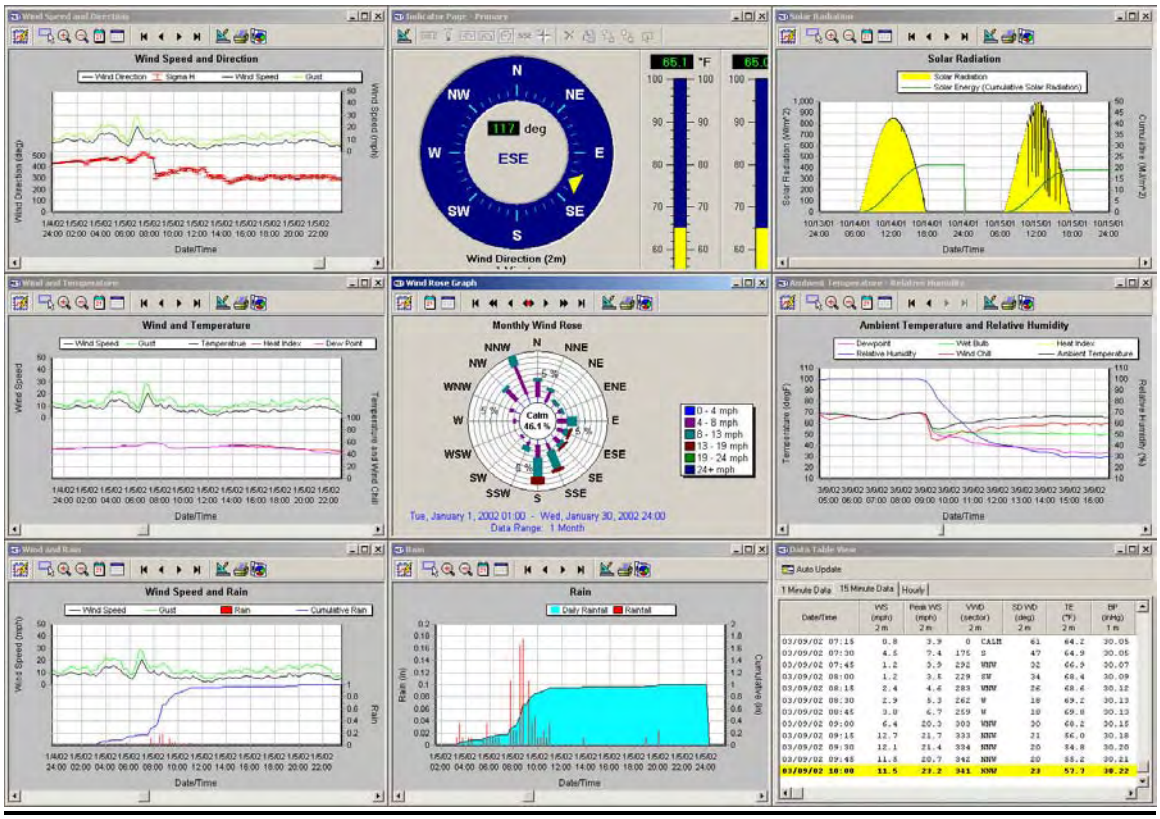
MET MANAGER™ USER'S MANUAL

User's Manual Version: 1.5
to support
Met Manager™ Version: 4.2.x



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Revision Notice (of this User's Manual)

Release Number	Rev	Date of Release	Description
450.078.001	1.0	April 20, 2002	Initial release
450.078.001	1.1	June 18, 2002	Incorporate customer feedback
450.078.001	1.2	July 21, 2002	Include software enhancements
450.078.001	1.3	August 14, 2002	Maintenance release
450.078.001	1.4	September 16, 2002	Graph and wind rose auto-scale enhancements; new trouble-shooting section; new calibration capability
450.078.001	1.5	December 6, 2002	Add agriculture and energy parameters and reports. Add "difference" as a derived parameter.

Warranty

No warranties are made with respect to this User's Manual. The software is warranted per the terms of its accompanying Software License Agreement.

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1 INTRODUCTION

1.1 General

Congratulations on your selection of Met Manager™ software with your weather (meteorological) station. Met Manager provides a powerful and easy way to acquire and view weather data in a variety of ways.

Weather systems are used in many applications including air quality monitoring, diffusion modeling, environmental health and safety (EH&S), environmental studies, agriculture, education, energy, fire weather, research, etc. Generally, the purpose of a weather station is to measure and report data that is representative of the local environment. This data may include any combination of wind speed, wind direction, temperature, humidity, pressure, solar radiation, and precipitation (or rainfall). Additional data may include voltage, user-defined parameters, agricultural parameters (soil moisture, soil temperature, leaf wetness, and so forth) and many others (see Appendix A for a complete list).

1.2 Features of Met Manager Software

Some of the features of the Met Manager software include:

- Acquires data in real-time when supported by the data logger in your weather station. The link between the PC computer and the weather station's data logger is serial RS-232 by direct connection. The connection is usually by serial cable, short haul modem, or wireless radio modem. Depending on the capabilities of the data logger, the weather station may measure sensory data as fast as once per second.

- Acquires data by capturing it from the internal memory of the data logger (if supported by your data logger). The link between the PC computer and the data logger is usually by dial modem or cellular modem, but can also be a direct connection.

- Is database-centric. Acquired data is stored in a database on a PC computer, workstation, or a Microsoft®-compatible network file server.

- Stores acquired data into database tables at user-selected intervals of 1, 5, 10, 15, 20, and 30 minutes and hourly. The data can represent averages, totals, minimums, maximums, standard deviations, change, rates of change, and so forth. You can easily view historical data of any of the tables by simple reverse scrolling.

- The data records in each data table can be kept indefinitely, or can be deleted from the database by a user-defined "wrap" interval (expressed in days). For example, you may want to keep 1-minute data for 7 days, 5-minute data for 90

days, and 15-minute and hourly data indefinitely.

- Calculates many derived parameters from the measured parameters. For example, general industrial and non-industrial derived parameters include wind chill temperature, heat index temperature, dew point temperature, wet bulb temperature, peak wind speed, scalar and resultant vector horizontal wind speed and direction, unit vector wind direction, Sigma Theta (standard deviation of horizontal wind direction), Sigma Phi (standard deviation of vertical wind direction), and so forth. Energy derived parameters include heating and cooling degree days. Agricultural derived parameters include growing degree days and hours, reference and crop evapotranspiration, and chill units and hours. Additionally, when acquiring data in real-time from a direct connection to the data logger, Met Manager can derive minimums, maximums, change, rates of change, difference, and standard deviations for most parameters.

- Is "project-based." Data is stored in a project folder that you name.

- Makes extensive use of trend graphics. You can setup named trend charts with multiple traces per chart, use of dual y-axis, and so on. These graphs can also be printed and copied to the clipboard.

- Displays a wind rose for graphically viewing wind speed and wind direction data as a joint frequency distribution. You can select time periods of 1, 3, 6, 8, and 12, hours, and daily, weekly, monthly or custom-defined.

- Displays readings with one or more indicator views. You can setup multiple indicator views to indicate current readings with the use of digital indicators, vertical bar graphs, 120°, 180° and 270° meters, wind direction labels (e.g., SSE, CALM, etc.) and wind direction indicators.

- Generates serially-complete data tables. Missing data records are flagged with a missing status tag. Invalid and calibration data are also tagged within the data tables.

- Lets you change the units of measurement for display and reporting purposes.

- Handles sensor slope and offset calibration needs.

- Generates fault, communication error, and system event logs. Acquired sensory data is automatically range-checked against limits that you define. Communication faults are logged for system failure diagnostic purposes.

- Generates a number of very useful reports including various data log reports, daily summary report, rainfall report, wind frequency distribution report, monthly parameter reports, and monthly data recovery. Agricultural summary reports include reference and crop evapotranspiration, chill hours/units, and growing

degree days/hours. Energy summary reports include heating and cooling degree days.

- And has many other features including data export to another drive path in comma-delimited (CSV), Paradox and dBase formats, a report header that you define, and so on.

Met Manager can run on a variety of Microsoft Windows operating systems (Windows 95, 98, NT 4.0, 2000, and XP). Met Manager can run on a desktop PC or notebook computer, or on a workstation of a Microsoft-compatible network. Network architectures include peer-to-peer and file server.

1.3 Features of Met Mirror Software

The use of Met Mirror™ software is optional. Met Mirror allows you to create and maintain a mirror image of data tables on a network file server from a database managed by Met Manager on a workstation. This allows you to acquire and store weather data on a workstation independently of the network, but then replicate the data to the network for use by others (by the use of Met Viewer as discussed below). Should the network go out-of-service for some reason, or be down for maintenance, Met Manager will continue to store its data on the local workstation. Then, when the network is back online, Met Mirror can be reactivated to "catch-up" the mirrored data tables. The Met Mirror software is automatically installed with the Met Manager software.

1.4 Features of Met Viewer Software

Met Viewer™ software is useful for allowing other network users to have access to the weather database. In a peer-to-peer or file server network, Met Viewer attaches to the database maintained by Met Manager, or to a replicated database maintained by Met Mirror. With Met Viewer, you can recall, view, graph, indicate, report, and export the data in a variety of ways, and in the same way as Met Manager.

The Met Viewer software product is purchased separately from Met Manager. Met Viewer licenses are available for 1, 5, 10, 20, 50, and unlimited number of users (at one physical site location).

1.5 Organization of User's Manual

Section 2 provides an overview of the software including minimum computer requirements, and use of Met Manager, Met Mirror and Met Viewer in both non-networked and networked environments.

Section 3 discusses software installation and configuration.

Section 4 provides a detailed description on using Met Manager.

Section 5 discuses maintenance and calibration operations.

Section 6 includes some pointers on troubleshooting, and a list of frequently asked questions.

Appendix A is a list of acquired and derived parameters managed by the software.

Appendix B is an overview on installing, configuring, and using the Met Mirror software.

Appendix C provides an overview on installing and using the Met Database Utility (MetDBU) software.

Appendix D provides command line options useful for starting Met Manager, Met Viewer and Met Mirror in particular ways.

Appendix E presents an overview of the calibration process. An endpoint-to-endpoint calibration is discussed, as well as pros and cons to consider when deciding where and how to make calibration adjustments.

2 OVERVIEW

2.1 Minimum Requirements for Using the Software

The Met Manager software is usually installed on a desktop or notebook personal computer (PC), or on a workstation. Minimum and recommended requirements are listed below.

- PC computer with a Pentium or compatible processor
- Pentium II (or compatible) or higher processor recommended
- Processor speed of 180 MHz (300 MHz or higher recommended)
- Microsoft Windows® 95 / 98 / NT4.0 / 2000 / XP Operating System (98 or later recommended)
- 32 MB RAM memory (64 MB or more recommended)
- Hard disk space requirements: less than 10 MB for programs; database storage requirements vary depending on the number of data channels, frequency of data, and time period of data stored. A minimum configuration may require 5 to 10 MB of data storage, and a maximum configuration may require 100 or more MB.
- Display resolution of 800 x 600 (1024 x 768 or higher recommended)
- CD-ROM drive (for installation of the software only)
- Standard floppy disk drive (for some installations only)
- A printer is recommended but not required
- A modem may be required for some applications
- Standard Microsoft® network protocols are required when used in a network

2.2 Overview of the Software Suite

2.2.1 General

The Met Manager™ suite of software includes Met Manager™, Met Viewer™, and Met Mirror™. Met Manager and Met Mirror come together on one CD. Met Viewer is purchased separately.

Met Manager acquires data from the data logger of a weather station, processes and stores both acquired and derived data into a project database, and lets the user view, trend, indicate, and report the project data. The project database can be located on a standalone desktop PC, on a workstation of a network, or directly on a network server.

Met Manager can run by itself, or in conjunction with Met Viewer™ and/or Met Mirror™ software.

Met Mirror is used to mirror a copy of the master project database to other locations within a network. Its use is optional.

Met Viewer allows other workstations in a network setting to view, trend and report the project data. Met Viewer gets its data directly from the original or a mirrored project database.

This manual focuses on Met Manager and Met Mirror, but also provides an overview of the Met Viewer software.

2.2.2 Met Manager Software

Met Manager acquires sensory data from a data logger and derives many additional parameters (see Appendix A). Data parameters, whether acquired or derived, are saved in a user-defined project database for viewing, trending, and reporting.

Met Manager makes data available to the user in several formats: data tables, trend charts, indicator pages, wind roses, and reports. Met Manager also logs communication and sensor faults that it detects.

Some of the reports provided by Met Manager include data table reports, daily summary report, daily rainfall report, monthly parameter reports, monthly wind frequency report, and data recovery report.

Additional features of Met Manager include user selection of measurement and display units, applying slope and offset calibration values to each sensor channel, and exporting of the database in comma-delimited ASCII, Paradox, and dBase file formats.

2.2.3 Met Mirror Software

Met Mirror software is used only in a networked environment and its use is optional. Met Mirror is used to mirror a copy of Met Manager's project database to another computer on a peer-to-peer or file server network. Typically this is done for the following reasons:

- Met Manager can store its data on a local workstation, and in a way that is independent from other users on the network. Other users may access the copy created and managed by Met Mirror, but cannot access the original project database.

- Met Mirror is also useful for situations in which the network may temporarily go out of service. In this situation, Met Manager continues to acquire and store data on its local workstation, and Met Mirror will update the mirrored copy on the network when the network server is back on line.

The Met Mirror software is discussed in Appendix B.

2.2.4 Met Viewer Software

Met Viewer software is used only in a peer-to-peer or file server-based networked environment. The operation of Met Viewer is very similar to Met Manager. The primary

difference is that Met Manager gets its data from the data logger and stores that data and additional derived data into a project database. Met Viewer does not get data from a data logger. Met Viewer gets its data from the project database.

A separate User's Manual is available for Met Viewer with the purchase of Met Viewer software.

2.2.5 Project Folder

The weather database managed by Met Manager is stored in a "project" folder (directory). The project folder is governed by the following general rules:

- Met project folders are generated by Met Manager or mirrored by Met Mirror.
- Met Manager, Met Mirror and Met Viewer can access a project folder through any valid Microsoft® operating system mechanism that supports read/write/create access permission for the connected system. Connection mechanisms include, but are not limited to, a local folder, a local area network (LAN) shared folder, a remote access (RAS) connection to a shared folder, etc.
- The Met Viewer program can access any valid project folder. This folder can exist on a local path or a network path. The network path can be through a LAN or remote access dial-up connection. Met Viewer must have read/write/create access permission to the project folder.

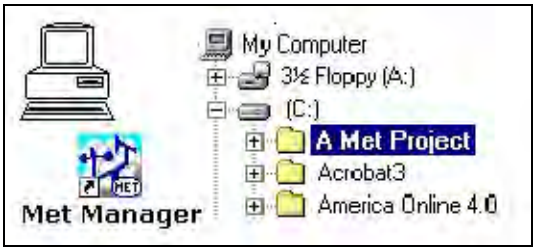
2.3 Scenarios for Using Met Manager, Met Viewer and Met Mirror

2.3.1 General Overview

It is relatively easy to acquire sensor-based data with Met Manager. However, it is also important to be able to have easy access to the data once it is acquired. In this section, several scenarios provide an overview on how data can be distributed and accessed.

2.3.2 Scenario 1: Met Manager Only; Local PC (Non-network)

In this scenario, Met Manager stores its weather data in a database in a project folder named "A Met Project" (it can be any name - you name it when you configure Met Manager) on the "C:" hard drive of a desktop computer, as shown in the figure below.



Local PC (Not Networked)

This scenario is very common for the following cases:

- With Met Manager, a PC computer has a direct link (hard wire, direct modem, or wireless) to a data logger of a weather station. The project database is stored on the PC and is not shared with others in a network.

- With Met Manager, a PC computer dials out to the weather station. The data log is captured from the data logger and is stored on the PC in a project database. The database is not shared with others in a network.

