

ADDENDUM

**USER'S GUIDE FOR THE
AERMOD METEOROLOGICAL PREPROCESSOR
(AERMET)
(EPA-454/B-03-002, November 2004)**

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1.0 INTRODUCTION

This document provides user instructions for revisions to the AERMOD meteorological preprocessor program, AERMET. These revisions were first introduced with version 06341 of AERMET. The discussion provided here supplements the information contained in the current AERMET User's Guide (EPA, 2004), and it is assumed that the reader is already familiar with the contents of that document.

1.1 OVERVIEW OF AERMET REVISIONS

AERMET is designed to be run as a three-stage process (see Figure 1-1 of the AERMET User's Guide) and to operate on three types of data -- National Weather Service (NWS) hourly surface observations, NWS twice-daily upper air soundings, and data collected from an on-site measurement program such as from an instrumented tower. The first stage extracts (retrieves) data from the raw data files and assesses data quality. The second stage combines (merges) the available data from the three types of data for 24-hour periods and writes these data to an intermediate file. The third and final stage reads the merged data file and develops the necessary boundary layer parameters for dispersion calculations by AERMOD.

The AERMET program has been revised to use a single executable file, AERMET.EXE, to perform all three stages of processing, replacing the STAGE1N2.EXE and STAGE3.EXE executable files used in previous versions of AERMET. The AERMET program is designed to read a hardcoded input filename of 'AERMET.INP' for all three stages, and the program is run by entering 'AERMET' at a 'DOS' command prompt, or by double-clicking the AERMET.EXE file from a folder view. Note that this change only affects the number of executables; AERMET, as currently configured, can still only handle one stage of processing at a time.

The AERMET.INP file is a text file containing the instructions for processing (a.k.a., the command input file); this file must be located in the same directory as the AERMET executable. As currently configured, AERMET can only handle one processing stage at a time. Therefore, in a typical application the command line would be entered three times, once for stage 1 processing (extraction and QA), a second time for stage 2 processing (merge), and a third time for stage 3 processing (met preparation). Prior to running AERMET one should review the instructions in the command input file and, as necessary, replace them with instructions appropriate to the particular application and stage of processing. A batch file to facilitate the procedure of running AERMET for the three processing stages follows:

```
@          ECHO OFF
rem          RUNAERMET  filename

rem          This is a DOS utility program for use in running the meteorological
rem          preprocessor, AERMET.  The program is run from the DOS prompt using
rem          the following syntax:

rem          where:  RUNAERMET is entered 'as is' and
rem                  filename is the name of the input file

:START
    IF '%1' == '' GOTO END
    IF EXIST %1 GOTO COPY
    ECHO Error locating input file
    GOTO STOP

:COPY
    COPY %1  AERMET.INP
    ECHO Proceed with processing
    PAUSE
    AERMET
    GOTO STOP

:END

ECHO ..
ECHO ..
ECHO ..  AERMET is run from the DOS prompt using the following syntax
ECHO ..
ECHO ..          RUNAERMET  filename
ECHO ..
ECHO ..  where:  RUNAERMET is entered 'as is'
ECHO ..          filename is the name of the input file
ECHO ..
ECHO ..
ECHO ..          PAUSE

:STOP
```

The revised AERMET program includes modifications to address several problems associated with extraction and processing of National Weather Service airport data in the Integrated Surface Hourly Data (a.k.a., ISHD, ISH, ISD, TD-3505) format, including:

- corrections to the procedure for selecting which record to process for hours with multiple records;
- corrections to code for processing of sky cover fields;
- addition of code for identifying "variable" winds with valid wind speed but missing wind direction (formerly flagged as calms);
- code for initializing the "additional" character variable to avoid data fields from previous hours being used; and
- code for handling mixed-format ISHD data files with full and condensed archival formats.

Additional details regarding these and other revisions to the AERMET code are presented in the AERMET Model Change Bulletin #1, through comments embedded in the Fortran source code, and through an annotated list of changes which accompanies the source code.

2.0 USER INSTRUCTIONS

This section documents revisions to the user instructions for the AERMET program.

