES >= A THRESHOLD OF    50.00
*         FOR SOURCE GROUP: ALL
*         FORMAT: (1X,I3,1X,A8,1X,I8.8,2(1X,F13.5),3(1X,F7.2),1X,F13.5)
*AVE   GRP      DATE          X             Y        ZELEV   ZHILL   ZFLAG  AVERAGE CONC
*___ ________ ________ _____________ _____________ _______ _______ _______ _____________
   3 ALL      88030112     344.68271     -60.77686    0.00    0.00    0.00      67.83944
   3 ALL      88030112     492.40387     -86.82408    0.00    0.00    0.00      68.92943
   3 ALL      88030112     164.44621     -59.85352    0.00    0.00    0.00     114.30801
```

D.3 POSTPROCESSOR FILES (POSTFILE OPTION)

The OU POSTFILE card for the AERMOD model allows the user the option of creating output files of concurrent concentration values suitable for postprocessing. The model offers

two options for the type of file generated - one is an unformatted file, and the other is a formatted file of X, Y, CONC values suitable for inputting to plotting programs.

The unformatted POSTFILE option generates a separate unformatted data record of concurrent values for each averaging period and source group specified. The averaging period and source group combinations may be written to separate files, or combined into a single file. Each record begins with the date variable for the end of the averaging period (an integer variable of the form YYMMDDHH), the averaging period (e.g., an integer value of 3 for 3-hour averages), and the source group ID (eight characters). Following these three header variables, the record includes the concentration values for each receptor location, in the order in which the receptors are defined on the RE pathway. The results are output to the unformatted file or files as they are calculated by the model.

The formatted plot file option for the POSTFILE keyword includes several lines of header information, each identified with an asterisk (*) in column one. The header information includes the model name and version number, the first line of the title information for the run, the list of modeling option keywords applicable to the results, the averaging period and source group included in the file, and the number of receptors included. The header also includes the format used for writing the data records, and column headers for the variables included in the file. The variables provided on each data record include the X and Y coordinates of the receptor location, the concentration value for that location, receptor terrain elevation, hill height scale, flagpole receptor height, the averaging period, the source group ID, and the either the date variable for the end of the averaging period (in the form of YYMMDDHH) for short term averages or the number of hours in the period for PERIOD averages. The following example from a formatted postprocessor file for PERIOD averages identifies the contents of the POSTFILE:

```
* AERMOD (02222): A Simple Example Problem for the AERMOD Model with PRIME
* MODELING OPTIONS USED:
*  CONC                                FLAT
*         POST/PLOT FILE OF PERIOD VALUES FOR SOURCE GROUP: ALL
*         FOR A TOTAL OF   144 RECEPTORS.
*         FORMAT: (3(1X,F13.5),3(1X,F8.2),2X,A6,2X,A8,2X,I8.8,2X,A8)
*        X             Y      AVERAGE CONC    ZELEV    ZHILL    ZFLAG    AVE     GRP      NUM HRS   NET ID
*
```

X	Y	AVERAGE CONC	ZELEV	ZHILL	ZFLAG	AVE	GRP	NUM HRS	NET ID
30.38843	172.34135	0.12122	0.00	0.00	0.00	PERIOD	ALL	00000096	POL1
60.77686	344.68271	0.40298	0.00	0.00	0.00	PERIOD	ALL	00000096	POL1
86.82409	492.40387	0.72628	0.00	0.00	0.00	PERIOD	ALL	00000096	POL1
173.64818	984.80774	1.19873	0.00	0.00	0.00	PERIOD	ALL	00000096	POL1
59.85352	164.44621	0.12341	0.00	0.00	0.00	PERIOD	ALL	00000096	POL1
119.70705	328.89243	0.54534	0.00	0.00	0.00	PERIOD	ALL	00000096	POL1
171.01007	469.84631	1.15766	0.00	0.00	0.00	PERIOD	ALL	00000096	POL1
342.02014	939.69263	2.35508	0.00	0.00	0.00	PERIOD	ALL	00000096	POL1
87.50000	151.55444	0.12574	0.00	0.00	0.00	PERIOD	ALL	00000096	POL1
175.00000	303.10889	0.51807	0.00	0.00	0.00	PERIOD	ALL	00000096	POL1

D.4 HIGH VALUE RESULTS FOR PLOTTING (PLOTFILE OPTION)

The OU PLOTFILE card for the AERMOD model allows the user the option of creating output files of highest concentration values suitable for importing into graphics software to generate contour plots. The formatted plot files generated by the PLOTFILE include several lines of header information, each identified with an asterisk (*) in column one. The header information includes the model name and version number, the first line of the title information for the run, the list of modeling option keywords applicable to the results, the averaging period and source group included in the file, the high value (e.g. 2ND highest) included for plotting, and the number of receptors included. The header also includes the format used for writing the data records, and column headers for the variables included in the file. The variables provided on each data record include the X and Y coordinates of the receptor location, the concentration value for that location, receptor terrain elevation, hill height scale, flagpole receptor height, averaging period, the source group ID, and either the high value included for short term averages or the number of hours in the period for PERIOD averages. For short term averages, the PLOTFILE also includes the date variable for the end of the averaging period (in the form of YYMMDDHH). The PERIOD average PLOTFILE uses the same format for the data records as the PERIOD average formatted POSTFILE shown in the previous section. The following example from a plot file for high second highest 24-hour averages identifies the contents of the PLOTFILE:

```
* AERMOD (02222): A Simple Example Problem for the AERMOD Model with PRIME
* MODELING OPTIONS USED:
*  CONC                                FLAT

*         PLOT FILE OF  HIGH 2ND  HIGH 24-HR VALUES FOR SOURCE GROUP: ALL
*         FOR A TOTAL OF   144 RECEPTORS.