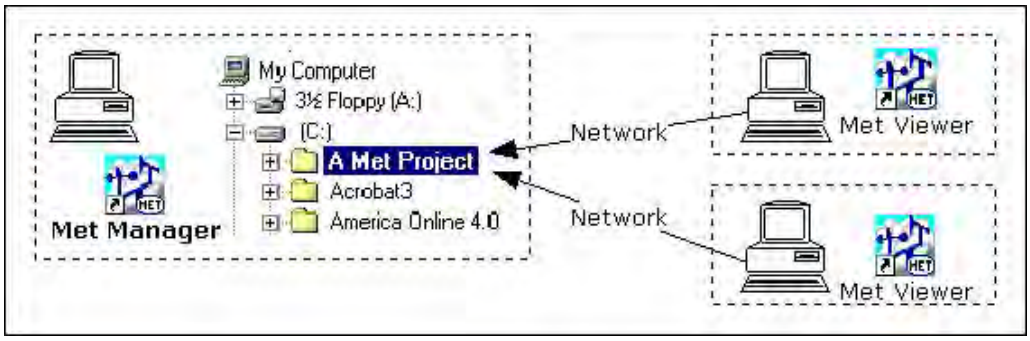
Requirements include:

- The Met Manager user must have read/write/create access permission to the project folder.

- The Met Manager program must have read/write/create access permission to the Windows registry.

2.3.3 Scenario 2: Met Manager and Met Viewer; Peer-to-Peer Network

In this example, Met Manager stores its database in a project folder named "A Met Project" on the local workstation's "C:" hard drive. One or more users can then connect directly to the main Met Manager project folder (in this example, "c:\A Met Project") with the Met Viewer software using standard Microsoft peer-to-peer networking protocols.



Peer-to-Peer Network

Requirements include:

- The Met Manager user must have read/write/create access permission to the project folder located on its workstation.

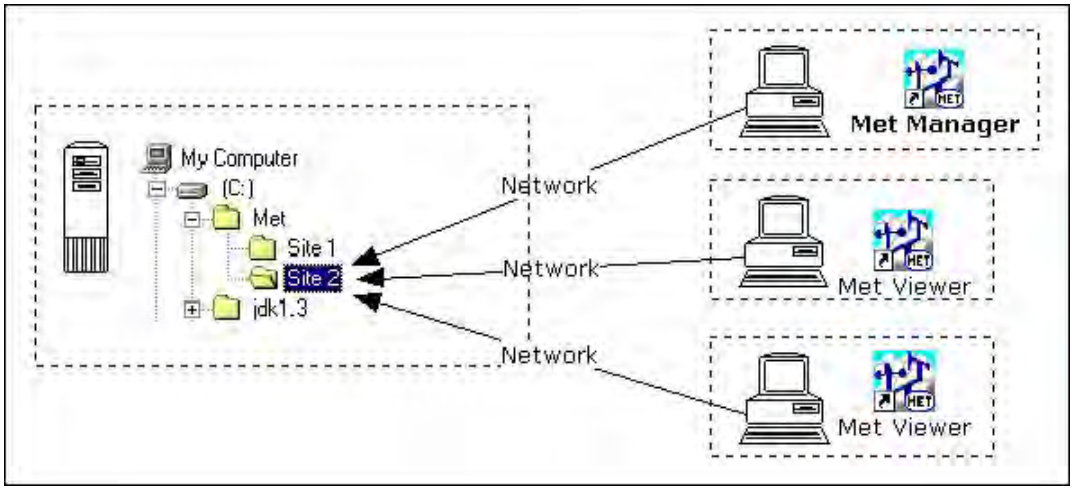
- The Met Manager program must have read/write/create access permission to the Windows registry on its workstation.

- Met Viewer peer-to-peer network users must have read/write/create access permission to the project folder located on Met Manager's workstation.

- The Met Viewer program must have read/write/create access permission to the Windows registry on its workstation.

2.3.4 Scenario 3: Met Manager and Met Viewer; File Server Network

The following example demonstrates a file server network with Met Manager and two Met Viewer users. Met Manager runs on a workstation and creates and maintains its project folder on the server (in this example, "\\server\share\Met\Site 2"). One or more Met Viewer users (on other workstations) then connect directly to the main Met Manager project folder on the server ("\\server\share\Met\Site 2").



File Server Network

Requirements include:

- The Met Manager user must have read/write/create access permission to the project folder located on the network file server.

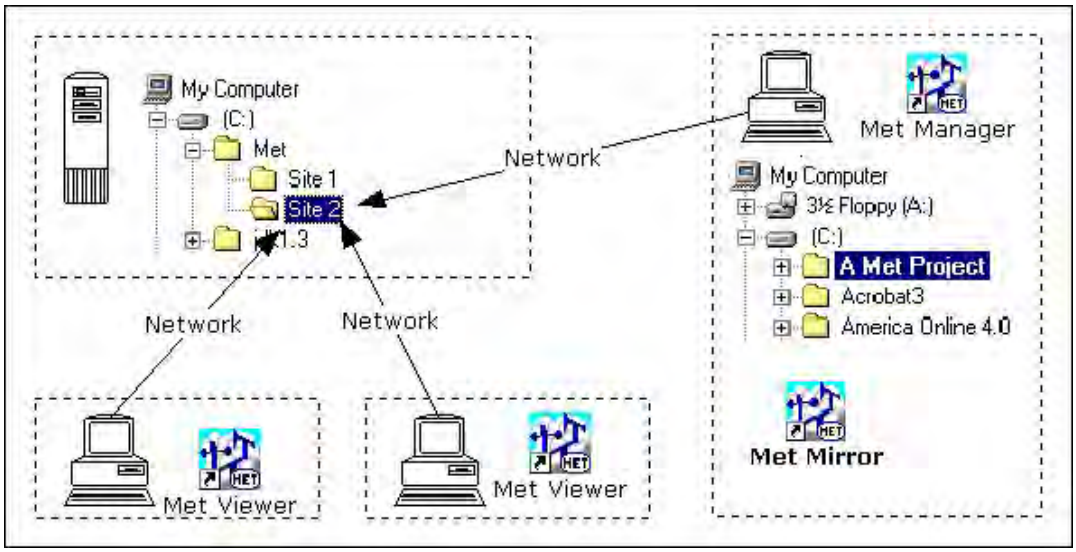
- The Met Manager program must have read/write/create access permission to the Windows registry on its workstation.

- Met Viewer network users must have read/write/create access permission to the project folder located on the network file server.

- The Met Viewer program must have read/write/create access permission to the Windows registry on its workstation.

2.3.5 Scenario 4: Met Manager, Met Viewer and Met Mirror; File Server Network with Mirrored Database

This scenario demonstrates a file server network with Met Manager, Met Mirror and two Met Viewer users. Met Manager manages a master project folder located on its local workstation (in this example, "c:\A Met Project"). Met Mirror creates and mirrors a copy of the master database of the project folder onto the server (in this example "\\server\share\Met\Site 2"). One or more Met Viewer users then connect directly to the mirrored project folder on the server ("\\server\share\Met\Site 2").



File Server Network - Mirrored Project Database

Requirements include:

- The Met Manager user must have read/write/create access permission to the master project folder located on its workstation.
- The Met Manager program must have read/write/create access permission to the Windows registry on its workstation.
- Met Mirror resides on the same workstation as Met Manager. Met Mirror mirrors a copy of the master project database to the network file server. Thus the Met Mirror user must have read permission to the master project folder located on its workstation and read/write/create permission to the mirrored project folder located on the network file server.
- The Met Mirror program must have read/write/create access permission to the Windows registry on its workstation.
- Met Viewer network users connect directly to the mirrored project folder located on the network file server. Thus, Met Viewer users must have

read/write/create access permission to the project folder located on the network file server.

- The Met Viewer program must have read/write/create access permission to the Windows registry on its workstation.

3 INSTALLING AND CONFIGURING MET MANAGER

3.1 Installing the Software

IMPORTANT: Met Manager uses the Windows registry to retain information about how it was last shut down. This information is then read from the registry on startup. Therefore, Met Manager must be installed in a way that it can have create/read/write access to the Windows registry. Before installing the software, ensure that your Windows log-on profile is configured to allow Met Manager to have create/read/write access to the Windows registry.

Refer to Section 2.3 for scenarios for using Met Manager, Met Viewer, and Met Mirror. Included are requirements for project folder read/write/create access permission depending on your application requirements.

To install the software simply place the Met Manager installation CD in to the CD drive. The install program should automatically run. Then follow the on-screen instructions.

If the install program does not automatically run, then follow these steps (with the CD in the CD drive):

1. Click on the "start" button (on Windows desktop), then select the "run" menu item.

2. Type d:\install.exe (replace "d" with the drive designator of your CD drive) and press the OK button.

IMPORTANT: After installing the software, be sure to review the README.TXT text file located on the installation CD. This file includes additional documentation not included in this User's Manual as well as a list of known issues with the software.

3.2 Steps to Setting Up Met Manager

After the Met Manager software is installed, it must be configured for use. Follow these steps:

1. On your computer, check the Microsoft Windows' computer date, time and time zone settings. Correct them if necessary. Ensure that the Windows-based daylight saving time adjustment setting is checked (enabled) if daylight saving time applies to your computer during any time of the year.

2. Create a project folder to store data and configuration settings. You have two options: 1) create a new project from scratch or 2)create a new project from an existing project. See Section 3.3.

3. Configure site settings such as latitude, longitude, elevation, and time zone. See Section 3.4.

4. Configure the data source. This defines where the sensory data comes from; for example, continuous direct-connection with the data logger in real time or by dial-up connection to the internal memory log of a data logger. See Section 3.5.

5. Assign parameters to the data source. This defines the various sensor channels and ordering of data received from the data logger, and the base units, measurement height, decimal display digits, and slope and offset coefficients to convert the acquired measurement to base units. See Section 3.6.

6. Assign parameters to be stored in the database. This defines both acquired sensor parameters and derived parameters to be stored in a database for later viewing, trending, reporting and exporting. See Section 3.7.

7. Define data tables and related time intervals to hold the database parameters. Tables include 1, 5, 10, 15, 20, 30-minute, and hourly time intervals. See Section 3.8.

8. Connect to the data source. With this step, Met Manager can begin receiving data from the weather station. See Section 3.9.

9. After following the instructions in Section 3.9, verify that Met Manager is receiving data from the data source. View the data from the Instantaneous View (see Section 4.6) and the Data View (see Section 4.4). If you have intermittent communication problems, review the "Current Data Source Events" tab of the Event Log. See Section 4.5.

10. Calibrate the weather station sensors and subsystems. See Section 5.2 and Appendix E.

11. Review the "Current Faults" tab of the Event Log to ensure that all measured values are within the minimum-to-maximum range defined for each data source parameter. See Sections 4.5 and 3.6.

12. Configure new trend charts and review existing ones (if any). See Sections 4.8, 4.9 and 4.10.

13. Configure new indicator pages and review existing ones (if any). See Sections 4.11 and 4.12.

14. Configure a new wind rose or review an existing one (if any). See Sections 4.13 and 4.14.

15. Configure the Data View and report options. See Section 4.15.

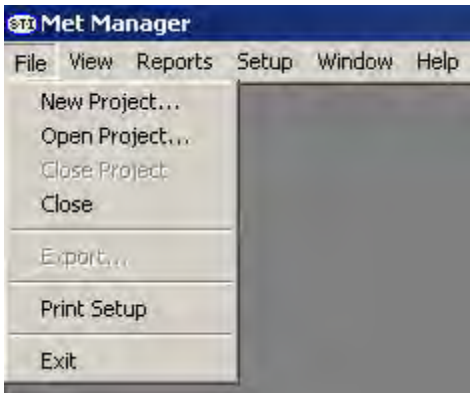
16. Configure display options when Met Manager is started. See Section 4.16.

IMPORTANT: Configure Met Manager to automatically startup when Windows starts up. Place a shortcut of the Met Manager executable program (MetMgr.exe) in the Windows "Startup" folder. This folder may be located under "Administrators", "All Users", "Default Users", or may be applicable only to your particular log-on profile depending on your version of Microsoft Windows. Check with your network or system administrator for the proper startup folder to contain the Met Manager shortcut.

Command line options can be used to force Met Manager to open a particular project and data source when starting up in Windows. *Command line options are not required*, but if you use them, you will want to assign them to the Met Manager shortcut in the Windows "Startup" folder. See Appendix D.

3.3 Creating a New Project

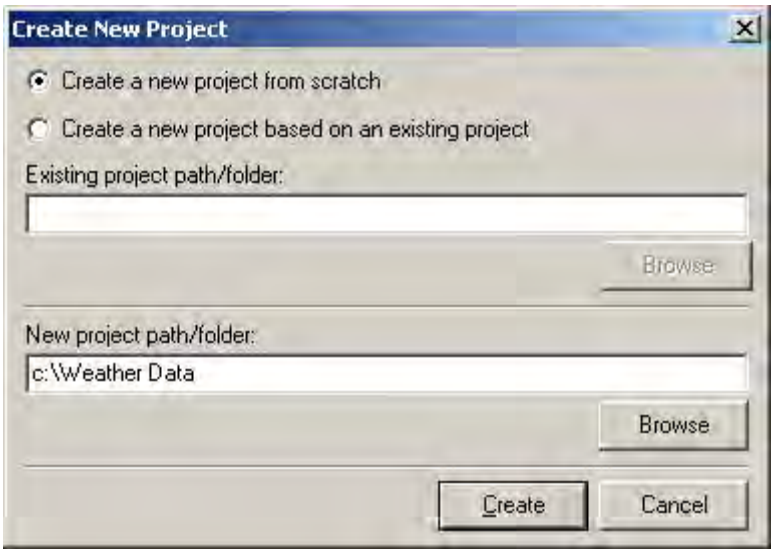
Met Manager stores its data into a "project". A project is simply a folder name that you assign, and is a location for holding the data and configuration settings associated with the project. To create a new project, select "New Project" from the File menu. See the figure below.



You have two options: 1) create a new project from scratch or 2) create a new project based on an existing project. Each of these options is explained below.

3.3.1 Creating a New Project from Scratch

In the example below, a new project is created from scratch on drive C of the local workstation, and is named "Weather Data".



(The above figure is an example only; your configuration may be different.)

Be sure to include the drive designator to the project path/folder name. In the above example, the drive designator is "C:\"; yours may be different. You can also press the "browse" button to locate the path or folder that will contain your project folder.

You must configure all elements of a new project that is created from scratch. Follow these steps in the order given:

1. Configure your site settings for the location of the weather station. These settings include latitude, longitude, elevation and time zone. See Section 3.4.

2. Configure the data source; that is, define where the sensory data comes from and properties such as serial communications port or modem and phone number, baud rate and so forth. See Section 3.5.

3. Assign parameters to the data source. This defines the various sensor channels and ordering of data received from the data logger, and the base units, measurement height, decimal display digits, and slope and offset coefficients to convert the acquired measurement to base units. See Section 3.6.

4. Assign parameters to be stored in the project database. This defines both acquired sensor parameters and derived parameters to be stored in a database for later viewing, trending, reporting and exporting. See Section 3.7.

> **IMPORTANT**: Be sure to review all wind speed and wind direction *database parameter* assignments for your particular application. Wind speed database parameters include scalar wind speed and resultant wind speed. Wind direction database parameters include scalar wind direction, resultant vector wind direction, and unit vector wind direction. USEPA or other state or local governmental requirements may require specific parameters, or may require all, depending on your application. When in doubt you may wish to record all of them. That way, the data will be available should you later need it.

5. Define data tables and related time intervals to hold the database parameters. Tables include 1, 5, 10, 15, 20, 30-minute, and hourly time intervals. See Section 3.8.

> **IMPORTANT**: USEPA or other state or local governmental requirements may require that you record your data at specific intervals, usually 15-minutes and hourly. However, you may wish to also record 1-minute data with a short wrap interval of 7, 14, or 30 days and 5-minute data with a wrap interval of 1 to 3 months. That way you can inspect the data at a higher frequency. <u>In order to minimize data storage and potential problems with larger data tables, we recommend that you limit your 1-minute data table to 1 month (30 days) of storage or less, your 5-minute data table to 6 months (185 days) or less, and your 10-minute data table to 1 year (365 days) or less</u>. The 15-minute, 20-minute, 30-minute, and hourly data tables can be kept indefinitely.

6. Connect to the data source. With this step, Met Manager can begin receiving data from the weather station. See Section 3.9.

After you have connected to the data source and followed the guidelines of Section 3.9, then complete these steps:

1. Verify that Met Manager is receiving data from the data source. View the data from the Instantaneous View (see Section 4.6) and the Data View (see Section 4.4). If you have intermittent communication problems, review the "Current Data Source Events" tab of the Event Log. See Section 4.5.