2.1 STATION ELEVATIONS

The AERMET code for processing the 'LOCATION' input image for each of the data pathways, UPPERAIR, SURFACE, and ONSITE, has been revised to allow users the option to specify the station elevation above mean sea-level (MSL) in the last field on the input image. Inclusion of this optional input addresses potential problems related to the estimation of surface pressure from sea-level pressure in cases where the former is missing when processing surface data in the Integrated Surface Hourly Data (ISHD) or TD-3505 format. The optional station elevation input is currently only used by AERMET for processing ISHD data on the SURFACE pathway. Elevation values input for other surface meteorological data formats, or for the UPPERAIR, ONSITE and METPREP pathways, are currently ignored.

A default station elevation of 100 meters MSL is assumed if the optional elevation field is omitted from the LOCATION card. However, AERMET will read the station elevation from the input data for ISHD surface data, if the data records include the elevation field. The modified tables from Appendix A of the current AERMET User's Guide (EPA, 2004) are provided below.

2.2 REVISIONS TO QUALITY ASSURANCE (QA) DEFAULTS

Some of the QA defaults presented in the current AERMET User's Guide (EPA, 2004) have been revised to maintain consistency with the current AERMET code, including upper and lower bounds and missing indicators. These revisions are reflected in modified tables from Appendix B of the AERMET User's Guide provided below.

2.3 REVISED SURFACE FILE FORMAT TO SUPPORT AERMOD DEPOSITION ALGORITHMS

The revised AERMET program includes additional meteorological parameters in the surface file that are needed to support the deposition algorithms in AERMOD. The additional variables include the precipitation code, precipitation rate, relative humidity, surface pressure, and cloud cover. These additional variables are automatically included after the standard variables for each hour, and do not require any additional user input. The precipitation data needed for wet deposition calculations in AERMOD can be obtained from the SAMSON, HUSWO or ISHD (TD-3505) formats currently supported by AERMET (EPA, 2004). A description of the revised surface file format is provided below, based on a revision to page C-11 of the current AERMET User's Guide:

The AERMET Surface File

Header record:

```
READ( ) latitude, longitude, UA identifier, SF identifier, OS identifier, Version date
```

```
FORMAT (2(2X,A8), 8X,' UA_ID: ',A8,' SF_ID: ',A8,' OS_ID: ',A8, T85,'VERSION:', A6 )
```

where	<i>latitude</i>	=	latitude specified in Stage 3
	<i>longitude</i>	=	longitude specified in Stage 3
	<i>UA identifier</i>	=	station identifier for upper air data; usually the WBAN number used to extract the data from an archive data set
	<i>SF identifier</i>	=	station identifier for hourly surface observations; usually the WBAN number used in extracting the data
	<i>OS identifier</i>	=	site-specific identifier
	<i>Version date</i>	=	AERMET version date; this date also appears in the banner on each page of the summary reports

Note that the ' ??_ID: ' fields in the FORMAT statement above include two spaces before the 2-character pathway ID and one space after the colon.

Data records:

READ() *year, month, day, j_day, hour, H, u* , w* , VPTG, Zic, Zim, L, z_o , B_o , r, W_s , W_d , z_{ref} , temp, z_{temp}, ipcode, pamt, rh, pres, ccvr*

FORMAT (3(I2,1X), I3,1X, I2,1X, F6.1,1X, 3(F6.3,1X), 2(F5.0,1X), F8.1,1X, F6.3,1X, 2(F6.2,1X), F7.2,1X, F5.0, 3(1X,F6.1), 1X,I5, 1X,F6.2, 2(1X, F6.0), 1X, I5)

where

<i>j_day</i>	=	Julian day
<i>H</i>	=	sensible heat flux (W/m ²)
<i>u*</i>	=	surface friction velocity (m/s)
<i>w*</i>	=	convective velocity scale (m/s)
<i>VPTG</i>	=	vertical potential temperature gradient above <i>Zic</i> (K/m)
<i>Zic</i>	=	height of convectively-generated boundary layer (m)
<i>Zim</i>	=	height of mechanically-generated boundary layer (m)
<i>L</i>	=	Monin-Obukhov length (m)
<i>z_o</i>	=	surface roughness length (m)
<i>B_o</i>	=	Bowen ratio
<i>r</i>	=	Albedo
<i>W_s</i>	=	reference wind speed (m/s)
<i>W_d</i>	=	reference wind direction (degrees)
<i>z_{ref}</i>	=	reference height for wind (m)
<i>temp</i>	=	reference temperature (K)
<i>z_{temp}</i>	=	reference height for temperature (m)
<i>ipcode</i>	=	precipitation code
<i>pamt</i>	=	precipitation amount (mm/hr)
<i>rh</i>	=	relative humidity (percent)
<i>pres</i>	=	station pressure (mb)
<i>ccvr</i>	=	cloud cover (tenths)