*         FORMAT: (3(1X,F13.5),3(1X,F8.2),3X,A5,2X,A8,2X,A4,6X,A8)
*        X            Y       AVERAGE CONC    ZELEV    ZHILL    ZFLAG    AVE     GRP       HIVAL    NET ID
*
     30.38843     172.34135      0.20960      0.00     0.00     0.00    24-HR   ALL       2ND      POL1
     60.77686     344.68271      0.53718      0.00     0.00     0.00    24-HR   ALL       2ND      POL1
     86.82409     492.40387      0.92291      0.00     0.00     0.00    24-HR   ALL       2ND      POL1
    173.64818     984.80774      0.95650      0.00     0.00     0.00    24-HR   ALL       2ND      POL1
     59.85352     164.44621      0.19456      0.00     0.00     0.00    24-HR   ALL       2ND      POL1
    119.70705     328.89243      0.53717      0.00     0.00     0.00    24-HR   ALL       2ND      POL1
    171.01007     469.84631      0.92291      0.00     0.00     0.00    24-HR   ALL       2ND      POL1
    342.02014     939.69263      0.95650      0.00     0.00     0.00    24-HR   ALL       2ND      POL1
     87.50000     151.55444      0.19213      0.00     0.00     0.00    24-HR   ALL       2ND      POL1
    175.00000     303.10889      0.53711      0.00     0.00     0.00    24-HR   ALL       2ND      POL1
```

The PLOTFILE output also includes a flag ('**') identifying the receptor with the highest concentration. For short term averages, the flag precedes the date field. For period averages, the flag precedes the field with the number of hours in the period.

D.5 TOXX MODEL INPUT FILES (TOXXFILE OPTION)

The OU TOXXFILE card for the AERMOD model allows the user the option to generate an unformatted file or files of threshold violations for a specific averaging period for use with the TOXX model component of TOXST. The file consists of three header records, including the first line of the title information for the run, the number of source groups, receptors and averaging periods, information on the type of receptor network, and the threshold cutoff value. Following the header records are pairs of records identifying the specific averaging period, source group and receptor location and corresponding concentration value for the values exceeding the user-specified threshold. If any source group exceeds the threshold for a given averaging period and receptor location, then the concentrations for all source groups are output for that period and receptor. The structure of the unformatted file for the AERMOD model TOXXFILE option is described below:

Record #	Description
1	Title (80 characters)
2	IYEAR, NUMGRP, NUMREC, NUMPER, ITAB, NXTOX, NYTOX, IDUM1, IDUM2, IDUM3

3 CUTOFF, RDUM1, ..., RDUM9

where: TITLE = First line of title (80 characters)
IYEAR = Year of simulation
NUMGRP = No. of source groups
NUMREC = Total no. of receptors
NUMPER = No. of averaging periods (e.g., number of hours in the year)
ITAB = 1 for polar grid; 2 for Cartesian grid; 0 for discrete receptors or mixed grids
NXTOX = No. of x-coordinates (or distances) in receptor network
NYTOX = No. of y-coordinates (or directions) in receptor network
IDUM1, IDUM2, IDUM3 = dummy integer variables, arbitrarily set equal to zero
CUTOFF = User-specified threshold for outputting results (g/m^3)
RDUM1, ..., RDUM9 = Dummy real variables (nine) arbitrarily set equal to zero

Following the header records, the file consists of pairs of records including an ID variable identifying the data period, source group number and receptor number, and the corresponding concentration values. The number of values included in each record is controlled by the NPAIR PARAMETER, which is initially set at 100 in MODULE MAIN1. The identification variable is determined as follows:

IDCONC = IPER*100000 + IGRP*1000 + IREC

where: IPER = the hour number for the year corresponding to the concentration value
IGRP = the source group number (the order in which the group was defined on the SO pathway)
IREC = the receptor number (the order in which the receptor was defined on the RE pathway)

D.6 MAXIMUM VALUES BY RANK (RANKFILE OPTION)

The OU RANKFILE card for the AERMOD model allows the user the option of creating output files of the maximum concentration values by rank, suitable for generating Q-Q or quantile plots. The data contained in the RANKFILE output is based on the MAXTABLE arrays, except that only one occurrence per data period is included. The formatted data files

generated by the RANKFILE include several lines of header information, each identified with an asterisk (*) in column one. The header information includes the model name and version number, the first line of the title information for the run, the list of modeling option keywords applicable to the results, the averaging period included in the file, and the number of ranked values included. The header also includes the format used for writing the data records, and column headers for the variables included in the file. The variables provided on each data record include the rank, concentration value, X and Y coordinates of the receptor location, receptor terrain elevation, hill height scale, flagpole receptor height, and the source group ID. Each RANKFILE includes results for all of the source groups for a particular averaging period. Since the RANKFILE only include one occurrence per data period, the file may not include the number of ranked values requested, especially for evaluation data bases of limited duration. The following example identifies the contents of the RANKFILE:

```
* AERMOD (02222): A Simple Example Problem for the AERMOD Model with PRIME
* MODELING OPTIONS USED:
*  CONC                                  FLAT
*          RANK-FILE OF UP TO    40 TOP  3-HR VALUES FOR     1 SOURCE GROUPS
*          INCLUDES OVERALL MAXIMUM VALUES WITH DUPLICATE DATA PERIODS REMOVED
*          FORMAT: (1X,I3,1X,F13.5,1X,I8.8,2(1X,F13.5),3(1X,F7.2),2X,A8)
*RANK AVERAGE CONC   DATE          X              Y          ZELEV   ZHILL   ZFLAG     GRP
*____ ____________ ________ ____________ ____________ ______ ______ ______ ________
   1     335.81046 88030112    433.01270    -250.00000   0.00    0.00    0.00  ALL
   2     329.29599 88030115    469.84631    -171.01007   0.00    0.00    0.00  ALL
   3     111.95577 88030118    433.01270    -250.00000   0.00    0.00    0.00  ALL
   4      71.34813 88030312    433.01270    -250.00000   0.00    0.00    0.00  ALL
   5      45.24860 88030215    342.02014     939.69263   0.00    0.00    0.00  ALL
```

D.7 ARC-MAXIMUM VALUES FOR EVALUATION (EVALFILE OPTION)

The OU EVALFILE card for the AERMOD model allows the user the option of creating output files of the arc-maximum concentration values for individual sources suitable for use in model evaluation studies. The data contained in the EVALFILE output is based on the maximum value along arcs of receptors, identified using the RE EVALCART card.

Receptors may be grouped on arcs based on their distance from the source, or other logical grouping. The formatted EVALFILE output includes five records of information for each selected source and each hour of meteorological data. The information provided is as follows:

Record 1:
- Source ID (eight characters)
- Date variable (YYMMDDHH)
- Arc ID (eight characters)
- Arc maximum χ/Q
- Emission rate for arc maximum (including unit conversions)
- Crosswind integrated concentration based on true centerline concentration
- Normalized non-dimensional crosswind integrated concentration

Record 2:
- Downwind distance corresponding to arc maximum (m)
- Effective wind speed corresponding to arc maximum (m/s)
- Effective σ_v corresponding to arc maximum (m/s)
- Effective σ_w corresponding to arc maximum (m/s)
- σ_y corresponding to arc maximum (m)
- Effective plume height corresponding to arc maximum (m)

Record 3:
- Monin-Obukhov length for current hour (m)
- Mixing height for current hour (m)
- Surface friction velocity for current hour (m/s)
- Convective velocity scale for current hour if unstable (m/s), or σ_z for current hour if stable (m)
- Buoyancy flux for current hour (m^4/s^3)
- Momentum flux for current hour (m^4/s^2)

Record 4:
- Bowen ratio for current hour
- Plume penetration factor for current hour
- Centerline χ/Q for direct plume
- Centerline χ/Q for indirect plume
- Centerline χ/Q for penetrated plume
- Nondimensional downwind distance

Record 5:
- Plume height/mixing height ratio
- Non-dimensional buoyancy flux
- Source release height (m)
- Arc centerline χ/Q
- Developmental option settings place holder (string of 10 zeroes)
- Flow vector for current hour (degrees)
- Effective height for stable plume reflections (m)

The following Fortran WRITE and FORMAT statements are used to write the results to the EVALFILE output:

```
      WRITE(IELUNT(ISRC),9000) SRCID(ISRC), KURDAT, ARCID(I),
     &                         ARCMAX(I), QMAX(I), CWIC, CWICN,
     &                         DXMAX(I), UOUT, SVMAX(I),
     &                         SWMAX(I), SYOUT, HEMAX(I),
     &                         OBULEN, ZI, USTAR, PWSTAR, FB, FM,
     &                         BOWEN, PPF, CHIDML(I), CHINML(I), CHI3ML(I),
     &                         XNDIM, HEOZI, FSTAR, AHS(ISRC), ARCCL(I),
     &                         AFV, HSBLMX(I)

9000  FORMAT(1X,A8,1X,I8,1X,A8,4(1X,G12.6),
     &       /,9X,6(1X,G12.4),/,9X,6(1X,G12.4),
     &       /,9X,6(1X,G12.4),/,9X,4(1X,G12.4),1X,'0000000000',
     &       1X,G12.4,1X,G12.4)
```

D.8 RESULTS BY SEASON AND HOUR-OF-DAY (SEASONHR OPTION)

The SEASONHR option is used to output a file containing the average results by season and hour-of-day. The formatted data files generated by the SEASONHR option include several lines of header information, each identified with an asterisk (*) in column one. The header information includes the model name and version number, the first line of the title information for the run, the list of modeling option keywords applicable to the results, the source group included in the file, and the number of receptors. The header also includes the format used for writing the data records, and column headers for the variables included in the file. The variables provided on each data record include the X and Y coordinates of the receptor location, the average concentration value, receptor terrain elevation, hill height scale, flagpole receptor height, source group ID, number of non-calm and non-missing hours used to calculate the season-by-hour-of-day averages (the NHRS column), season index (the SEAS column with 1 for winter, 2 for spring, 3 for summer, and 4 for fall), and the hour-of-day for the concentration value. A sample from a SEASONHR output file is shown below:

```
* AERMOD (02222): A Simple Example Problem for the AERMOD Model with
PRIME
* MODELING OPTIONS USED:
*  CONC                                  FLAT

*         FILE OF SEASON/HOUR VALUES FOR SOURCE GROUP: ALL
*         FOR A TOTAL OF   144 RECEPTORS.