2. Calibrate the weather station sensors and subsystems. See Section 5.2 and Appendix E.

3. Review the "Current Faults" tab of the Event Log. If it is empty then all measured values are within the minimum-to-maximum range defined for each data source parameter. See Sections 4.5 and 3.6.

4. Configure new trend charts. See Sections 4.8, 4.9 and 4.10.

5. Configure new indicator pages (views). See Sections 4.11 and 4.12.

6. Configure a wind rose. See Sections 4.13 and 4.14.

7. Configure the Data View and report options. See Section 4.15.

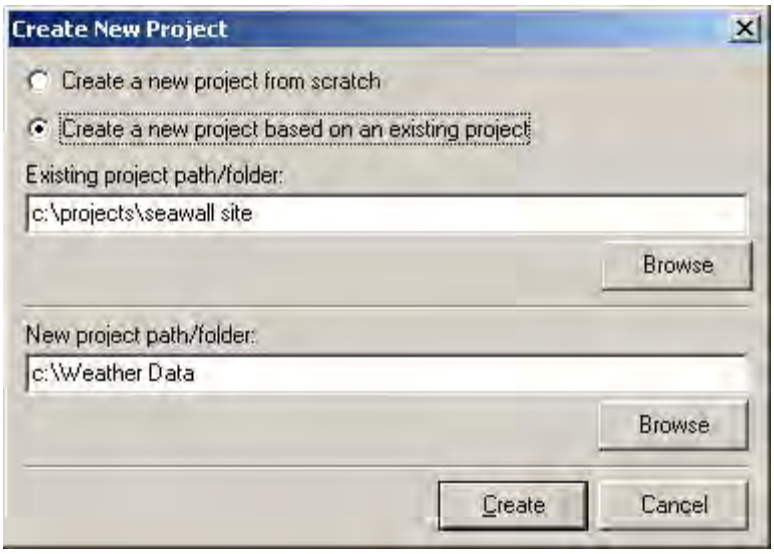
8. Configure display startup options. See Section 4.16.

9. Configure Met Manager to automatically startup when Windows starts up.

3.3.2 Creating a New Project from an Existing Project

A new project can be created from an existing project. Met Manager simply copies over the existing project configuration settings to the new project folder. This greatly simplifies setting up a new project.

In the example below, a new project is created on drive C of the local workstation, and is named "Weather Data". This new project is created from an existing project named "seawall site" that is located on drive C in folder "projects".



(The above figure is an example only; your configuration may be different.)

This method is useful for starting a new project to hold the weather data while keeping your existing site settings, data source parameter settings, database parameter settings, data table settings, trend charts, and indicator displays. The new project gets the old configuration settings and begins a new database from those settings.

This method is also useful for starting a new project with configuration settings supplied by the manufacturer of the weather station. **Check your weather station**

documentation to see if you can create a new project based on an existing factory-supplied configuration. If available, the factory configuration will usually be supplied on a separate floppy disk or CD. This can save you time in getting your project configured and operating.

Be sure to include the drive designator to the project path/folder names. In the above example, the drive designator is "C:\"; yours may be different. You can also press the "browse" button to locate the path or folder that you want to put your project folder in.

You must configure *some* of the elements of a new project that is created from an existing project. Configuration steps include:

1. Check your site settings. These will be zero if you created your project from a factory-supplied configuration. See Section 3.4.

2. Check your data source assignment and configure its properties as needed, especially the communication port or modem settings. See Section 3.5.

3. Check your sensor channel assignments to the data source. Add or delete channel assignments as needed. See Section 3.6.

4. Check your measured and derived parameters to store in the PC's database. Add or delete database parameters as needed. See Section 3.7.

IMPORTANT: If you are creating a new project from a factory-supplied configuration, then be sure to review all wind speed and wind direction *database parameter* assignments for your particular application. Wind speed database parameters include scalar wind speed (default) and resultant wind speed. Wind direction database parameters include scalar wind direction (default), resultant vector wind direction, and unit vector wind direction. The factory-supplied configuration may only include the default parameters. However, only you (or your employer) can determine which parameters apply to your particular application. USEPA or other state or local governmental requirements may require specific parameters, or may require all, depending on your application. When in doubt you may wish to record all of them. That way, the data will be available should you later need it.

5. Check your data tables to hold the parameters in the project database; 1-minute table, 5-minute table, and so forth. Make any needed changes to the configuration such as including or excluding tables from the database, or modifying the "wrap interval" of each table. See Section 3.8.

> **IMPORTANT**: USEPA or other state or local governmental requirements may require that you record your data at specific intervals, usually 15-minutes and hourly. However, you may wish to also record 1-minute data with a short wrap interval of 7, 14, or 30 days and 5-minute data with a wrap interval of 1 to 3 months. That way you can inspect the data at a higher frequency. In order to minimize data storage and potential problems with larger data tables, we recommend that you limit your 1-minute data table to 1 month (30 days) of storage or less, your 5-minute data table to 6 months (185 days) or less, and your 10-minute data table to 1 year (365 days) or less. The 15-minute, 20-minute, 30-minute, and hourly data tables can be kept indefinitely.

6. Connect to the data source to begin acquiring data. See Section 3.9.

After you have connected to the data source and followed the guidelines of Section 3.9, then complete these steps:

1. Verify that Met Manager is receiving data from the data source. View the data from the Instantaneous View (see Section 4.6) and the Data View (see Section 4.4). If you have intermittent communication problems, review the "Current Data Source Events" tab of the Event Log. See Section 4.5.

2. For a new system, calibrate the weather station sensors and subsystems. See Section 5.2 and Appendix E.

3. Review the "Current Faults" tab of the Event Log. If it is empty or there are no current faults, then all measured values are within the minimum-to-maximum range defined for each data source parameter. See Sections 4.5 and 3.6.

4. Modify existing trend charts and create new ones as appropriate. See Sections 4.8, 4.9 and 4.10. You may have to acquire data for a while (from a few hours to a day or so) so that you can see how the trend chart handles the data.

5. Modify existing indicator pages and create new ones as appropriate. See Sections 4.11 and 4.12.

6. Modify the existing wind rose or create a new one as appropriate. See Sections 4.13 and 4.14. As with trend charts, you may have to acquire data for a while so that you can see how the wind rose handles the data.

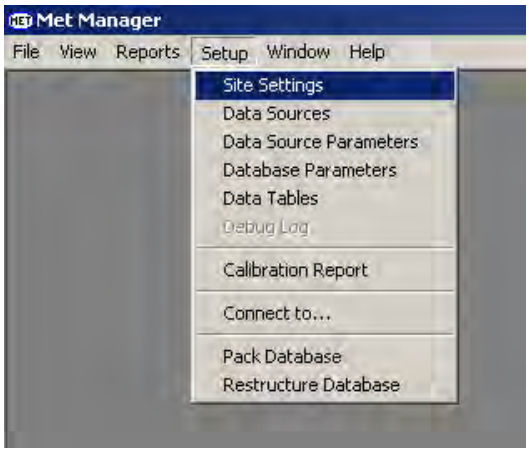
7. Review and configure the Data View and report options. See Section 4.15.

8. Review and configure display startup options. See Section 4.16.

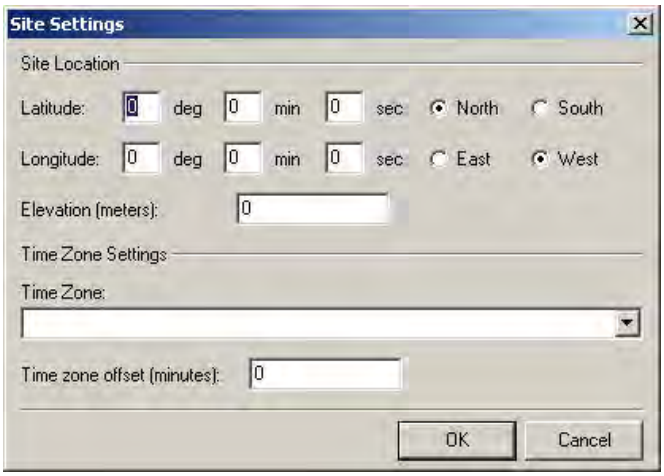
9. Configure Met Manager to automatically startup when Windows starts up.

3.4 Configuring the Site Settings

Site settings are used to define the location of the weather station and time zone information. To configure the site settings, select the Setup menu and then "Site Settings":



Next, define the latitude, longitude, and elevation at the location of your weather station, and the time zone:



Latitude and longitude are a coordinate system used to locate points on the earth's surface. Latitude is the angular distance, in degrees, minutes and seconds of a point north or south of the Equator. Longitude is the angular distance, in degrees, minutes, and seconds of a point east or west of the Prime Meridian (Greenwich, England). Longitudes are measured in half circles of 0 deg to 180 deg East and from 0 deg to 180 deg West of the Prime Meridian.

All USA points are located with northern latitude and western longitude. You may be able to get latitude and longitude for your location from the world wide web. Simply search the web for the keywords "latitude" and "longitude". The web also has calculators for converting decimal degrees to the "degree, minute, second" format required by Met Manager.

Enter the elevation of the location of the weather station in meters.

The "Time zone offset" is normally zero, but can be set to +30 or -30 if your specific time zone is not listed but is 30 minutes from the closest time zone listed in the "Time zone" list box. Usually the "Time zone offset" is not required since most worldwide times zones are listed.

Note: The latitude, longitude, and time zone settings are used in calculations that require locating the orientation of the sun. Elevation is useful for estimating barometric pressure. Be sure to define the elevation in meters.

Latitude, longitude and elevation settings are required for calculating reference evapotranspiration. **Be sure to properly setup these parameters if you are using Met Manager to calculate reference evapotranspiration.**

3.5 Configuring the Data Source

3.5.1 Overview of Data Sources

Met Manager gets its raw sensor-based data from a data source. A *data source* is simply an object such as a data logger or data file that is the source of sensory-based data.

Met Manager commonly interfaces to the following types of data sources depending on the capabilities of your data logger:

- "Direct Connect" data source. This includes a data logger that is directly-connected to the computer on which Met Manager resides, and that regularly transmits its data to Met Manager. The direct connection can be by serial cable, short haul modem, other direct-connect modem, or wireless radio modem.

  Choose a "Direct Connect" data source when the PC computer is directly-connected to the data logger of the weather station and you want to frequently (at least every few seconds or so) get data from the logger.

- "Data Log Capture (Modem)" data source. This includes a remote data logger that stores its data into an internal memory log and must be periodically captured by Met Manager. Met Manager connects to the data logger with a dial modem or cellular phone.

Choose a "Data Log Capture (Modem)" data source when you wish for Met Manager to get data from the internal memory log of a remote data logger by telephone modem or cellular phone dialup.

- "Data Log Capture (COM Port)" data source. This includes a data logger that is directly-connected to a COM (serial) port of the computer on which Met Manager resides but that stores its data into an internal memory log and only *periodically* transmits its internal log to Met Manager on request of Met Manager. The direct connection can be by serial cable, short haul modem, other direct-connect (i.e., non-dial) modem, or wireless radio modem.

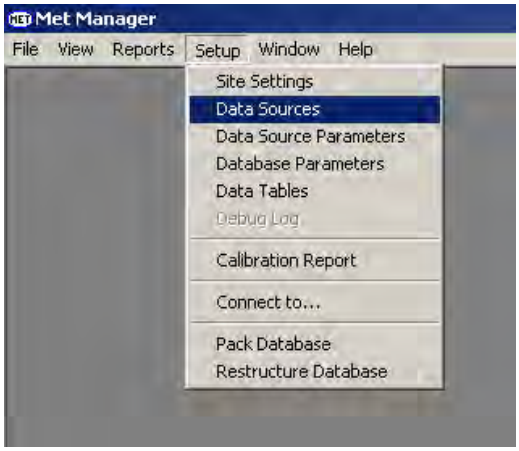
  Choose a "Data Log Capture (COM Port)" data source when the PC is directly connected to a data logger by serial communications (COM) and you wish to capture data from the log memory of the data logger periodically, but rather infrequently. For example, this option could be used to get data once a day, every few days, or on demand.

  This data source is also useful when your weather station is in a remote location with no telephone access. You travel to the remote location with a notebook PC, connect up, and then with Met Manager you capture the data from the data logger to the notebook PC.

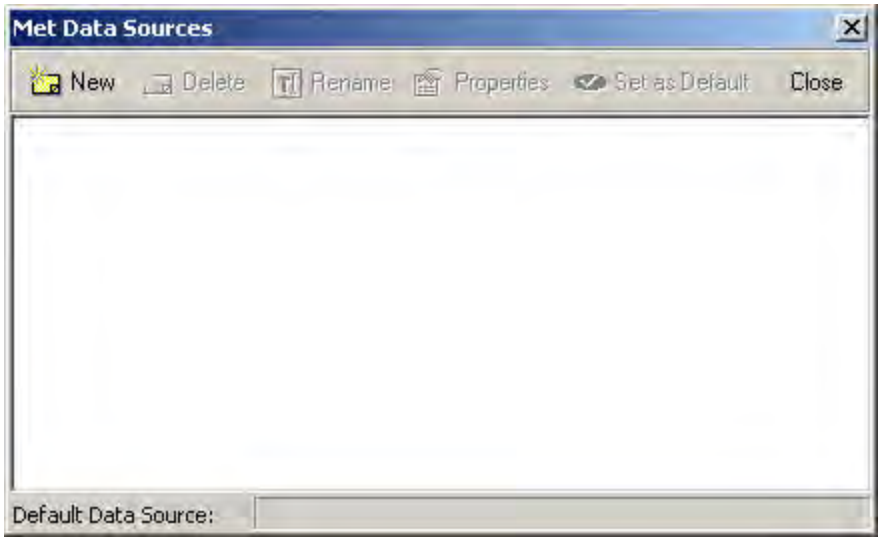
- CSV or data log "File Import" data source. Choose this data source to build the Met Manager database by importing a comma-delimited (CSV) file or a data log file that has already been saved to disk.

Note: Different data logger applications support different types of data sources. Some of the data sources defined above may not be available to you, depending on the particular capabilities of your system.

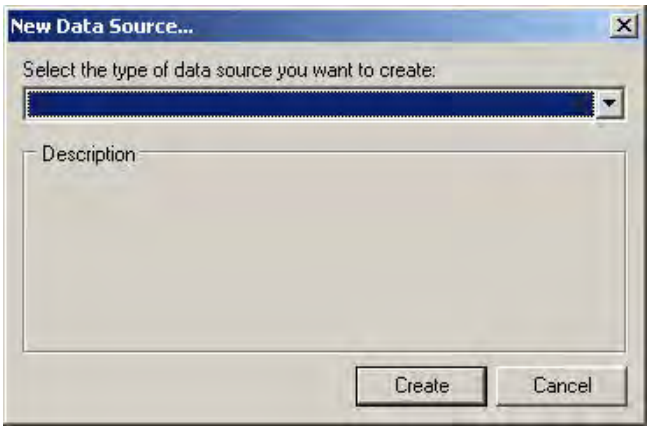
To configure your data source, first select the Setup menu, then "Data Sources":



If no data sources have been assigned, then the following dialog will be displayed.



Press the "New" tool button to pick and assign a data source for your particular application:

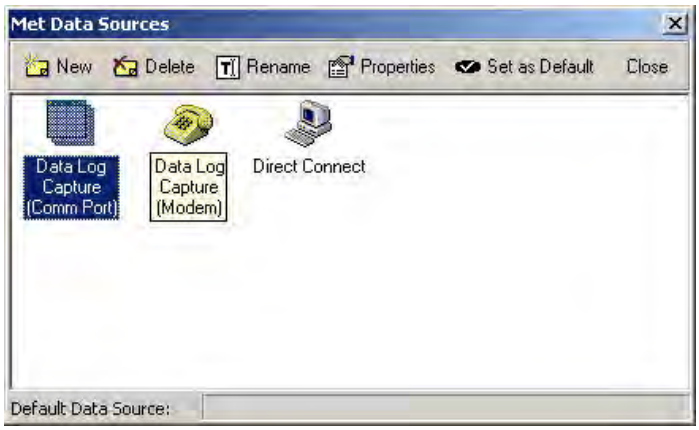


Press the down arrow button to select the type of data source that you want to create:

- Direct Connect
- Data Log Capture (COM Port)
- Data Log Capture (Modem)
- Data Log File Import
- CSV File Import

Note: The list above shows different types of data sources for different data logger applications. Your list may be different and may not include all of the above types of data sources, depending on the capabilities of your system.