TABLE A-4

DESCRIPTION OF KEYWORD PARAMETERS FOR THE UPPERAIR PATHWAY

Keyword	Parameter(s)	
AUDIT	uaname1 ... uanameN	
where:	uaname1 ... uanameN	Name(s) of variables that are to be tracked and reported during quality assessment (as defined in Table B-1 of Appendix B).
DATA	archive_filename file_format [blocking_factor] [type]	
where:	archive_filename file_format [blocking_factor] [type]	<p>The name of the file (or tape) containing the archive of upper air data</p> <p>Archive file format; valid parameters are:</p> <p style="padding-left: 40px;">6201FB (TD-6201 fixed-length blocks) or 6201VB (TD-6201 variable-length blocks) or FSL for data retrieved from National Climatic Data Center (NCDC) web site. Also available on the 'Radiosonde Data of North America' CD-ROM.</p> <p>Number of logical records in one physical record; default value is 1</p> <p>Collating sequence; valid parameters are: ASCII (default) or EBCDIC</p> <p>This parameter is needed only if AERMET is running on a computer that utilizes the EBCDIC collating sequence, such as IBM mainframe computers</p>
EXTRACT	extracted_data_filename	
where:	extracted_data_filename	Name of the output file for data extracted from an archive data file and the name of the input file for upper air data QA

TABLE A-4, continued

DESCRIPTION OF KEYWORD PARAMETERS FOR THE UPPERAIR PATHWAY

LOCATION	site_id lat(long) long(lat) [tadjust] [elevation]	
where:	site_id	Site identifier for which data are to be processed.
	lat(long)	Station latitude (or longitude) in decimal degrees with the suffix N for sites north of the equator, S for sites south of the equator (or W for sites west of Greenwich, E for sites east of Greenwich).
	long(lat)	Station longitude (or latitude) in decimal degrees with the suffix W for sites west of Greenwich, E for sites east of Greenwich (or N for sites north of the equator, S for sites south of the equator).
	[tadjust]	An integer used to convert the time reported in the database to local Standard time. For standard upper-air data reported in Greenwich Mean Time (GMT), the value is the same as the time zone for the station (e.g., a value of 5 for the Eastern time zone).
	[elevation]	Station elevation (m above sea-level); default of 100m if omitted. <u>Note:</u> The optional station elevation on the UPPERAIR pathway is currently not used by AERMET.

TABLE A-6

DESCRIPTION OF KEYWORD PARAMETERS FOR THE SURFACE PATHWAY

Keyword	Parameter(s)	
AUDIT	sfname1 ... sfnameN	
where:	sfname1 sfnameN	Name(s) of variables that are to be tracked and reported during quality assessment (as defined in Table B-2 of Appendix B).
DATA	archive_filename file_format [blocking_factor] [type]	
where:	archive_filename	The name of the file (or tape) containing the archive of hourly surface observations
	file_format	Archive file format; valid parameters are: CD144 or SCRAM or SAMSON (data retrieved from SAMSON CD-ROM) or 3280VB and 3280FB or HUSWO (data retrieved from HUSWO CD-ROM) or ISHD (data archived in TD-3505 format)
	[blocking_factor]	Number of logical records per physical record; default value is 1
	[type]	Collating sequence; valid parameters are: ASCII (default) or EBCDIC ; This parameter is needed only if AERMET is running on a computer that utilizes the EBCDIC collating sequence, such as an IBM mainframe computer
EXTRACT	extracted_data_filename	
where:	extracted_data_ filename	Name of the output file for data extracted from an archive data file

TABLE A-6, continued

DESCRIPTION OF KEYWORD PARAMETERS FOR THE SURFACE PATHWAY

LOCATION	site_id lat(long) long(lat) [tadjust] [elevation]	
where:	site_id	Site identifier for which data are to be processed.
	lat(long)	Station latitude (or longitude) in decimal degrees with the suffix N for sites north of the equator, S for sites south of the equator (or W for sites west of Greenwich, E for sites east of Greenwich).
	long(lat)	Station longitude (or latitude) in decimal degrees with the suffix W for sites west of Greenwich, E for sites east of Greenwich (or N for sites north of the equator, S for sites south of the equator).
	[tadjust]	An integer used to convert the time reported in the database to local Standard time. For most surface databases, the value is 0. For TD-3505 (ISHD) data, which is reported in GMT, the value is the same as the time zone for the station (e.g., a value of 5 for the Eastern time zone).
	[elevation]	Station elevation (m above sea-level); default of 100m if omitted. <u>Note:</u> The optional station elevation on the SURFACE pathway is currently used by AERMET only with ISHD surface data.