*         FORMAT:
(2(1X,F13.5),1(1X,F13.8),3(1X,F7.2),2X,A8,2X,3(I4,2X),A8)
*        X              Y      AVERAGE CONC   ZELEV   ZHILL   ZFLAG
GRP     NHRS  SEAS  HOUR   NET ID
* ____________ ____________ ____________ ______ ______ ______
________ ____ ____ ____ ________
      30.38843     172.34135    0.01390196    0.00    0.00    0.00  ALL
       4     2     1  POL1
```

APPENDIX E.

QUICK REFERENCE FOR AERMOD

CO Keywords	Type	Parameters	Section
TITLEONE	M-N	Title1	3.2.1
TITLETWO	O-N	Title2	3.2.1
MODELOPT	M-N	DFAULT CONC FLAT NOSTD NOCHKD NOWARN SCREEN TOXICS SCIM	3.2.2
AVERTIME	M-N	Time1 Time2 Time3 Time4 MONTH PERIOD ANNUAL	3.2.3
URBANOPT	O-N	UrbPop (UrbName) (UrbRoughness)	3.2.4
POLLUTID	M-N	Pollut	3.2.5
HALFLIFE	O-N	Haflif	3.2.6
DCAYCOEF	O-N	Decay	3.2.6
FLAGPOLE	O-N	(Flagdf)	3.2.7
RUNORNOT	M-N	RUN or NOT	3.2.8
EVENTFIL	O-N	(Evfile) (Evopt)	3.2.9
SAVEFILE	O-N	(Savfil) (Dayinc) (Savfl2)	3.2.10
INITFILE	O-N	(Inifil)	3.2.10
MULTYEAR	O-N	H6H Savfil (Inifil)	3.2.11
DEBUGOPT	O-N	MODEL (Dbgfil) and/or METEOR (Dbmfil)	3.2.13
ERRORFIL	O-N	(Errfil)	3.2.14

SO Keywords	Type	Parameters	Section
ELEVUNIT	O-N	METERS or FEET	3.3
LOCATION	M-R	Srcid Srctyp Xs Ys (Zs) (Srctyp = POINT, VOLUME or AREA)	3.3.1
SRCPARAM	M-R	Srcid Ptemis Stkhgt Stktmp Stkvel Stkdia (POINT Source) Vlemis Relhgt Syinit Szinit (VOLUME Source) Aremis Relhgt Xinit (Yinit) (Angle) (Szinit) (AREA Source) Aremis Relhgt Nverts (Szinit) (AREAPOLY source) Aremis Relhgt Radius (Nverts) (Szinit) (AREACIRC source)	3.3.1
BUILDHGT	O-R	Srcid (or Srcrng) Dsbh(i),i=1,Nsec	3.3.3
BUILDWID	O-R	Srcid (or Srcrng) Dsbw(i),i=1,Nsec	3.3.3
XBADJ	O-R	Srcid (or Srcrng) Xbadj(i),i=1,Nsec	3.3.3
YBADJ	O-R	Srcid (or Srcrng) Ybadj(i),i=1,Nsec	3.3.3
AREAVERT	O-R	Srcid Xv(1) Yv(1) Xv(2) Yv(2) ... Xv(i) Yv(i)	3.3.2
URBANSRC	O-R	Srcid's and/or Srcrng's	3.3.4
EMISFACT	O-R	Srcid (or Srcrng) Qflag Qfact(i),i=1,Nqf	3.3.5
EMISUNIT	O-N	Emifac Emilbl Conlbl	3.3.6
HOUREMIS	O-R	Emifil Srcid's Srcrng's	3.3.9
INCLUDED	O-R	Incfil	3.3.10
SRCGROUP	M-R	Grpid Srcid's Srcrng's	3.3.11

Type: M - Mandatory N - Non-repeatable
O - Optional R - Repeatable

RE Keywords	Type	Parameters	Section
ELEVUNIT	O-N	METERS or FEET	3.4
GRIDCART	O-R	Netid STA XYINC Xinit Xnum Xdelta Yinit Ynum Ydelta, or XPNTS Gridx1 Gridx2 Gridx3 ... GridxN, and YPNTS Gridy1 Gridy2 Gridy3 ... GridyN ELEV Row Zelev1 Zelev2 Zelev3 ... ZelevN HILL Row Zhill1 Zhill2 Zhill3 ... ZhillN FLAG Row Zflag1 Zflag2 Zflag3 ... ZflagN END	3.4.1
GRIDPOLR	O-R	Netid STA ORIG Xinit Yinit, or ORIG Srcid DIST Ring1 Ring2 Ring3 ... RingN DDIR Dir1 Dir2 Dir3 ... DirN, or GDIR Dirnum Dirini Dirinc ELEV Rad Zelev1 Zelev2 Zelev3 ... ZelevN HILL Rad Zhill1 Zhill2 Zhill3 ... ZhillN FLAG Rad Zflag1 Zflag2 Zflag3 ... ZflagN END	3.4.1
DISCCART	O-R	Xcoord Ycoord (Zelev Zhill) (Zflag)	3.4.3
EVALCART	O-R	Xcoord Ycoord Zelev Zhill Zflag Arcid (Name)	3.4.3
DISCPOLR	O-R	Srcid Range Direct (Zelev Zhill) (Zflag)	3.4.3
INCLUDED	O-R	Incfil	3.4.4

Note: While all RE keywords are optional, at least one receptor must be defined for each run.