After picking a data source from the list, a display similar to the following is shown, with the new data source then being added to the "Data Sources" display:



(The above figure is an example only; your configuration may be different.)

IMPORTANT: With your mouse, select the data source that you want to use and then press the "Set as Default" button to make that particular data source the active one. A little check mark should appear above the data source, and the name will be assigned as the default in the "Default Data Source" field at the bottom of the dialog box.

Note: Actual data source names may include a one or two word descriptor that identifies the data logger and precedes the names given above.

CAUTION: While the above figure shows that multiple data sources can be created for an application, you may activate ***only one*** data source for a particular project. *Therefore you should create only one data source for your particular application*. Remove unused data sources by deleting them (as explained below).

To delete a data source, select its icon, then press the "Delete" button. You can always recreate it later by pressing the "New" button should your application requirements change.

To rename a data source, select the data source icon, then press the "Rename" button.

IMPORTANT: The name of the data source may be used by other services of the Met Manager Suite of software; for example for startup automation of Met Manager (see Appendix D). Therefore, if you change the name of the data source, be sure to reconfigure any other services that refer to that data source with the new name.

Once a data source has been created, you must further edit its properties. Select the data source icon with the mouse, then press the "Properties" button (or double-click the icon). The following sections discuss ways to configure the properties of different types of data sources.

3.5.2 "Direct Connect" Data Source Properties

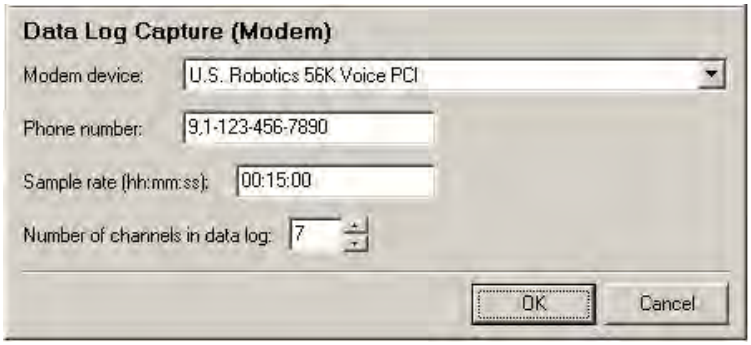
To set the properties of the "Direct Connect" data source, select its icon with the mouse (or double click it), then press the "Properties" button. Configure the communications COM port setting, baud rate, and sample rate. The following example shows communications with the data logger through the PC COM1 port at a baud rate of 9600. A sample rate of 5 seconds means that Met Manager will receive data from the data logger every 5 seconds.

(The above figure is an example only; your configuration may be different.)

Note: The data logger must be programmed to transmit its data to Met Manager at the configured sample rate. Programming the data logger is outside of the scope of the Met Manager software. Refer to your weather station or data logger manuals or consult with your weather station or data logger vendor.

3.5.3 "Data Log Capture (Modem)" Data Source Properties

To set the properties of the "Data Log Capture (Modem)" data source, select its icon with the mouse (or double click it), then press the "Properties" button. Configure the active modem device, phone number, sample rate, and number of channels in the data log:



(The above figure is an example only; your configuration may be different.)

Note: Prior to setting up the "Data Log Capture (Modem)" data source, you must *first* install the computer's modem in Microsoft Windows. This is typically done with modem software supplied by the modem manufacturer, and is outside the scope of the Met Manager software. If not installed beforehand, then the "modem device" field list may be blank.

Be sure to obey the phone number dialing rules at your location. Some places require a 10-digit phone number for local calls. Most places require a 1 before the 10-digit sequence for long distance calls. Some internal telephone systems require dialing a 9 followed by a short delay to get an outside line. To do this, enter 9 followed by a comma. Each comma creates a two second delay. To make the delay longer, simply insert more commas. For example, suppose you wish to dial a long-distance number to area code "123" and need to select 9 to get an outside line. The entry format would be 9,1-123-456-7890.

IMPORTANT: Set the sample rate to match the rate in which the data logger stores its data within its internal log memory. For example, this may be once every 5 minutes (00:05:00), 15 minutes (00:15:00) or once per hour (1:00:00). In the above example, a sample rate of 15 minutes means that the data logger will log a data record to its internal memory every 15 minutes.

Note: Some data logger configurations may not require the "Number of channels in data log" field above. In that case the field will be missing from the dialog. Other configurations may have a "clear" setting for user control over clearing the memory log of the data logger.

Note: The data logger must be programmed to store data into its internal memory log and to transmit the log to Met Manager when requested by Met Manager. Programming the data logger is outside of the scope of the Met Manager software. Refer to your weather station or data logger manuals or consult with your vendor.

3.5.4 "Data Log Capture (COM Port)" Data Source Properties

To set the properties of the "Data Log Capture (COM Port)" data source, select its icon with the mouse (or double click it), then press the "Properties" button. Configure the serial communications port (COM1, COM2, etc.), baud rate, sample rate, and number of sensors in the data log. This is similar to configuring the "Data Log Capture (Modem)" data source above except that you configure a serial communications port instead of a modem.

3.5.5 CSV or Data Log "File Import" Data Source Properties

To set the properties of a "File Import" type of data source, select its icon with the mouse (or double click it), then press the "Properties" button.

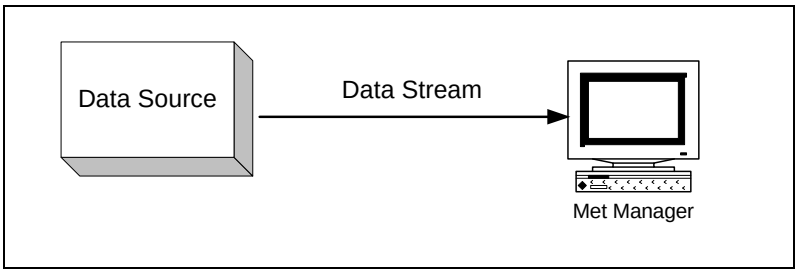
(The above figure is an example only; your configuration may be different.)

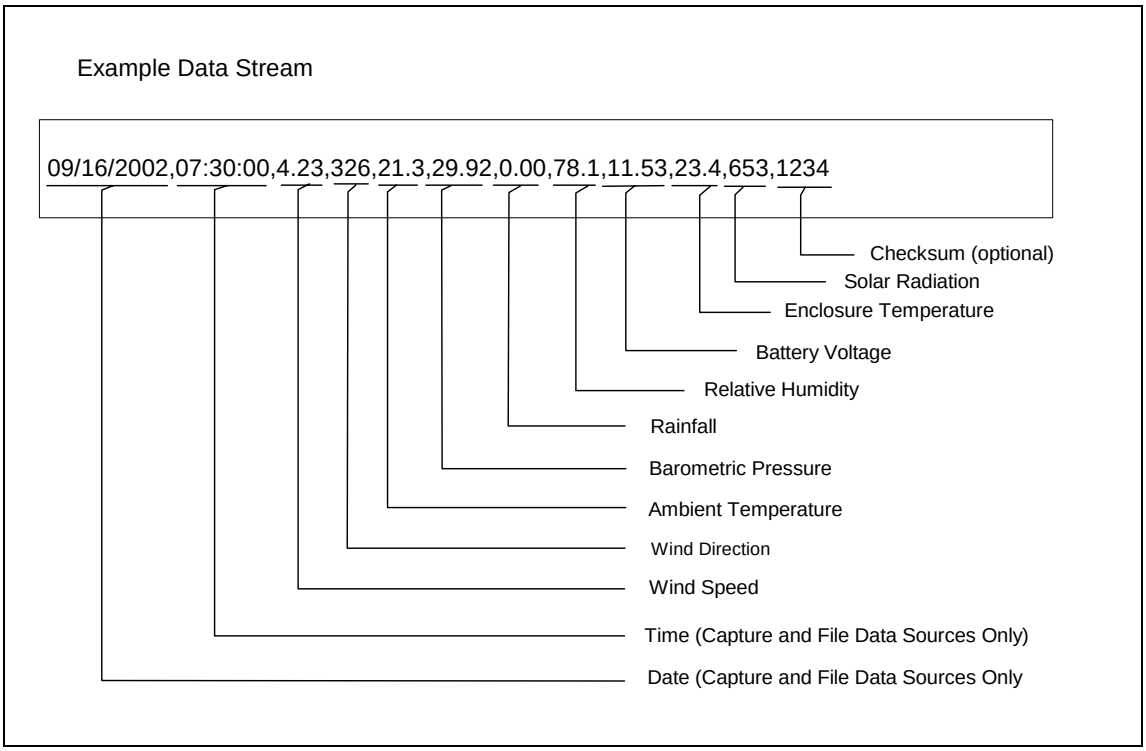
Configure the sample rate to match the time interval of the data within the imported file. The format is "hh:mm:ss" where "hh" is hours, "mm" is minutes, and "ss" is seconds. For example, if the data records are 15 minutes apart, then set the sample rate to "00:15:00".

3.6 Assigning Sensor Channels to the Data Source

The purpose of assigning sensor channels to a data source (typically a data logger but sometimes an import data file) is to let Met Manager know the order and type of information coming from the data source. You must have separate documentation on sensor channel assignments from your weather station supplier.

The linkage between Met Manager and the data source is defined by the type and order of data within the output data stream of the data source:





The above figure is meant to show an example of a data stream to illustrate the importance of ordering within the stream. Your configuration will probably be different. Depending on your particular data logger model, continuous direct-connect data sources may not include the date and time parameters (if these parameters are assigned by Met Manager). The checksum helps to identify communication errors but is optional with some data loggers. Also, the above example shows a comma as a data delimiter; however, other data sources may use other delimiters.

CAUTION: Unless you are setting up a brand new project, and you wish to add or remove one or more sensor channels or database parameters to (or from) the project, then follow the guideline below. Read all of the steps below before making any changes. Then make the changes in the order given.

Guideline for Adding or Deleting Data Source or Database Parameters

1. Before adding or removing data source parameters (that represent sensors) or database parameters:

    a. Stop Met Manager (exit the program).
    b. If you have a peer-to-peer network configuration, then stop any Met Viewer users attached to the master project folder. The master project folder is the one managed by Met Manager.
    c. Back up the master project folder (or copy the entire project folder to an archive location). Be sure to first exit the Met Manager program (step a), so that Met Manager will not be adding new data to the project database while the backup (or copy) program is running. The purpose of the backup (copy) is to both protect your master weather database should you make a mistake, as well as to archive your master database before making substantial changes to it. Keep in mind that removing sensors from the data source will likely affect your derived database parameters.

2. If you are using the optional Met Mirror software to mirror your local weather database to a network file server or other location, then:

    a. Stop Met Mirror and cause it to exit (see Appendix B).
    b. Create a new empty project folder on the network file server to retain the modified mirrored project database. Use Windows File Explorer (or similar software) to create the new empty destination project folder on the network server.

3. With Met Manager, make any needed data source parameter (sensor) and database parameter additions or deletions:

    a. Restart Met Manager.
    b. Close Met Manager's connection to the data source, if it is currently active. Choose the "Close Connection" item under the "Setup" menu.
    c. Make the data source parameter additions or deletions by following the instructions below these guidelines (remainder of Section 3.6 and below step 5).
    d. Make any needed database parameter additions or deletions as discussed in Section 3.7. Met Manager will automatically restructure its database when you are finished (as signified by pressing the OK button on the Database Parameters Editor dialog). *Thus it's best to make all database*

parameter additions and deletions at one time before pressing the OK button.

e. Reconnect Met Manager to the data source. From the Setup menu, choose "Connect to …" and connect to the appropriate data source. Met Manager should then begin acquiring data from the data source, and storing that data into the modified project database.

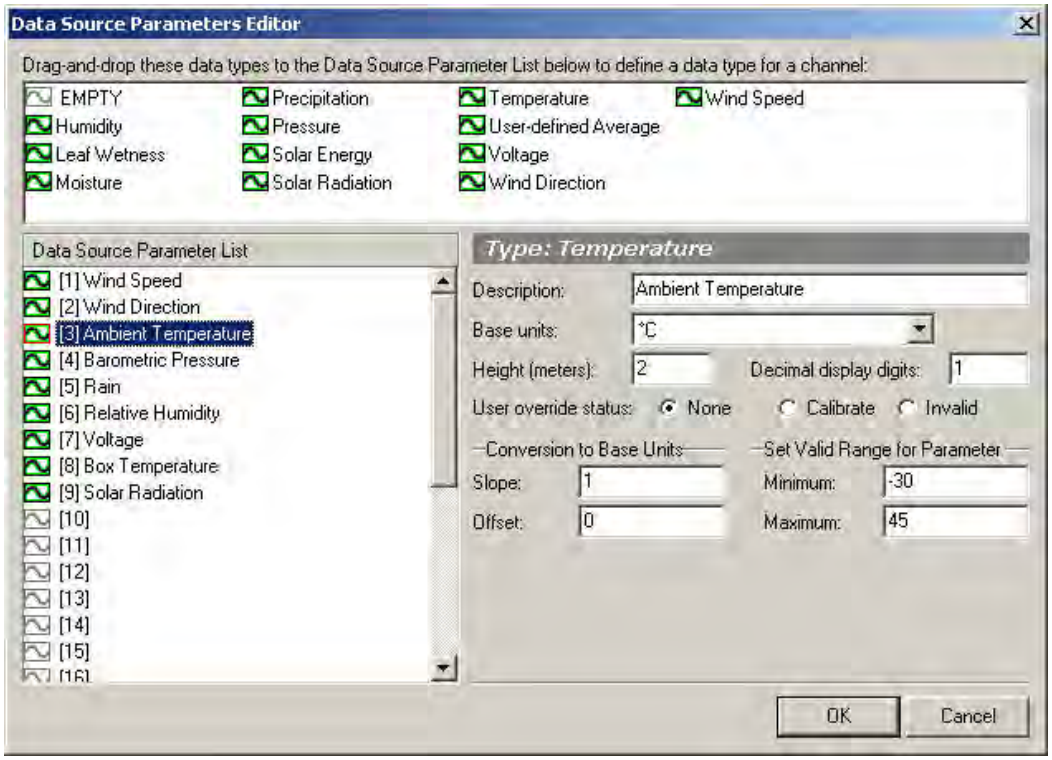
4. <u>If you are using the optional Met Mirror software, then:</u>

   a. Point Met Mirror through Met Mirror's definition settings to the new project folder pathname. Simply change the name of the *destination* folder to the new path. Save Met Mirror's new definition settings. See Appendix B.
   b. Restart Met Mirror. As appropriate, first modify any Met Mirror startup command line options (if used).
   c. Copy all Met Viewer user settings files from the original mirrored project location to the new location. The file names end with the extension ".mvs". DO NOT COPY ANY ADDITIONAL FILES. Use Microsoft Windows Explorer or equivalent software to make the copy. This step ensures that all Met Viewer users can now access the new project database with their current view settings.

5. <u>If you have Met Viewer users, then:</u>

   a. Have each Met Viewer user open the project at the new pathname location.
   b. Have each Met Viewer user adjust indicator views, wind roses, and trend charts to reflect the changes (additions and deletions) to the database.
   c. As appropriate, modify any Met Viewer startup command line options (if used).

Data types (pressure, precipitation, temperature and so forth) are assigned to the various sensor channels of the active data source. To assign sensory data types to the data source, select "Data Source Parameters" from the Setup menu:



(The above figure is an example only; See Appendix A for a list of all supported Data Source Parameters.)

Note: If the parameters in the top of the above figure are not displayed, then select "Close Connection" from the Setup menu to show them.

As shown in the figure above, the example data source was configured with 9 sensor-based channels (see the Data Source Parameter List in the figure). Each channel was setup by selecting and dragging a *data type* from the top box to a channel number in the left-hand box. The data type must match the sensor that is associated with that channel. Then, each channel's assigned data type is converted to a *data source parameter* by selecting the channel name in the left-hand box and editing its properties in the right-hand box.