TABLE A-8 continued

DESCRIPTION OF KEYWORD PARAMETERS FOR THE ONSITE PATHWAY

LOCATION	site_id lat(long) long(lat) [tadjust] [elevation]	
where:	site_id	Site identifier for which data are to be processed.
	lat(long)	Station latitude (or longitude) in decimal degrees with the suffix N for sites north of the equator, S for sites south of the equator (or W for sites west of Greenwich, E for sites east of Greenwich).
	long(lat)	Station longitude (or latitude) in decimal degrees with the suffix W for sites west of Greenwich, E for sites east of Greenwich (or N for sites north of the equator, S for sites south of the equator).
	[tadjust]	An integer used to convert the time reported in the database to local Standard time. For most onsite databases, the value is 0.
	[elevation]	Station elevation (m above sea-level); default of 100m if omitted. <u>Note:</u> The optional station elevation on the ONSITE pathway is currently not used by AERMET.

TABLE A-12 continued

DESCRIPTION OF KEYWORD PARAMETERS FOR THE METPREP PATHWAY

LOCATION	site_id lat(long) long(lat) [tadjust] [elevation]	
where:	site_id	Site identifier for which data are to be processed.
	lat(long)	Station latitude (or longitude) in decimal degrees with the suffix N for sites north of the equator, S for sites south of the equator (or W for sites west of Greenwich, E for sites east of Greenwich).
	long(lat)	Station longitude (or latitude) in decimal degrees with the suffix W for sites west of Greenwich, E for sites east of Greenwich (or N for sites north of the equator, S for sites south of the equator).
	[tadjust]	The time zone for the application location (a positive value in the Western Hemisphere).
	[elevation]	Station elevation (m above sea-level); default of 100m if omitted. <u>Note:</u> The optional station elevation on the METPREP pathway is currently not used by AERMET.

TABLE B-2

VARIABLE AND QA DEFAULTS FOR THE SURFACE VARIABLES

Variable Name	Description	Units	Type	Missing Indicator	Lower Bound	Upper Bound
PRCP	Precipitation amount	millimeters*1000	<=	-9	0	25400
SLVP [†]	Sea level pressure	millibars*10	<	99999	9000	10999
PRES	Station pressure	millibars*10	<	99999	9000	10999
CLHT	Ceiling height	kilometers*10	<=	999	0	300
TSKC	Total//opaque sky cover	tenths//tenths	<=	9999	0	1010
ALC1 ^a	Sky cond//height, level 1	code//hundredths ft	<=	09999	0	07300
ALC2 ^a	Sky cond//height, level 2	code//hundredths ft	<=	09999	0	07300
ALC3 ^a	Sky cond//height, level 3	code//hundredths ft	<=	09999	0	07300
ALC4 ^b	Sky cond//height, level 4	code//hundredths ft	<=	09999	0	07850
ALC5 ^b	Sky cond//height, level 5	code//hundredths ft	<=	09999	0	07850
ALC6 ^b	Sky cond//height, level 6	code//hundredths ft	<=	09999	0	07850
PWVC	Present weather (vicinity)		<=	9999	0	9800
PWTH	Precipitation type		<=	9999	0	9800
ASKY ^c	ASOS Sky condition	tenths	<=	99	0	10
ACHT ^d	ASOS Ceiling	kilometers*10	<=	999	0	888
HZVS	Horizontal visibility	kilometers*10	<=	99999	0	1640
TMPD [*]	Dry bulb temperature	°C*10	<	999	-300	360
TMPW	Wet bulb temperature	°C*10	<	999	-650	350
DPTP	Dew-point temperature	°C*10	<	999	-650	350
RHUM	Relative humidity	whole percent	<=	999	0	100
WDIR [*]	Wind direction	tens of degrees	<=	999	0	36
WSPD [*]	Wind speed	meters/second*10	<=	999	0	500

* Automatically included in audit report.