ME Keywords	Type	Parameters	Section
SURFFILE	M-N	Sfcfil (Format)	3.5.1
PROFFILE	M-N	Profil (Format)	3.5.1
SURFDATA	M-N	Stanum Year (Name) (Xcoord Ycoord)	3.5.2
UAIRDATA	M-N	Stanum Year (Name) (Xcoord Ycoord)	3.5.2
SITEDATA	O-N	Stanum Year (Name) (Xcoord Ycoord)	3.5.2
PROFBASE	M-N	BaseElev (Units)	3.5.3
STARTEND	O-N	Strtyr Strtmn Strtdy (Strthr) Endyr Endmn Enddy (Endhr)	3.5.4
DAYRANGE	O-R	Range1 Range2 Range3 ... RangeN	3.5.4
SCIMBYHR	O-N	NRegStart NRegInt NWetStart NWetInt (SfcFilnam PflFilnam	3.5.7
WDROTATE	O-N	Rotang	3.5.5
WINDCATS	O-N	Ws1 Ws2 Ws3 Ws4 Ws5	3.5.6

EV Keywords	Type	Parameters	Section
EVENTPER	M-R	Evname Aveper Grpid Date	3.6.1
EVENTLOC	M-R	Evname XR= Xr YR= Yr (Zelev) (Zflag) or RNG= Rng DIR= Dir (Zelev) (Zflag)	3.6.2

OU Keywords	Type	Parameters	Section
RECTABLE	O-R	Aveper FIRST SECOND ... SIXTH or 1ST 2ND ... 6TH	3.7.1
MAXTABLE	O-R	Aveper Maxnum	3.7.1
DAYTABLE	O-N	Avper1 Avper2 Avper3 Avper4	3.7.1
MAXIFILE	O-R	Aveper Grpid Thresh Filnam (Funit)	3.7.2
PLOTFILE	O-R	Aveper Grpid Hivalu Filnam (Funit) Aveper Grpid Filnam (Funit) (PERIOD or ANNUAL Ave)	3.7.2
POSTFILE	O-R	Aveper Grpid Format Filnam (Funit)	3.7.2
RANKFILE	O-R	Aveper Hinum Filnam (Funit)	3.7.2
EVALFILE	O-R	Srcid Filnam (Funit)	3.7.2
TOXXFILE	O-R	Aveper Cutoff Filnam (Funit)	3.7.2
SEASONHR	O-R	GroupID Filenam (Funit)	3.7.2
EVENTOUT	M-N	SOCONT or DETAIL (Applies for EVENT processing only)	3.7.3

GLOSSARY

AERMAP -- AMS/EPA Regulatory Model (AERMOD) Terrain Preprocessor.

AERMET -- AMS/EPA Regulatory Model (AERMOD) Meteorological Preprocessor.

AERMOD -- AMS/EPA Regulatory Model.

ASCII -- American Standard Code for Information Interchange, a standard set of codes used by computers and communication devices. Sometimes used to refer to files containing only such standard codes, without any application-specific codes such as might be present in a document file from a word processor program.

CD-144 Format -- Card Deck-144 data format available from NCDC for National Weather Service surface observations commonly used for dispersion models. Each record represents an 80-column "card image".

CO -- **CO**ntrol, the 2-character pathway ID for input runstream images used to specify overall job control options.

CO Pathway -- Collective term for the group of input runstream images used to specify the overall job control options, including titles, dispersion options, terrain options, etc.

Directory -- A logical subdivision of a disk used to organize files stored on a disk.

Dispersion Model -- A group of related mathematical algorithms used to estimate (model) the dispersion of pollutants in the atmosphere due to transport by the mean (average) wind and small scale turbulence.

DOS -- Disk Operating System. Software that manages applications software and provides an interface between applications and the system hardware components, such as the disk drive, terminal, and keyboard.

Echo of inputs -- By default, the AERMOD model will echo the input runstream images, character by character, into the main printed output file. This serves as a record of the inputs as originally entered by the user, without any rounding of the numerical values. The echoing can be suppressed with the NO ECHO option.

EOF -- End-of-File.

EPA -- U. S. Environmental Protection Agency.

Error message -- A message written by the model to the error/message file whenever an error is encountered that will inhibit data processing.

Error/Message File -- A file used for storage of messages written by the model.

EV -- **EV**ent, the 2-character pathway ID for input runstream images used to specify event inputs for the Short Term EVENT model.