For example (and as shown above), a "Temperature" data type was initially assigned to channel 3 by selecting the "Temperature" data type from the top box and dragging and dropping it onto channel 3. Then that channel was converted from a data type to a data source parameter by setting its properties in the right-hand box: (1) renaming it to "Ambient Temperature" in the "Description" property, (2) setting its base units to °C, (3) setting its height (level) above the ground to 2 meters, (4) setting its slope and offset values to convert the value received from the data source to base units, and (4) setting its range of valid values (in base units).

Similarly, the "Precipitation" data type was initially assigned to channel 5 and then converted to a data source parameter by renaming it to "Rain" in the "Description" field

and setting its other properties. Also, "Pressure" was renamed "Barometric Pressure", "Humidity" as "Relative Humidity", and "Voltage" as "Battery Voltage".

The "EMPTY" data type allows you to remove a channel assignment, or to define a data value to ignore within the received data stream. Just drag and drop the "EMPTY" parameter to a channel number. Or, select the channel number that you wish to delete, and press the "delete" key on your keyboard.

In the right-hand box, the "Base units" represents the units that Met Manager assigns to the parameter *after* applying the base unit conversion slope and offset values. These slope and offset values are typically used for converting a raw value (data source parameter) in voltage or counts to a value in the base units, or for converting a value received in one engineering unit to another. If the received value is already in the desired base units, then the slope should be 1 and the offset 0 (as in the above figure). Calibration slope and offset corrections are assigned elsewhere; see Section 5.2.

The "Height (meters)" field is the measurement height of the sensor above the ground (or below ground for soil moisture sensors), in meters. Met Manager uses this parameter as a label, for example to identify wind speed at two different heights on a tower or soil temperatures at different depths. If you are not concerned about using height as a label, then you may leave this field blank.

Note: The above height parameter is used only as a label and is not used in calculations. However, the calculation of some derived parameters may depend on the height of the sensor. In that case, the derived parameter will have a separate height-related parameter for you to set up (see Section 3.7).

The "User override status" field allows the user to override the channel's "normal" status with "calibrate" or "invalid" status. This is useful in keeping questionable data out of the database by flagging the channel with "calibrate" or "invalid" status when the system is first started up. Once initial data has been acquired and verified, then the "User override status" can be set to "none". The normal status is "none" (i.e., no override of the status).

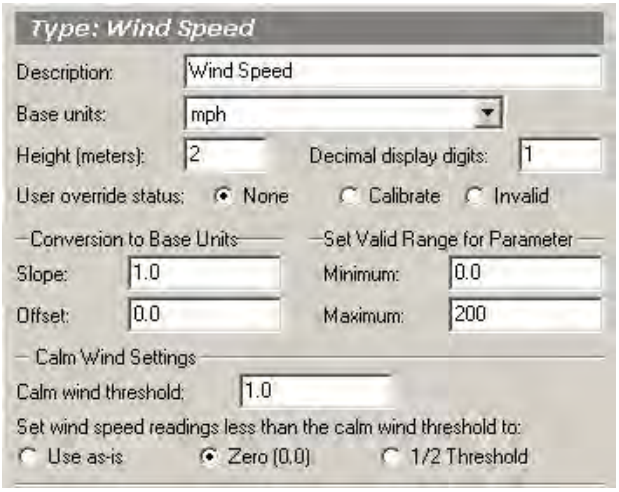
The "Decimal display digits" field is the number of decimal places to display to the right of the decimal point when showing the parameter on the *left-hand* side of the Instantaneous View (see Section 4.6).

The "Minimum" and "Maximum" fields are used for range checking of the parameter. When new data is received from the data source, the data parameter's value is range-checked in base units, and after applying calibration adjustments. When Met Manager detects that a parameter's value is out-of-range, then Met Manager logs the date/time, parameter, and fault value in a fault log and sets the status of the parameter to "invalid". Refer to Section 4.5. The parameter status returns to "valid" when back in range.

To summarize, the above figure shows that 9 channels of data are received in the data stream from the example data source. Each channel began as a *data type* (for example,

temperature or precipitation) and was then assigned some property values to convert it to a *data source parameter*. Properties include a descriptive name (for example, ambient temperature or rainfall) and height. By supplying additional information, you can assign base units, linear conversion slope and offset values for converting the received raw value into the base units, and so forth.

Wind speed has some additional information related to calm winds:



(The above figure is an example only; your configuration may be different.)

The "calm wind threshold" is that value below which the wind should be considered calm. The unit of the "calm wind threshold" is specified in the "Base units" field. The value you should assign for the threshold usually depends on the manufacturer's specifications of the wind speed and wind direction sensors, and is the highest of the two. For example, if the manufacturer-assigned calm threshold for the wind speed sensor is 0.5 mph and for the wind direction sensor is 1.0 mph, then the "calm wind threshold" should be set to 1.0 mph.

Met Manager will set wind speed readings *less than* the calm threshold to one of:

- Use as is - The wind speed value will not be adjusted when it is below the calm wind threshold. However, the wind direction value will be set to 0 to indicate calm winds.
- Zero (0.0) - The wind speed value will be set to 0.0 when below the calm wind threshold. The wind direction value will be set to 0 to indicate calm.
- ½ Threshold - the wind speed value will be set to ½ the calm wind threshold value when below the calm wind threshold. The wind direction value will be set to 0 to indicate calm.

For example, in the above figure, wind speed values below 1.0 mph will be set to 0.0 mph. Wind speed and wind direction will be considered calm.

Note: Some weather systems may consider both 0 and 360 degrees as a wind direction from the north. *To avoid ambiguity, Met Manager reports a non-calm wind direction in the range of 1 to 360 degrees, and sets a calm wind direction to 0 degrees.* Essentially, during calm winds there is no wind direction.

Note: It is possible that the wind speed sensor's output is reading below the calm wind threshold because the sensor has malfunctioned. In this case, you probably do not want your wind direction values to be set to calm. By simply flagging the wind speed sensor as "invalid", the calm setting will be ignored for the wind direction sensor. Flagging a channel to "invalid" is a maintenance function that is described in Section 5.1.

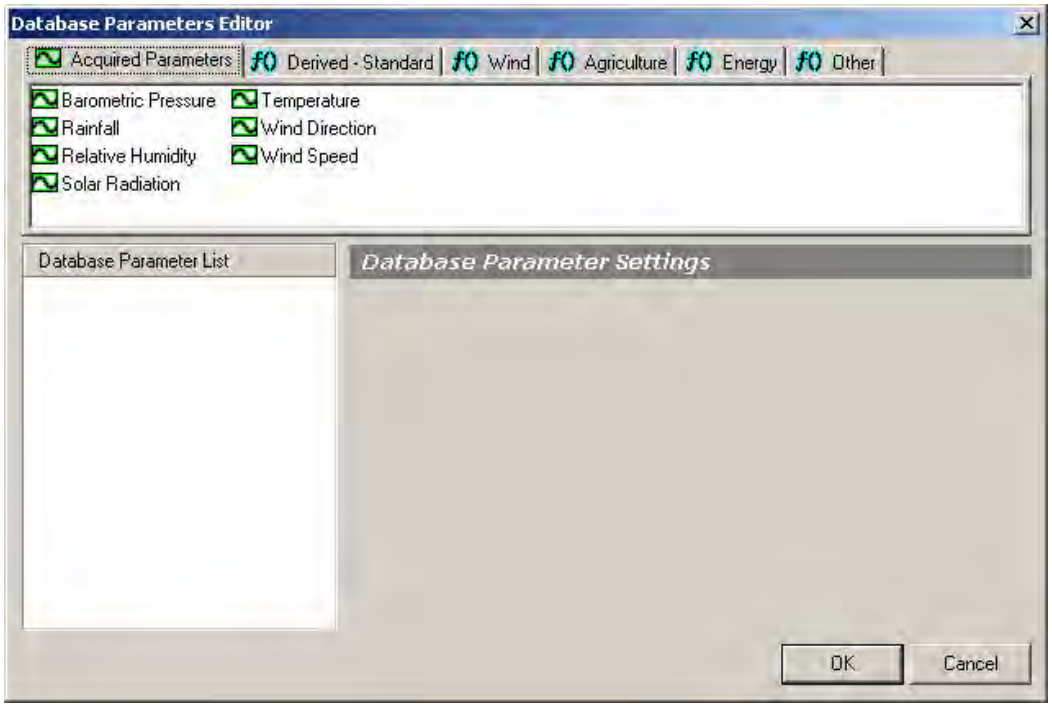
Note: If you do not wish Met Manager to set the wind direction to calm based on the wind speed, then set the "Calm wind threshold" value to 0.0. Calm wind will not be detected, and a measured calm wind speed of 0.0 will indicate calm.

3.7 Assigning Parameters to Store in the Database

The purpose of assigning parameters to store in the database is to be able to later view, trend, report, and export the data represented by the parameters. These parameters include both acquired and derived parameters, and are referred to as "database parameters."

CAUTION: Please review the caution in Section 3.6 when adding or deleting database parameters. Unless you are setting up a brand new project from scratch, then very carefully follow the guideline of Section 3.6 titled "Guideline for Adding or Deleting Data Source or Database Parameters".

To assign parameters to the database, select "Database Parameters" from the Setup menu:



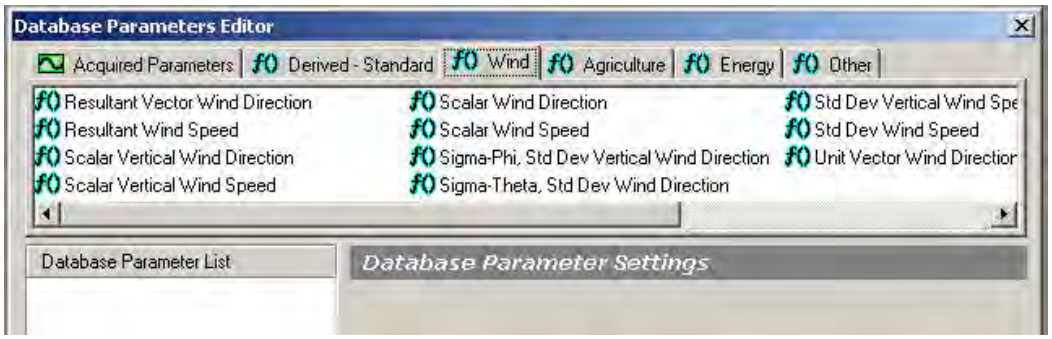
Note: If the top part of the above display is not shown, then select "Close Connection" from the Setup menu to show it. The top part of the display is not shown when Met Manager is acquired data.

The "Acquired Parameters" above are those that you setup earlier as "data source parameters". One at a time, drag and drop the ones you want to store in Met Manager's database to the "Database Parameter List" (left-hand box). Usually you will want to store all of them, so drag and drop each one, one at a time.

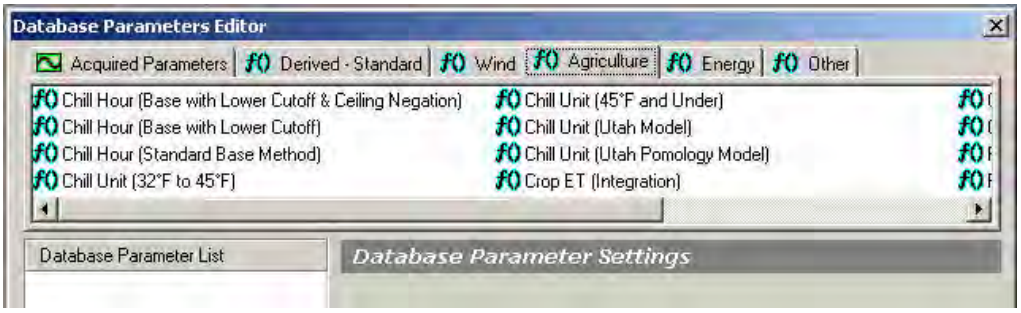
Next select the Derived - Standard, Wind, Agriculture, Energy or Other tab from the top window, and drag and drop parameters of interest. Refer to Appendix A for a list and brief explanation of each derived parameter.

The "Derived - Standard" tab is shown below:

The "Wind" tab is shown below:

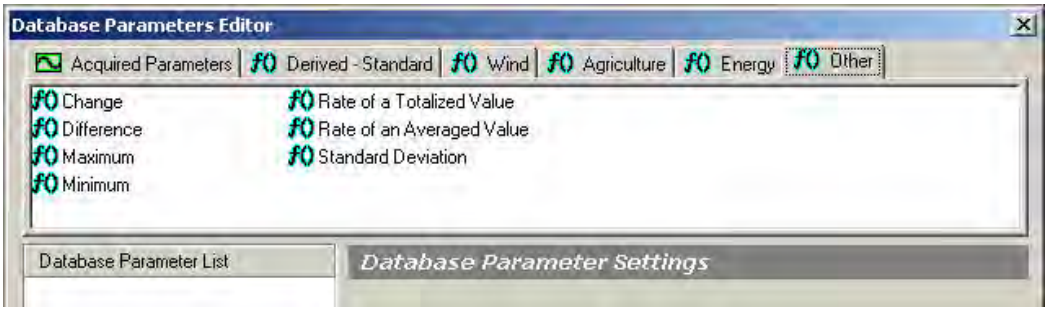


The "Agriculture" tab is:



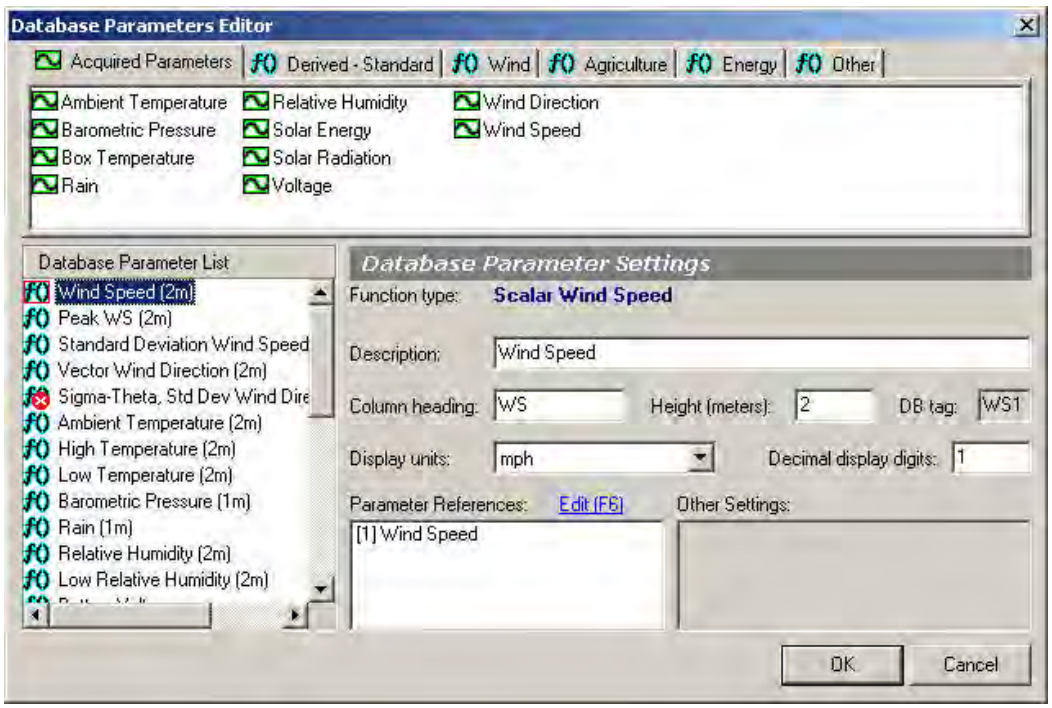
The "Energy" tab is:

The "Other" tab is shown below:



Note: Your version of Met Manager may include additional parameters not listed above. Refer to Appendix A for a list of the latest parameter data types and derived parameters reported by Met Manager.

The figure below shows an example of parameters that have been assigned (dragged and dropped) to the Database Parameter List for storage into the Met Manager project database.



(The above figure is an example only; your configuration may be different.)

In the above example, peak wind speed was setup as the maximum wind speed, high temperature as the maximum temperature, low temperature as the minimum temperature, and low relative humidity as the minimum relative humidity. The "maximum" and "minimum" derived parameters originated from the "Other" tab.