† A value < 800 in CD144 files is converted to SLVP/10.0 + 1000.0

// The two variables have been combined to form one variable; the missing value flags, as well as the upper and lower bounds have also been concatenated.

^a ASOS sky condition (code table) and height (hundredths of feet) for levels 1-3

^b ASOS sky condition (code table) and height (hundredths of feet) for levels 4-6 (for augmented sites)

^c ASOS sky condition (tenths), derived from layer data.

^d ASOS ceiling (kilometers *10), derived from layer data.

TABLE B-3a

VARIABLE AND QA DEFAULTS FOR THE SITE-SPECIFIC SINGLE-VALUE
AND DATE/TIME VARIABLES

Variable name	Description	Units	Type	Missing Indicator	Lower Bound	Upper Bound
HFLX	Surface heat flux	watts/square meter	<	-999	-100	800
USTR	Surface friction velocity	meters/second	<	-9	0	2
MHGT	Mixing height	meters	<	9999	0	4000
ZOHT	Surface roughness length	meters	<	999	0	2
SAMT	Snow amount	centimeters	<=	999	0	250
PAMT	Precipitation amount	centimeters	<=	999	0	100
INSO	Insolation	watts/square meter	<	9999	0	1250
NRAD	Net radiation	watts/square meter	<	999	-100	800
DT01	Temperature diff.(U - L) ¹	°C	<	9	-2	5
DT02	Temperature diff.(U - L) ¹	°C	<	9	-2	5
DT03	Temperature diff.(U - L) ¹	°C	<	9	-2	5
US01	User's scalar #1	user's units	<	999	0	100
US02	User's scalar #2	user's units	<	999	0	100
US03	User's scalar #3	user's units	<	999	0	100
PRCP	Precipitation	mm	<=	-9	0	25400
SLVP*	Sea level pressure	millibars*10	<	99999	9000	10999
PRES*	Station pressure	millibars*10	<	99999	9000	10999
CLHT*	Ceiling height	kilometers*10	<=	999	0	300
TSKC*	Sky cover (total/opaque)	tenths	<=	9999	0	1010
OSDY	Day		<=	-9	1	31
OSMO	Month		<=	-9	1	12
OSYR	Year		<=	-9	0	99
OSHR	Hour		<=	-9	0	24
OSMN	Minutes		<=	-9	0	60

¹(U - L) indicates (upper level) - (lower level).

*Automatically included in audit report.

TABLE B-3b

VARIABLE AND QA DEFAULTS FOR THE SITE-SPECIFIC MULTI-LEVEL VARIABLES

Variable name	Description	Units	Type	Missing Indicator	Lower Bound	Upper Bound
HTnn	Height	meters	<	9999	0	4000
SAnn	Std. dev. horizontal wind	degrees	<	99	0	35
SEnn	Std. dev. vertical wind	degrees	<	99	0	25
SVnn	Std. dev. v-comp. of wind	meters/second	<	99	0	3
SWnn	Std. dev. w-comp. of wind	meters/second	<	99	0	3
SUnn	Std. dev. u-comp. of wind	meters/second	<	99	0	3
TTnn*	Temperature	°C	<	99	-30	35
WDnn*	Wind direction	degrees from north	<=	999	0	360
WSnn*	Wind speed	meters/second	<	99	0	50
VVnn	Vertical wind component	meters/second	<	999	0	5
DPnn	Dew-point temperature	°C	<	99	-65	35
RHnn	Relative humidity	whole percent	<=	999	0	100
V1nn	User's vector #1	user's units	<	999	0	100
V2nn	User's vector #2	user's units	<	999	0	100
V3nn	User's vector #3	user's units	<	999	0	100

'nn' in variables HT to V3 refers to the level at which the observation was taken; e.g., TT01 is the temperature at the first level and WS02 is wind speed at the second level.

*Automatically included in audit report.

3.0 REFERENCES

Environmental Protection Agency, 2004: User's Guide for the AERMOD Meteorological Preprocessor (AERMET). EPA-454/B-03-002. U.S. Environmental Protection Agency, Research Triangle Park, North Carolina 27711.