EV Pathway -- Collective term for the group of input runstream images used to specify the event periods and location for the Short Term EVENT model.

EVENT Processing -- An option in the AERMOD model specifically designed to provide source contribution (culpability) information for specific events of interest, e.g., design values or threshold violations.

Extended Memory -- Additional memory on 80386 and 80486 PCs that allows programs to address memory beyond the 640 KB limit of DOS. Special software is required to utilize this extra memory.

Fatal Error -- Any error which inhibits further processing of data by the model. Model continues to read input images to check for errors during setup, and will continue to read input meteorological data during calculation phase.

Flow Vector -- The direction towards which the wind is blowing.

GMT -- Greenwich Mean Time, the time at the 0° meridian.

Informational Message -- Any message written to the error/message file that may be of interest to the user, but which have no direct bearing on the validity of the results, and do not affect processing.

Input Image -- User supplied input, read through the default input device, controlling the model options and data input. A single card or record from the input runstream file. Each input image consists of a pathway ID (may be blank indicating a continuation of the previous pathway), a keyword (may also be blank for continuation of a keyword), and possibly one or more parameter fields.

Input Runstream File -- The basic input file to the AERMOD model controlling the modeling options, source data, receptor locations, meteorological data file specifications, and output options. Consists of a series of input images grouped into functional pathways.

Julian Day -- The number of the day in the year, i.e., Julian Day = 1 for January 1 and 365 (or 366 for leap years) for December 31.

KB -- Kilobyte, 1000 bytes, a unit of storage on a disk

Keyword -- The 8-character codes that follow immediately after the pathway ID in the input run stream data.

LST -- Local Standard Time.

Math Co-processor -- A computer chip used to speed up floating point arithmetic in a personal computer.

MB -- Megabyte, one million bytes, a unit of storage on a disk

ME -- **ME**teorology, the 2-character pathway ID for input runstream images used to specify meteorological data options

ME Pathway -- Collective term for the group of input runstream images used to specify the input meteorological data file and other meteorological variables, including the period to process from the meteorological file for the AERMOD model.

Meteorological Data File -- Any file containing meteorological data, whether it be mixing heights, surface observations or on-site data.

Missing Value -- Alphanumeric character(s) that represent breaks in the temporal or spatial record of an atmospheric variable.

Mixing Height -- The depth through which atmospheric pollutants are typically mixed by dispersive processes.

NCDC -- National Climatic Data Center, the federal agency responsible for distribution of the National Weather Service upper air, mixing height and surface observation data.

NO ECHO -- Option to suppress echoing of the runstream input images to the main printed output file.

NWS -- National Weather Service.

On-site Data -- Data collected from a meteorological measurement program operated in the vicinity of the site to be modeled in the dispersion analysis.

OU -- **OU**tput, the 2-character pathway ID for input runstream images used to specify output options.

OU Pathway -- Collective term for the group of input runstream images used to specify the output options for a particular run.

Overlay -- One or more subprograms that reside on disk and are loaded into memory only when needed.

Pasquill Stability Categories -- A classification of the dispersive capacity of the atmosphere, originally defined using surface wind speed, solar insolation (daytime) and cloudiness

(nighttime). They have since been reinterpreted using various other meteorological variables.

Pathway -- One of the six major functional divisions in the input runstream file for the AERMOD model. These are **CO**ntrol, **SO**urce, **RE**ceptor, **ME**teorology, **EV**ent, and **OU**tput (see these entries in this section for a description).

PC -- Personal Computer, a wide ranging class of computers designed for personal use, typically small enough to fit on a desktop.

Quality Assessment -- Judgment of the quality of the data.

Quality Assessment Check -- Determining if the reported value of a variable is reasonable (see also Range Check).

Quality Assessment Message -- Message written to the error/message file when a data value is determined to be suspect.

Quality Assessment Violation -- Occurrences when data values are determined to be suspect (see also Range Check Violation).

RAM -- Random Access Memory on a personal computer.

RAMMET -- Meteorological processor program used for regulatory applications capable of processing twice-daily mixing heights (TD-9689 format) and hourly surface weather observations (CD-144 format) for use in dispersion models such as AERMOD, CRSTER, MPTER and RAM.

Range Check -- Determining if a variable falls within predefined upper and lower bounds.

Range Check Violation -- Determination that the value of a variable is outside range defined by upper and lower bound values (see also Quality Assessment Violation).

RE -- **RE**ceptor, the 2-character pathway ID for input runstream images used to specify receptor locations.

RE Pathway -- Collective term for the group of input runstream images used to specify the receptor locations for a particular run.

Regulatory Applications -- Dispersion modeling involving regulatory decision-making as described in the Guideline on Air Quality Models, which is published as Appendix W of 40 CFR Part 51 (as revised).

Regulatory Model -- A dispersion model that has been approved for use by the regulatory offices of the EPA, specifically one that is included in Appendix A of the Guideline on Air Quality Models, (as revised), such as the AERMOD model.

Runstream File -- Collectively, all input images required to process input options and input data for the AERMOD model.