Similar to the Data Source Parameters display of Section 3.6, the "decimal display digits" field represents the number of digits to the right of the decimal point for the parameter listed on the *right-hand* side of the Instantaneous View (see Section 4.6).

IMPORTANT: You *must* assign a name to the "column heading" field. This assigned name becomes the name of the parameter for display, trending, and reporting purposes. Make it short but descriptive, in order to minimize the width of the column. For example, a wind speed parameter might be named "WSPD" or "WS", scalar wind direction as "WDIR" or "WD", resultant vector wind direction as "vWDIR" or "VWD", unit vector wind direction as "uvWDIR", "uvWD", or "UVWD", ambient temperature as "TEMP" or "TE", maximum (or high) ambient temperature as "maxTEMP", "maxTE" or "MAX TE", soil temperature as "Soil TEMP" or "SOIL TE", relative humidity as "RHUM" or "RH" and so forth.

If you fail to assign a name to the column heading, then you will see column headings without a name, and various parameter selections as "New Parameter." If this happens to you, go back and assign a column heading to fix the problem.

Note: In a network setting, the users of the optional Met Viewer™ software will see the same column heading field names that you assign in Met Manager. Also these assignments will be printed within some of the reports. Make sure that the column heading names are short but descriptive and unambiguous to all personnel that will use the data.

Since a derived parameter depends on one or more primary parameters, it is helpful (but not required) to assign the needed primary parameters to the database parameter list *before* they are needed by a derived parameter. For example, the "dewpoint" derived parameter depends on ambient temperature and relative humidity. Therefore, it is best to assign the ambient temperature and relative humidity parameters to the database parameter list *before* assigning the dewpoint parameter. *In all cases, avoid circular references.*

The order of assignment of the various acquired and derived parameters to the database parameter list defines the final order of the parameters within the database and the initial order of the column headings within the Data View (the Data View is discussed in Section 4.4.) Although not required, consider assigning the most important parameters first (in your judgement), and group like parameters together. In the above example, the wind speed and wind direction parameters were assigned first. Also, the ambient temperature, high temperature and low temperature were grouped together so that their natural display order would be next to each other.

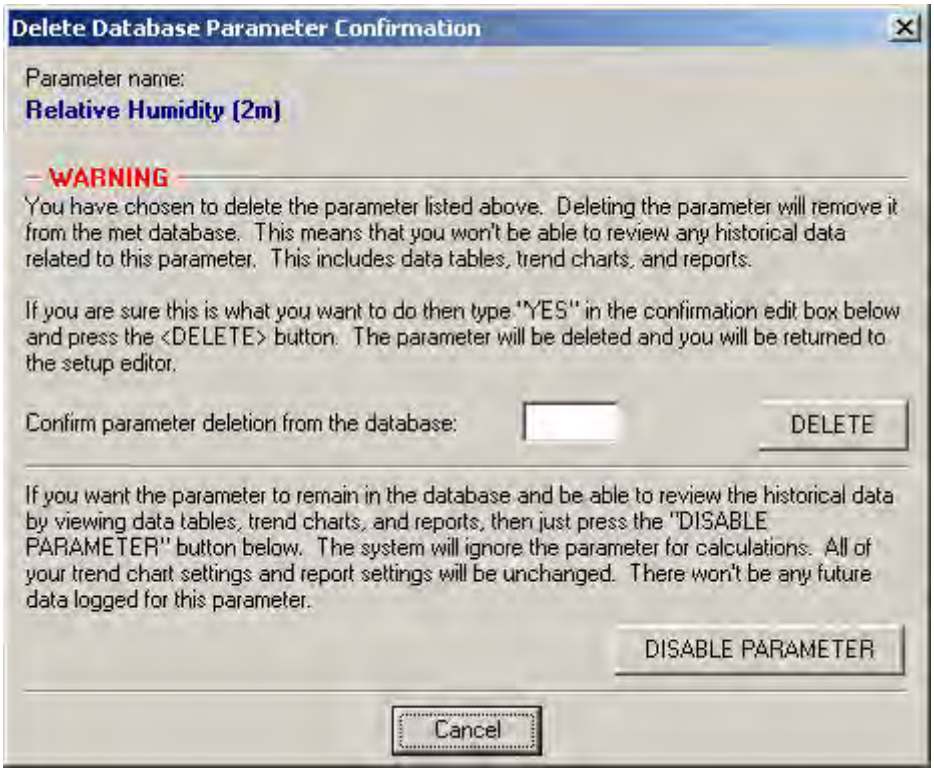
Note: All database parameters require one or more parameter reference assignments. For example, the "Wind Speed" database parameter shown above requires a wind speed data source parameter type. To change the assignment of this parameter reference, press the F6 key, or click on "Edit". If more than parameter reference of the same type is listed, then typically choose the one beginning with the channel number (for example "[1] Wind Speed"). That one is the "data source" parameter and represents the channel's "acquired" value after applying slope and offset values. However, in some cases it may be appropriate to select a derived parameter as the input argument, if the database parameter depends on it.

Note: In some cases when configuring a derived database parameter, the display units are not known until the parameter's argument has been assigned. For example, if you want to derive a "maximum" type database parameter, drag and drop the "maximum" parameter from the "Other" tab to the database list, rename it, then choose its argument (which can be any parameter), and finally select the display unit of choice.

Note: Notice the circle with an "x" on the "Sigma-Theta, Std Dev Wind Direction (2m)" parameter above. This indicates that an improper parameter reference assignment, or no assignment, had been made to that database parameter. Edit the "Parameter References" list to fix the problem. In this particular example, no parameter reference had yet been assigned. Assignment of the "[2] Wind Direction" reference parameter fixed the problem.

Note: Met Manager assigns to each database parameter a "Database tag" as shown in the figure above. This tag is the name of the field within each date/time stamped record of each table of the database that contains the value of the parameter.

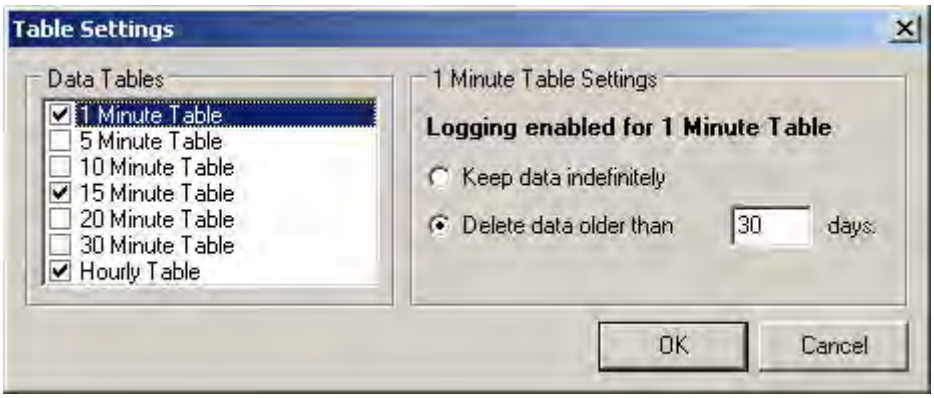
To delete a parameter from the Database Parameter List, select it with your mouse and then press the "delete" key on your keyboard. Met Manager displays the following message to make sure that you intended to delete the parameter:



To confirm deletion, type YES in the requested field and then press the "Delete" button.

3.8 Defining the Data Tables of the Database

Now that you have decided which measured and derived parameters to save in a database, it's time to decide which data tables to include in the database. Each data table represents a different frequency of data. From the Setup menu, select "Data Tables". A figure similar to the following is then shown:



(The above figure is an example only; your configuration may be different.)

Select the various data tables to be included in Met Manager's project folder. For each table chosen, also select an option:

- Keep data indefinitely. In this mode, the data is retained in the selected data table indefinitely.

- Delete data older than. In this mode, only the last specified number of days are retained in the selected data table. For example, if "30" days is specified for the 1 minute table, then at midnight, data older than 30 days will be deleted from the 1 minute data table. This is referred to as "wrapping" the data table.

Note: Normally, if the data is used for EPA or other regulatory purposes, it is best to retain the 15-minute and hourly data indefinitely. However, we recommend that you limit the 1-minute data table to 30 days (or less). Depending on the number of parameters being stored in the data table, a typical data record may be 200 to 300 bytes in size. For a 1-minute data table at 1,440 records per day, this represents a growth of the 1-minute data table at about 281K to 422K per day. A typical 30-day 1-minute data table would thus be 8.5 MB to 12.5 MB in size. Similarly, a 5-minute data table should be limited to 185 days (about 6 months), and a 10-minute data table should be limited to 365 days (a year).

IMPORTANT: When data is "deleted" in the database, it is marked as deleted and can no longer be viewed. However it is not entirely removed. To remove the data entirely, you must "pack" the database. This is done from the Setup menu, and Pack Database selection, and is explained in Section 5.4. If some of the tables are "wrapped", then you should pack the database on a regular schedule as explained in Section 5.4.

Note: Usually for a *new* project, the data tables are not created by Met Manager until the moment the data is first acquired from the data source. This gives you the opportunity to get the data source parameters and database parameters configured properly, and without restructuring of the database (since it doesn't yet exist.) Also, you can later check or uncheck tables to begin or stop adding data to them.

Technical Note: The project database is in Paradox 4 format, level 7. Met Manager connects to these files through the Borland Database Engine (BDE) which is automatically installed on your computer during installation of the software. The database is indexed.

CAUTION: Do not connect directly to the database with another database manager or with a spreadsheet program such as Quattro Pro. Unpredictable results may occur including complete loss of the data. If you wish to experiment, do so with a mirrored copy that no other software is using. If a problem occurs, you may have to delete the mirrored copy, and restart the mirror software to recreate it, *but at least you won't have damaged your master database*. See Appendix B for operation of Met Mirror software that allows mirroring of the project database.

CAUTION: Do not create a copy of the database with a copy program (such as Microsoft Windows Explorer) while data is being logged to the database. During the copy process, new data may be added to the database by Met Manager (or Met Mirror). The copy process can interfere with adding this data by causing index tables to get out of synchronization. The correct procedure is to stop Met Manager (and Met Mirror if running), and then perform the copy. Alternatively, although quite a bit slower, let Met Mirror perform the copy.

3.9 Connecting to the Data Source (Begin Acquiring Data)

If you have followed the above steps, then your system is nearly configured. Now you can connect to a data source and begin collecting data. From the Setup menu, you have two options to connect to a data source:

1. Select "Connect to". A figure similar to the following is then displayed (but usually with only one data source item in the list):

Note: The above figure shows an example of various data sources that can be created from the Setup menu, "Data Sources" submenu. However, not all of the above data sources are available to all data logger configurations (and the actual data sources may have different names than shown above). If your list is blank, then you need to first create the data source from the "Data Sources" submenu. And we recommend that you create only one data source per project.

2. Or, if you had previous set a data source as "default" (with a little check mark above it; see Section 3.5), then simply select "Connect to *data source name*" where "data source name" is the name of the default data source.

If you wish a full-time direct connection to the data source (for example, to your local weather station's data logger) then select the "Direct Connect" data source (or similar name). *All* of the following conditions must be met:

- You have a direct connection to the data logger (by serial cable, direct-connect modems, or wireless radio modems).

- Your data logger is programmed to transmit out a data stream at a regular and repetitive interval and in a way that Met Manager understands. This interval is usually every second or every five seconds depending on your data logger capability.

- You have tested the link between the data logger and the computer that Met Manager resides on, and have confirmed independently of Met Manager (i.e., with Met Manager shut down) that data is being repetitively transmitted from the data logger to the computer. You may have to use vendor-supplied software to perform the test, or the Windows Hyperlink program.

- You have properly created and configured a "direct-connect" data source (from the "Data Sources" submenu) with a communications port, baud rate, and sample rate that matches the configuration of the data logger.

You can choose a "Data Log Capture (COM Port)" data source if *all* of the following conditions are met:

- You have a direct connection to the data logger (by serial cable, direct-connect modems, or wireless radio modems).

- Your data logger has been programmed to store data in its internal log for a period of time (for example, every minute, 5 minutes, or 15 minutes), and Met Manager is aware of how to retrieve data from the log of your particular data logger.

- You want Met Manager to periodically capture (i.e., retrieve) the log on your request (i.e., not automatic).

- You have tested the link between the data logger and the computer that Met Manager resides on, and have confirmed that data can be transmitted from the internal memory log of the data logger to the computer. You may have to use vendor-supplied software to perform the test, or the Windows Hyperlink program.

- You have properly created and configured a "Data Log Capture (COM Port)" data source (from the "Data Sources" submenu) with a communications port, baud rate, and sample rate that matches the configuration of the data logger. In this case the sample rate is the rate at which the data logger logs a data record into its internal memory (for example, once each minute, 5 minutes, or 15 minutes).

You can choose a "Data Log Capture (Modem)" data source if *all* of the following conditions are met:

- Your data logger is located remotely from Met Manager and you do not have a direct connection to the data logger, but do have telephone modem or cellular modem access to the data logger.

- Your data logger has been programmed to store data in its internal log for a period of time, and Met Manager is aware of how to capture (i.e., retrieve) data from the log of your particular data logger.

- You want Met Manager to periodically retrieve the log on your request.

- You have installed the appropriate dial-out modem on the computer that Met Manager resides on. You have also installed the appropriate modem hardware at the data logger.

- You have tested the dial-out link and have confirmed that a log file can be received by the computer that hosts Met Manager. You may have to use vendor-supplied software to perform the test, or the Windows Hyperlink program.

- You have properly created and configured a "Data Log Capture (Modem)" data source (from the "Data Sources" submenu) with a modem device, phone number, and sample rate. In this case, the sample rate is the rate at which the data logger logs a data record into its internal memory (for example, once each 1 minute, 5 minutes, or 15 minutes).

You can choose a CSV or Data Log "File Import" data source if *all* of the following conditions are met:

- You do not have a direct or dial connection to the data logger, but you do have the data in a compatible file format.

- You have properly created and configured a CSV or data log "File Import" type of data source (from the "Data Sources" submenu). You have set the sample rate property of the File Import data source to match the time interval of the data file.

> **CAUTION**: Do not mix and match data sources in a project. A project should be configured with one and only one data source. Otherwise you run the potential of contaminating your project database because there is not necessarily a unique mapping between each data source's parameters and the database's parameters. (It may be possible to setup a common mapping between the data sources, but you will have to experiment. Experiment with a project database that is not important to you.)

Select the appropriate data source, and press the "Connect" button to activate the connection.

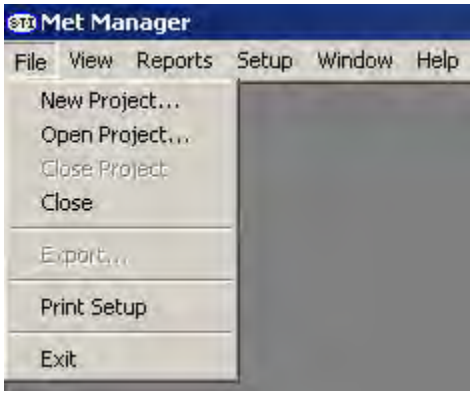
> **Note**: You may get an error message if the "Connect" button is pressed and you do not have a valid connection.

4 USING MET MANAGER

4.1 Connecting to a Project

The first step to acquiring data from a weather station is to assign a place to store the data and project settings. This place is called a "project" and is simply a folder (directory) on a desktop or notebook computer, workstation, or network server.

A new project is created from the File menu with selection of "New Project":



You have two options: (1) create a new project from scratch, or (2) create a new project from an existing project. Follow the steps in Section 3.3.

If a project already exists, then the project can be opened from the File menu with selection of "Open Project." This results in a dialog box (not shown) that allows you to browse and find an existing project folder.

Note: Met Manager checks to ensure that the project you selected is actually a real Met Manager project. If it doesn't find certain files within the project folder, the following error message is given:

4.2 Configuring the Project

After a project has been created, the project must be configured. The steps are:

1. Configure site settings such as latitude, longitude, elevation, and time zone. See Section 3.4.

2. Configure the data source. This defines where the sensory data comes from; for example, continuous direct-connection with the data logger in real time or by dial-up connection to the internal memory log of a data logger. See Section 3.5.

3. Assign parameters to the data source. This defines the various sensor channels and ordering of data received from the data logger, and the units, measurement height, decimal display digits, and coefficients (slope and offset) for converting to base units. See Section 3.6.