SCRAM -- Support Center for Regulatory Air Models - part of EPA's website on the internet, used by EPA for disseminating air quality dispersion models, modeling guidance, and related information.

Secondary Keyword -- A descriptive alphabetical keyword used as a parameter for one of the main runstream keywords to specify a particular option.

SO -- **SO**urce, the 2-character pathway ID for input runstream images used to specify input source parameters and source groups.

SO Pathway -- Collective term for the group of input runstream images used to specify the source input parameters and source group information.

Station Identification -- An integer or character string used to uniquely identify a station or site as provided in the upper air (TD-5600 and TD-6201), mixing height (TD-9689), and surface weather (CD-144 and TD-3280) data formats available from NCDC. There are no standard station numbers for on-site data or card image/screening data, and the user may include any integer string

Subdirectory -- A directory below the root, or highest level, directory or another subdirectory, used for organization of files on a storage medium such as a PC hard disk.

Surface Weather Observations -- A collection of atmospheric data on the state of the atmosphere as observed from the earth's surface. In the U.S. the National Weather Service collect these data on a regular basis at selected locations.

Surface Roughness Length -- Height at which the wind speed extrapolated from a near-surface wind speed profile becomes zero.

Syntax -- The order, structure and arrangement of the inputs that make of the input runstream file, specifically, the rules governing the placement of the various input elements including pathway IDs, keywords, and parameters.

TD-1440 Format -- A format available from NCDC for summarizing NWS surface observations in an 80-column format; the CD-144 format is a subset of this format. This format has been superseded by the TD-3280 format.

TD-3280 Format -- The current format available from NCDC for summarizing NWS surface weather observations in an elemental structure, i.e., observations of a single atmospheric variable are grouped together for a designated period of time.

TD-5600 Format -- A format available from NCDC for reporting NWS upper air sounding data. This format has been superseded by the TD-6201 format.

TD-6201 Format -- The current format available from NCDC for reporting NWS upper air data. The file structure is essentially the same as the TD-5600 format except that there is more quality assurance information.

TD-9689 Format -- The format available from NCDC for mixing heights estimated from morning upper air temperature and pressure data and hourly surface observations of temperature.

Unformatted File -- A file written without the use of a FORTRAN FORMAT statement, sometimes referred to as a binary file.

Upper Air Data (or soundings) -- Meteorological data obtained from balloon- borne instrumentation that provides information on pressure, temperature, humidity, and wind away from the surface of the earth.

Vertical Potential Temperature Gradient -- The change of potential temperature with height, used in modeling the plume rise through a stable layer, and indicates the strength of the stable temperature inversion. A positive value means that potential temperature increases with height above ground and indicates a stable atmosphere.

Warning Message -- A message written by the model to the error/message file whenever a problem arises that may reflect an erroneous condition, but does not inhibit further processing.

INDEX

Area sources
- emission rate parameter 3-21, 3-25, 3-27
- input parameters 3-20, B-8
- specification of location 3-16
- specification of source type 3-16

AREACIRC source type
- specifying source parameters 3-26

AREAPOLY source type
- specification of source parameters 3-25

AREAVERT keyword
- specification of vertices for AREAPOLY sources 3-25

Averaging periods
- specifying options for 3-5

Building downwash
- BUILDHGT keyword B-8
- BUILDLEN keyword 3-30
- BUILDWID keyword 3-27, 3-29, B-8
- example of building inputs 2-15
- LOWBOUND keyword B-9
- modeling options 1-6, 2-1, 3-15
- specification of building dimensions 2-17, 3-18, 3-27
- XBADJ keyword 3-31
- YBADJ keyword 3-31

Calm and missing data flags 3-4

Calms processing 3-3

Cartesian grid receptors 3-42
- specifying a receptor network 3-42
- specifying discrete receptors 3-49, 3-51

CO pathway 2-2
- brief tutorial 2-11
- example of inputs for 2-14
- keyword reference 3-2, B-3
- modeling options 2-6, 2-11

Command line for running AERMOD 2-31, 3-88

Concentration
- adjusting emission rate units for 3-36, B-9
- specifying calculation of 3-3, B-4

Concentration file
- description of files generated by AERMOD D-3
- POSTFILE option for generating 3-70

Daily table option 3-67
Data period
specifying period to process for AERMOD 3-56
Debugging output option 3-14
Decay coefficient
DCAYCOEF keyword 3-7, A-2, B-3, B-5
DECAY parameter 3-8
relationship to half life 3-8
specifying 3-7
Default option 2-6, 3-3
Discrete receptors 3-49
for use with EVALFILE output option 3-51
with Cartesian coordinates 3-49, 3-51
with polar coordinates 3-50
Dry deposition
specifying input parameters for 3-37

Echoing of the runstream file
suppressing with NO ECHO 2-33
Elevated terrain
example of inputs for Cartesian grid 3-44
example of inputs for polar network 3-47
modeling options 1-6
specifying receptor elevations and hill height scales 3-43, 3-46, 3-49, 3-50, 3-52, B-11-13
specifying units with RE ELEVUNIT 3-41
Error handling capabilities 2-26
detailed message descriptions C-5
example message summary table 2-29
message summary table C-2
message types 2-26
syntax of messages C-3
Error message 2-26, C-3
example of syntax 2-27
Error/message file 3-82
EV pathway
keyword reference 3-61
keyword reference B-17
Evaluation file output
EVALFILE output keyword 3-76
use of EVALCART receptor keyword 3-51
EVENT model (ISCEV2)
specifying event inputs 3-61
user defined events 3-64
EVENT processing

using events defined by AERMOD 3-62
Extended memory GLOSSARY-2

Flagpole receptor heights
default receptor height, FLAGDF 3-8, B-5
example of inputs for Cartesian grid 3-44
example of inputs for polar network 3-47
FLAGDF parameter 3-8
FLAGPOLE keyword 3-8, B-3, B-5
modeling options 1-6, 2-14, 3-8
specifying flagpole receptors 3-43, 3-46, 3-49, 3-51, 3-52, B-11-13
Flat terrain
specifying non-default option 3-3

Half life
HAFLIF parameter 3-8
HALFLIFE keyword 3-8, B-5
relationship to decay coefficient 3-8
High value output options 3-65

INCLUDED keyword
including receptor data from an external file 3-52
including source data from an external file 3-39, 3-64
Initial lateral dimension
for volume sources 3-20
Initial vertical dimension
for volume sources 3-20
Input meteorological data files 3-80
Input runstream file 2-2
definition GLOSSARY-2

Julian day
definition GLOSSARY-2
selecting specific days for processing 3-58

Keyword
definition GLOSSARY-2
detailed reference 3-1, B-1
Keyword/parameter approach
advantages explained 2-5
description of 2-1

Line sources, modeled as volumes 3-20
Locations
specifying receptor location inputs 3-41

specifying source location inputs 3-16

Maximum value output options 3-66
ME pathway 2-2
brief tutorial 2-20
example of inputs for 2-21
keyword reference 3-53, B-14
Message summary table
example for sample problem 2-29
example showing error condition 2-30
Meteorological data file descriptions D-1
Meteorological input data 1-7
Missing data processing 3-3

OU pathway 2-2
brief tutorial 2-22
example of inputs for 2-23
keyword reference 3-65, B-19
Output file
organization of main print file 2-32
Output options 3-65
overview 1-7
Output options for EVENT processing 3-79

Pathways
input runstream pathways explained 2-2
order of 2-2
Plotting files 3-72, 3-85, D-5, D-7, D-8
Point sources
and building downwash 3-27
input parameters 3-17, B-8
specification of location 3-16
specification of source type 3-16
Polar receptors 3-45
specifying a receptor network 3-45
specifying discrete receptors 3-45, 3-50
Postprocessing files 3-70, 3-84, D-3
estimating the size 3-72
Potential temperature profile
specifying base elevation for 2-22, 3-56
Precipitation scavenging
specifying input parameters 3-37
Printed output file 3-82

RE pathway 2-2

brief tutorial 2-19
example of inputs for 2-19
keyword reference 3-41, B-10
Re-start capability 3-10
file descriptions 3-81, 3-83
INITFILE keyword 3-10
SAVEFILE keyword 3-10
Receptor networks
Cartesian grid 3-42
defining receptor grids 3-42
example of defining polar 2-19
modifying inputs for 2-39
polar 3-45
using multiple 3-48
Receptor options 1-6
Regulatory default option 2-6
specifying on the MODELOPT card 3-3
Repeat value
using repeat values for numeric input 3-29
Runstream file 1-2, 2-1
debugging a 2-26
definition GLOSSARY-5
description of 3-80
example file for sample problem 2-25
Fortran unit number 3-80
functional keyword reference B-1
generated for EVENT model 3-10
modifying existing 2-38
numeric inputs 2-17
records or input images 2-3
rules for structuring 2-2
setting up an example 2-9
structure 2-2
using the RUNORNOT option with complex 2-13

SCREEN option for AERMOD 3-4
Secondary keywords
use of for certain input parameters 2-1, 2-7
Settling and removal
specifying input parameters for 3-37
SO pathway 2-2
brief tutorial 2-15
example of inputs for 2-15
keyword reference 3-15, B-7
Source contribution analyses 1-8

Source groups 3-39
specifying a group of ALL sources 3-40
SRCGROUP keyword 3-39, A-5, B-7
Source IDs
specifying alphanumeric 3-17
Source ranges
specifying and interpreting 3-28
Sources 3-15
specifying source location inputs 3-16
specifying source parameter inputs 3-15, 3-17
Stack parameters
see Point sources 3-17
Stack-tip downwash
and the regulatory default option 2-6
NOSTD parameter 3-3
specifying not to use on MODELOPT card 3-3, B-4
Storage limits 2-7

Terrain 1-6, 2-6
specifying non-default FLAT terrain option 3-3
Threshold violation files 3-69, 3-73, 3-83, 3-86, D-3, D-6

Units
input units for numeric data 2-4
Upper case vs lower case inputs 2-4
Urban modeling option 3-6
specifying sources for 3-32

Variable emission rates 3-33, A-2, B-7
EMISFACT keyword 3-33, B-7
Volume sources 3-20
input parameters 3-19, B-8
specification of location 3-16
specification of source type 3-16

Warning message 2-26, C-3
example of syntax 2-27
Wet deposition
specifying input parameters 3-37