4. Assign parameters to be stored in the database. This defines both acquired sensor parameters and derived parameters to be stored in a database for later viewing, trending, reporting and exporting. See Section 3.7.

5. Define data tables and related time intervals to hold the database parameters. Tables include 1, 5, 10, 15, 20, 30-minute, and hourly time intervals. See Section 3.8.

6. Connect to the data source. With this step, Met Manager can begin receiving data from the weather station. See Section 3.9.

7. After following the instructions in Section 3.9, verify that Met Manager is receiving data from the data source. View the data from the Instantaneous View (see Section 4.6) and the Data View (see Section 4.4). If you have intermittent communication problems, review the "Current Data Source Events" tab of the Event Log. See Section 4.5.

8. Calibrate the weather station sensors and subsystems. See Section 5.2 and Appendix E.

9. Review the "Current Faults" tab of the Event Log to ensure that all measured values are within the minimum-to-maximum range defined for each data source parameter. See Sections 4.5 and 3.6.

10. Configure new trend charts and review existing ones (if any). See Sections 4.8, 4.9 and 4.10.

11. Configure new indicator pages (views) and review existing ones (if any). See Sections 4.11 and 4.12.

12. Configure a new wind rose or review an existing one (if any). See Sections 4.13 and 4.14.

13. Configure the Data View and report options. See Section 4.15.

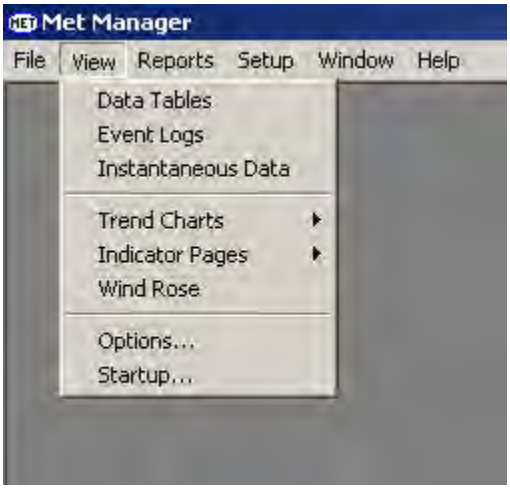
14. Configure display options when Met Manager is started. See Section 4.16.

15. Configure Met Manager to automatically startup when Windows starts up. Place a shortcut of the Met Manager executable program (MetMgr.exe) in the Windows "Startup" folder. This folder may be located under "Administrators", "All Users", "Default Users", or may be applicable only to your particular log-on profile depending on your version of Microsoft Windows. Check with your network or system administrator for the proper startup folder to contain the Met Manager shortcut.

    Command line options are not required but are useful for forcing Met Manager to open a particular project and data source when starting up in Windows. If you use a command line option, you will want to assign it to the Met Manager shortcut in the Windows "Startup" folder. See Appendix D.

4.3 View Menu

The following figure shows the View menu:



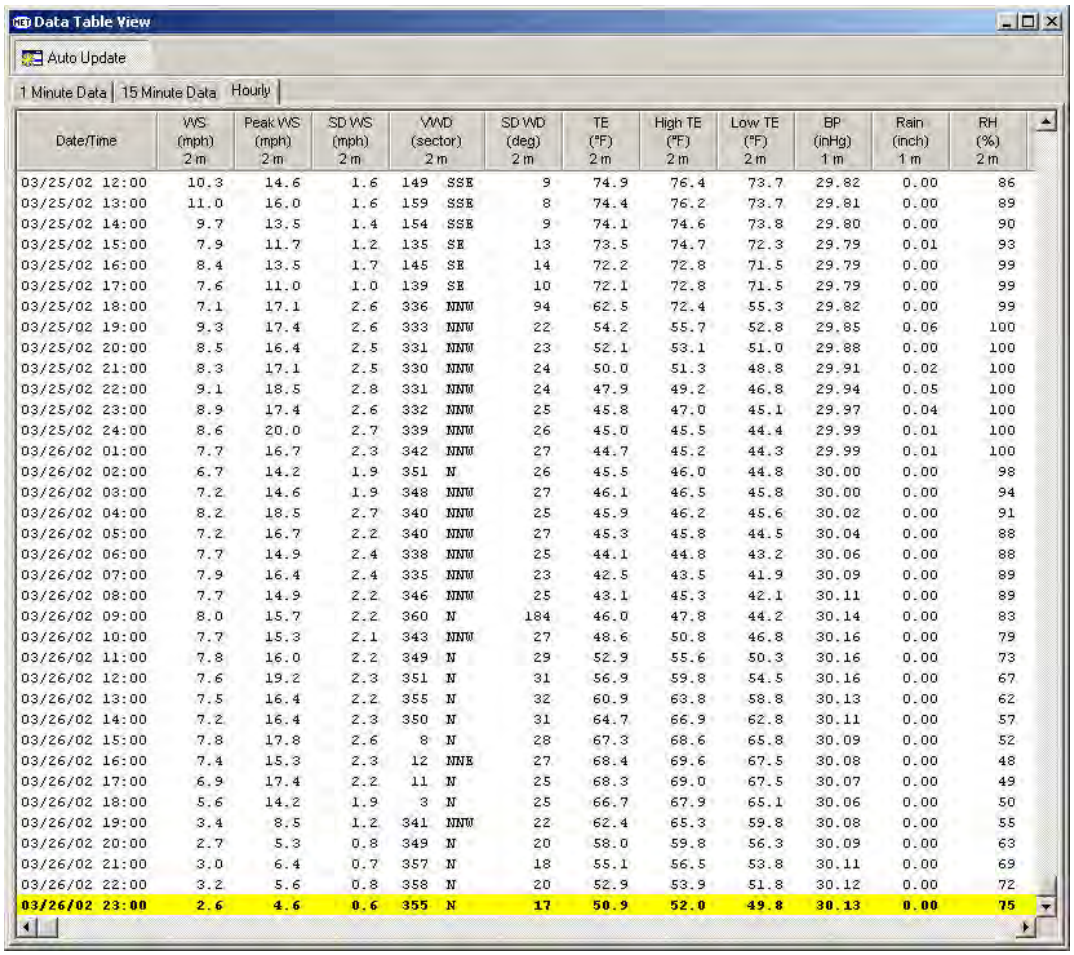
The View menu allows you to:

- View the data tables (referred to as the Data View). See Section 4.4.
- View event logs (Event Log View). See Section 4.5.
- View instantaneous data (Instantaneous View). See Section 4.6
- Create and view trend charts (Trend Chart View). See Sections 4.8, 4.9 and 4.10.
- Create and view indicator pages (Indicator View). See Sections 4.11 and 4.12.

- Create and view a wind rose (Wind Rose View). See Sections 4.13 and 4.14.
- Set view and report options. See Section 4.15.
- Set display options when starting Met Manager (startup options). See Section 4.16.

4.4 Viewing Data Tables

To view the data tables, select "Data Tables" from the View menu. Below is an example of the data table view (or simply Data View).



Data Table View

Auto Update

1 Minute Data | 15 Minute Data | Hourly

Date/Time	WS (mph) 2 m	Peak WS (mph) 2 m	SD WS (mph) 2 m	WWD (sector) 2 m		SD WD (deg) 2 m	TE (°F) 2 m	High TE (°F) 2 m	Low TE (°F) 2 m	BP (inHg) 1 m	Rain (inch) 1 m	RH (%) 2 m
03/25/02 12:00	10.3	14.6	1.6	149	SSE	9	74.9	76.4	73.7	29.82	0.00	86
03/25/02 13:00	11.0	16.0	1.6	159	SSE	8	74.4	76.2	73.7	29.81	0.00	89
03/25/02 14:00	9.7	13.5	1.4	154	SSE	9	74.1	74.6	73.8	29.80	0.00	90
03/25/02 15:00	7.9	11.7	1.2	135	SE	13	73.5	74.7	72.3	29.79	0.01	93
03/25/02 16:00	8.4	13.5	1.7	145	SE	14	72.2	72.8	71.5	29.79	0.00	99
03/25/02 17:00	7.6	11.0	1.0	139	SE	10	72.1	72.8	71.5	29.79	0.00	99
03/25/02 18:00	7.1	17.1	2.6	336	NNW	94	62.5	72.4	55.3	29.82	0.00	99
03/25/02 19:00	9.3	17.4	2.6	333	NNW	22	54.2	55.7	52.8	29.85	0.06	100
03/25/02 20:00	8.5	16.4	2.5	331	NNW	23	52.1	53.1	51.0	29.88	0.00	100
03/25/02 21:00	8.3	17.1	2.5	330	NNW	24	50.0	51.3	48.8	29.91	0.02	100
03/25/02 22:00	9.1	18.5	2.8	331	NNW	24	47.9	49.2	46.8	29.94	0.05	100
03/25/02 23:00	8.9	17.4	2.6	332	NNW	25	45.8	47.0	45.1	29.97	0.04	100
03/25/02 24:00	8.6	20.0	2.7	339	NNW	26	45.0	45.5	44.4	29.99	0.01	100
03/26/02 01:00	7.7	16.7	2.3	342	NNW	27	44.7	45.2	44.3	29.99	0.01	100
03/26/02 02:00	6.7	14.2	1.9	351	N	26	45.5	46.0	44.8	30.00	0.00	98
03/26/02 03:00	7.2	14.6	1.9	348	NNW	27	46.1	46.5	45.8	30.00	0.00	94
03/26/02 04:00	8.2	18.5	2.7	340	NNW	25	45.9	46.2	45.6	30.02	0.00	91
03/26/02 05:00	7.2	16.7	2.2	340	NNW	27	45.3	45.8	44.5	30.04	0.00	88
03/26/02 06:00	7.7	14.9	2.4	338	NNW	25	44.1	44.8	43.2	30.06	0.00	88
03/26/02 07:00	7.9	16.4	2.4	335	NNW	23	42.5	43.5	41.9	30.09	0.00	89
03/26/02 08:00	7.7	14.9	2.2	346	NNW	25	43.1	45.3	42.1	30.11	0.00	89
03/26/02 09:00	8.0	15.7	2.2	360	N	184	46.0	47.8	44.2	30.14	0.00	83
03/26/02 10:00	7.7	15.3	2.1	343	NNW	27	48.6	50.8	46.8	30.16	0.00	79
03/26/02 11:00	7.8	16.0	2.2	349	N	29	52.9	55.6	50.3	30.16	0.00	73
03/26/02 12:00	7.6	19.2	2.3	351	N	31	56.9	59.8	54.5	30.16	0.00	67
03/26/02 13:00	7.5	16.4	2.2	355	N	32	60.9	63.8	58.8	30.13	0.00	62
03/26/02 14:00	7.2	16.4	2.3	350	N	31	64.7	66.9	62.8	30.11	0.00	57
03/26/02 15:00	7.8	17.8	2.6	8	N	28	67.3	68.6	65.8	30.09	0.00	52
03/26/02 16:00	7.4	15.3	2.3	12	NNE	27	68.4	69.6	67.5	30.08	0.00	48
03/26/02 17:00	6.9	17.4	2.2	11	N	25	68.3	69.0	67.5	30.07	0.00	49
03/26/02 18:00	5.6	14.2	1.9	3	N	25	66.7	67.9	65.1	30.06	0.00	50
03/26/02 19:00	3.4	8.5	1.2	341	NNW	22	62.4	65.3	59.8	30.08	0.00	55
03/26/02 20:00	2.7	5.3	0.8	349	N	20	58.0	59.8	56.3	30.09	0.00	63
03/26/02 21:00	3.0	6.4	0.7	357	N	18	55.1	56.5	53.8	30.11	0.00	69
03/26/02 22:00	3.2	5.6	0.8	358	N	20	52.9	53.9	51.8	30.12	0.00	72
03/26/02 23:00	2.6	4.6	0.6	355	N	17	50.9	52.0	49.8	30.13	0.00	75

(The above figure is an example only; your configuration may be different.)

Each data table that you enabled when setting up the software (in Section 3.8) shows up on a separate tab on the Data View. Select the tab with your mouse to view the data.

To review the past data history, press the Page Up key, or drag the thumb bar located on the right of the display up or down with your mouse. You can also pan the view to see channels of data that may be located to the right of the display view. Drag the bottom horizontal thumb bar to the left or right to pan the view.

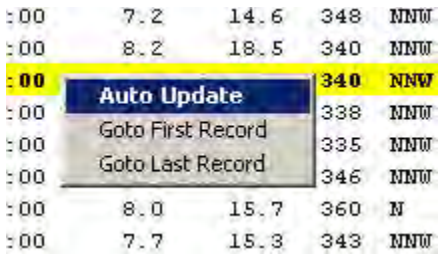
The "Auto Update" button (located in the upper left corner) is used to keep the display from being refreshed when new data arrives. Press this button to "freeze" the view. Press it again to unfreeze it. The operation of the button is:

- When highlighted (depressed), the display will update (refresh) with the arrival of new data. This is the normal setting.

- When not highlighted (not depressed), the display will not be affected by the arrival of new data.

When the Data View has been positioned so that the most current record is not highlighted, then a timer is started to keep new incoming data from refreshing the view. Within 15 minutes of no keyboard or mouse activity (that changes the highlighted record), the timer times out, and the view is refreshed (if the Auto Update button was highlighted prior to changing the Data View).

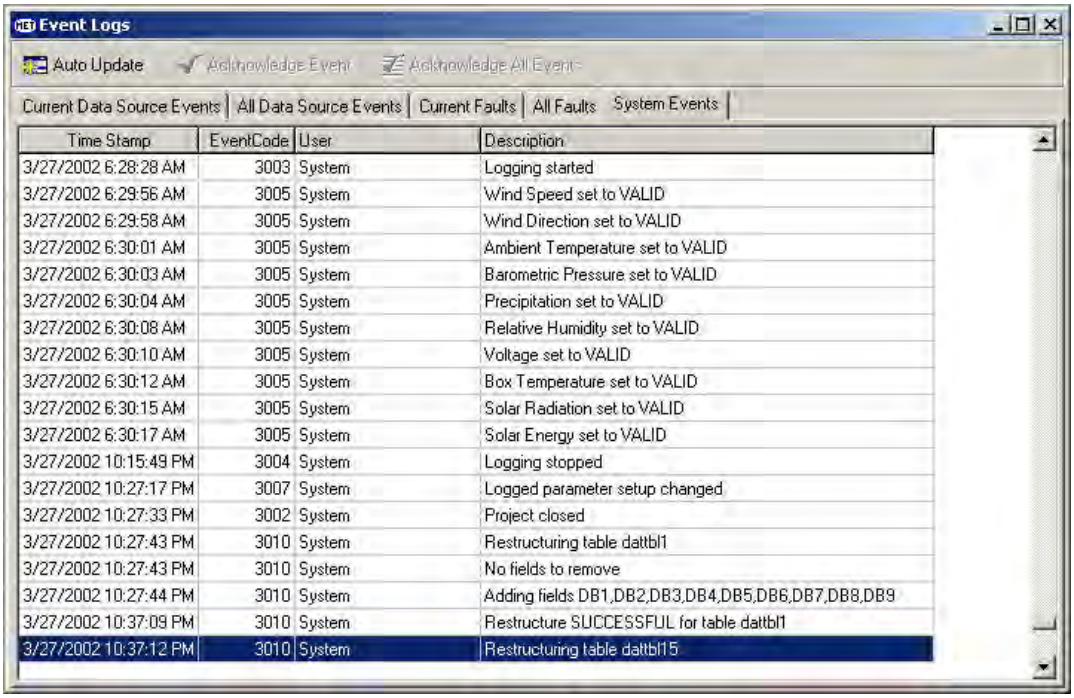
To go to the first or last record in the data table, or to force an auto-update, right-click with your mouse somewhere on the Data View. The following options are then displayed:



Note: Met Manager presents its data stamped with local standard time. During daylight savings time, the time stamp may be less than your local computer time by one hour.

4.5 Viewing Event Logs

Met Manager tracks communication faults, sensor faults, and system events. To view the event logs, select "Event Logs" from the View menu. Below is an example of the Event Log View:



Time Stamp	EventCode	User	Description
3/27/2002 6:28:28 AM	3003	System	Logging started
3/27/2002 6:29:56 AM	3005	System	Wind Speed set to VALID
3/27/2002 6:29:58 AM	3005	System	Wind Direction set to VALID
3/27/2002 6:30:01 AM	3005	System	Ambient Temperature set to VALID
3/27/2002 6:30:03 AM	3005	System	Barometric Pressure set to VALID
3/27/2002 6:30:04 AM	3005	System	Precipitation set to VALID
3/27/2002 6:30:08 AM	3005	System	Relative Humidity set to VALID
3/27/2002 6:30:10 AM	3005	System	Voltage set to VALID
3/27/2002 6:30:12 AM	3005	System	Box Temperature set to VALID
3/27/2002 6:30:15 AM	3005	System	Solar Radiation set to VALID
3/27/2002 6:30:17 AM	3005	System	Solar Energy set to VALID
3/27/2002 10:15:49 PM	3004	System	Logging stopped
3/27/2002 10:27:17 PM	3007	System	Logged parameter setup changed
3/27/2002 10:27:33 PM	3002	System	Project closed
3/27/2002 10:27:43 PM	3010	System	Restructuring table dattbl1
3/27/2002 10:27:43 PM	3010	System	No fields to remove
3/27/2002 10:27:44 PM	3010	System	Adding fields DB1,DB2,DB3,DB4,DB5,DB6,DB7,DB8,DB9
3/27/2002 10:37:09 PM	3010	System	Restructure SUCCESSFUL for table dattbl1
3/27/2002 10:37:12 PM	3010	System	Restructuring table dattbl15

When there are events in the "Current Data Source Events" or "Current Faults" logs, select the event and then press the "Acknowledge Event" button to tell Met Manager that you are aware of the event. Met Manager will retain the event in the respective "All Data Source Events" or "All Faults" log, but will remove the event from the "Current …" log. Or you can press the "Acknowledge All Events" button to acknowledge all events within a "Current …" event log.

System events are always retained in the "System Events" log.

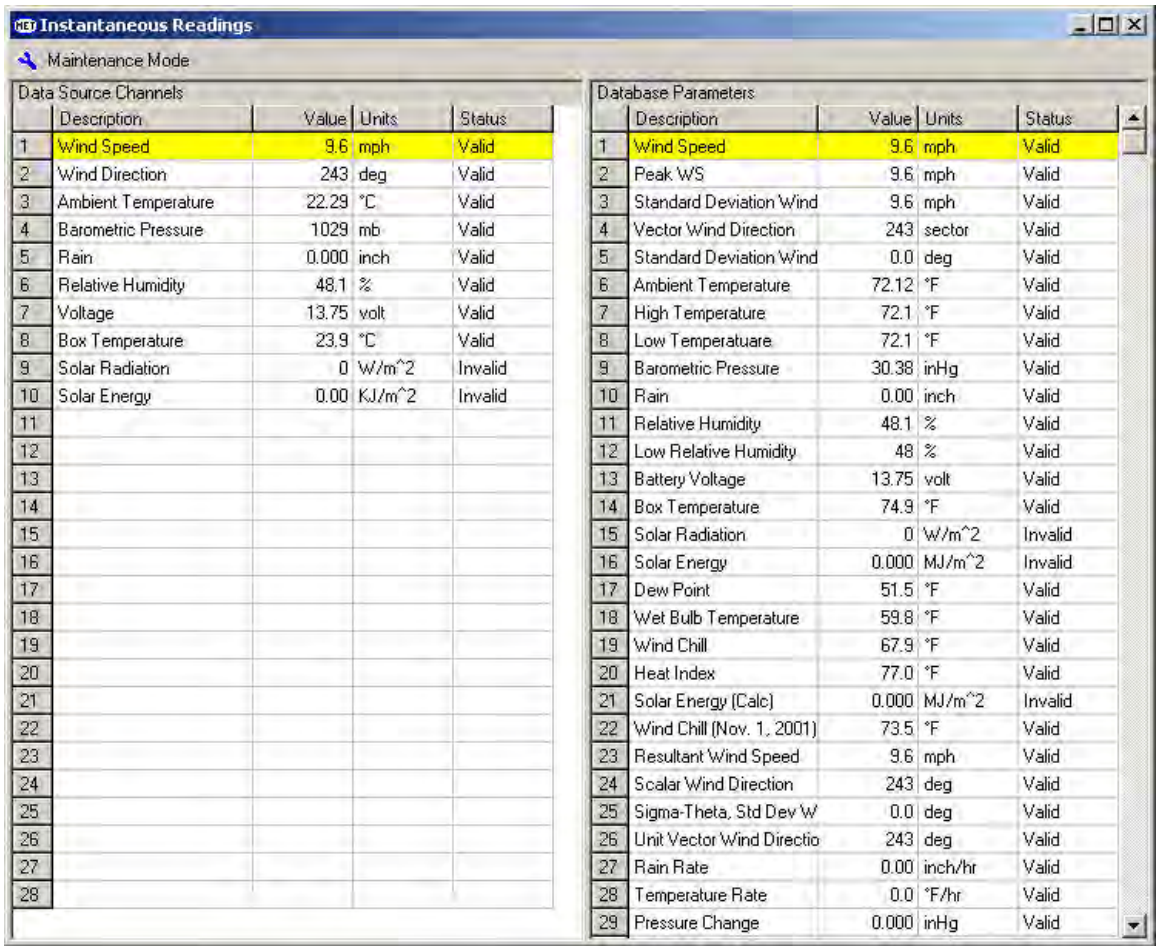
Refer to the following table for a list of various event codes:

Type of Event Log	Event Code	Description of Event
Data Source Events	1001	Communications timeout
	1002	[count] Incorrect packet format. "Count" is the number of occurrences. If count = 1 then reported at date and time of occurrence. If count > 1 then reported at the end of the hour of occurrence.
Faults	2001	Value of parameter back within min/max limits
	2002	Reserved
	2003	Reserved
	2004	Min limit fault value (V) limit (L) unit Where "V" = value that triggered fault, "L" = imposed minimum limit, "unit" = reported unit
	2005	Max limit fault value (V) limit (L) unit

		Where "V" = value that triggered fault, "L" = imposed maximum limit, "unit" = reported unit
System Events	3001	Project opened
	3002	Project closed
	3003	Logging started
	3004	Logging stopped
	3005	Parameter set to VALID (or invalid or calibration status)
	3006	Data source parameter setup changed
	3007	Database parameter setup changed
	3008	Data table setup changed
	3009	Pack SUCCESSFUL for table TBL 1, TBL 2, etc. (or unsuccessful status is reported)
	3010	Data table restructure status (one of): • Restructuring table TBL 1, TBL 2, etc. • No fields to remove • Adding fields DB1, DB2, etc. • Restructure successful for table TBL 1, etc.

4.6 Viewing Instantaneous Data

The Instantaneous View is useful when Met Manager is directly-connected to a weather station and gets data from the data logger of the weather station on a frequent basis. Below is an example of the Instantaneous View:



Instantaneous Readings

Maintenance Mode

Data Source Channels

	Description	Value	Units	Status
1	Wind Speed	9.6	mph	Valid
2	Wind Direction	243	deg	Valid
3	Ambient Temperature	22.29	°C	Valid
4	Barometric Pressure	1029	mb	Valid
5	Rain	0.000	inch	Valid
6	Relative Humidity	48.1	%	Valid
7	Voltage	13.75	volt	Valid
8	Box Temperature	23.9	°C	Valid
9	Solar Radiation	0	W/m^2	Invalid
10	Solar Energy	0.00	KJ/m^2	Invalid
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				

Database Parameters

	Description	Value	Units	Status
1	Wind Speed	9.6	mph	Valid
2	Peak WS	9.6	mph	Valid
3	Standard Deviation Wind	9.6	mph	Valid
4	Vector Wind Direction	243	sector	Valid
5	Standard Deviation Wind	0.0	deg	Valid
6	Ambient Temperature	72.12	°F	Valid
7	High Temperature	72.1	°F	Valid
8	Low Temperatuare	72.1	°F	Valid
9	Barometric Pressure	30.38	inHg	Valid
10	Rain	0.00	inch	Valid
11	Relative Humidity	48.1	%	Valid
12	Low Relative Humidity	48	%	Valid
13	Battery Voltage	13.75	volt	Valid
14	Box Temperature	74.9	°F	Valid
15	Solar Radiation	0	W/m^2	Invalid
16	Solar Energy	0.000	MJ/m^2	Invalid
17	Dew Point	51.5	°F	Valid
18	Wet Bulb Temperature	59.8	°F	Valid
19	Wind Chill	67.9	°F	Valid
20	Heat Index	77.0	°F	Valid
21	Solar Energy (Calc)	0.000	MJ/m^2	Invalid
22	Wind Chill (Nov. 1, 2001)	73.5	°F	Valid
23	Resultant Wind Speed	9.6	mph	Valid
24	Scalar Wind Direction	243	deg	Valid
25	Sigma-Theta, Std Dev W	0.0	deg	Valid
26	Unit Vector Wind Directio	243	deg	Valid
27	Rain Rate	0.00	inch/hr	Valid
28	Temperature Rate	0.0	°F/hr	Valid
29	Pressure Change	0.000	inHg	Valid

(The above figure is an example only; your configuration may be different.)

In the above figure, the channels on the left side of the display represent the *acquired* "data source" parameters that were received from the data source (e.g., data logger), and after both base unit conversion and calibration adjustments have been applied. See Section 3.6. These values are in base units.

The channels on the right side of the display represent the "database" parameters that were configured in the Database Parameter List, and that are to be stored in the data tables. See Section 3.7. These values also include calibration adjustments.

Once you have connected to a data source (e.g., a data logger), Met Manager can begin receiving data. If the data source is of the kind "direct-connect", and your data logger is working and properly connected to the same computer that is running Met Manager, then Met Manager should begin receiving the data. In that case, the Instantaneous View will update at the sample rate specified in the properties of the data source, and the "Missing" status will change to "Valid", "Invalid", or "Calibrate" depending on the prior configuration of the channel. See Sections 3.6 and 5.1.

Note: If necessary, consult other information supplied with the weather station or data logger to independently confirm that the weather station is properly connected to the computer. With Met Manager not running (that is, shut down), use instructions separate from this User's Manual to confirm that data is flowing between the data logger and the computer. For example, with some data loggers, and in conjunction with manufacturer-supplied instructions, you can use Microsoft's "Hyperlink" program to connect to the data logger and view the data on your computer. Or there may be a special diagnostic or test program supplied with your weather station hardware. *In summary, you cannot expect Met Manager to receive the data from the data logger if the data is not arriving at your computer, or if there is a cabling or communication problem of some kind.*

4.7 Maintenance and Calibration

4.7.1 Setting the Status of a Channel

To activate special maintenance functions such as setting a data source parameter to invalid or calibration status, see Section 5.1.

Note: If a data source parameter is set to invalid or calibration status, then derived database parameters that depend on that parameter will also be set to invalid or calibration status.

4.7.2 Calibrating a Channel

To set the calibration coefficients (slope and offset) of a data source parameter (channel), see Section 5.2.

4.7.3 Activating a Debug Log

For troubleshooting, you may want to capture and inspect the raw data coming from your data logger. You can setup a text file to hold the raw data if your data logger has a continuous connection to the computer. See Section 5.3 for activating a debug log file.

4.7.4 Packing the Database

The database managed by Met Manager must be periodically packed to permanently remove records that have been deleted. This affects those data tables that have been setup with a "wrap" interval. See Section 5.4 for a recommended pack schedule and more information.

4.7.5 Restructuring the Database

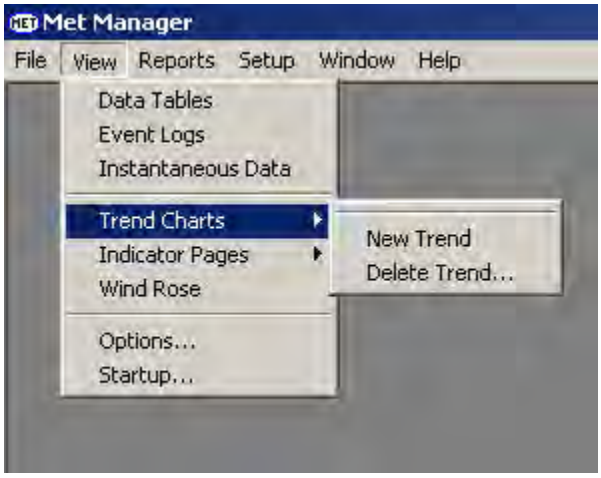
The database managed by Met Manager must be restructured when additions or deletions are made to the database parameters. Met Manager normally handles this restructure on its own when additions or deletions are made. However, see Section 5.5 on guidelines to follow if the normal restructure operation did not complete for some reason.

4.8 Creating Trend Charts

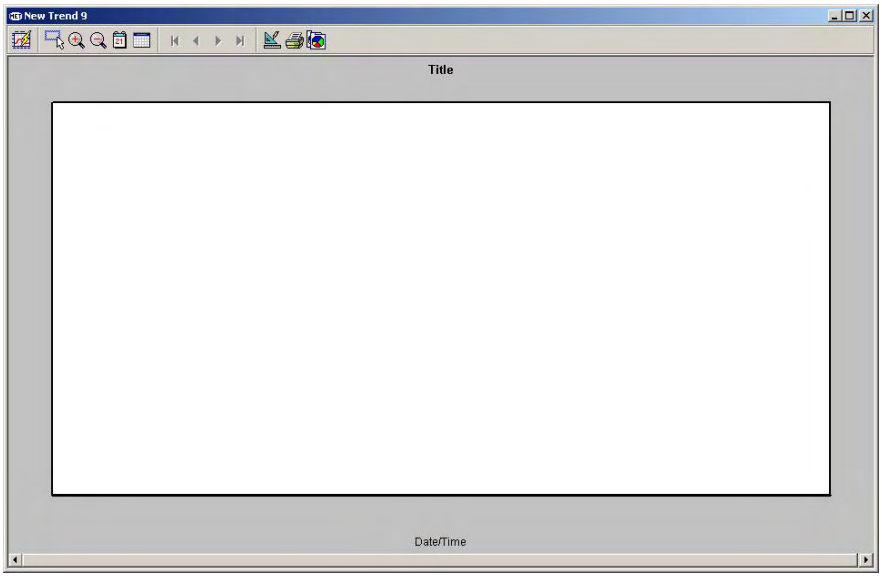
4.8.1 Creating a New Trend Chart

You can easily setup single or dual-axis and single or dual trend charts to review your weather data. Each trend chart can have multiple traces.

To create a new trend chart, select "Trend Charts", then "New Trend" from the View menu:



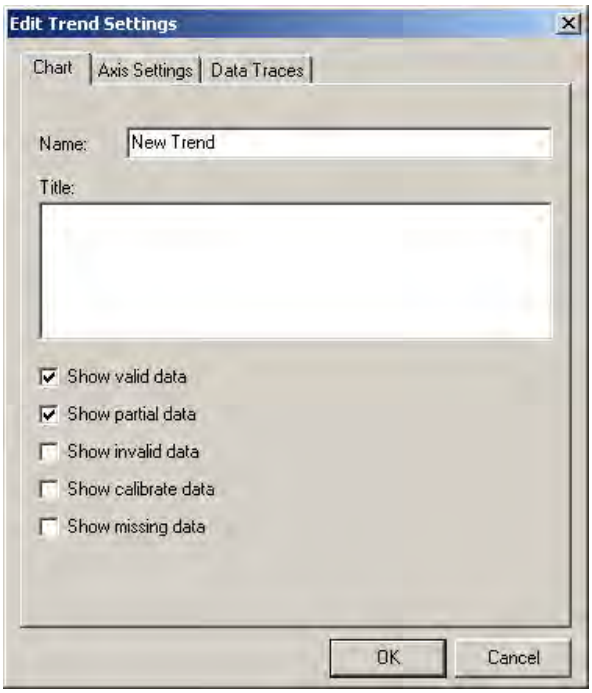
A new blank trend chart is shown below.



Let's setup a trend chart titled "Wind Direction" based on 15-minute scalar wind direction.

IMPORTANT: You must have a "scalar wind direction" database parameter already configured in order to create a "wind direction" trend chart by using the information in this section. If you don't have a "scalar wind direction" database parameter but have setup a resultant vector or unit vector wind direction parameter, then use that instead in order to follow along with the example. *It's also best if some wind direction data has already been acquired.*

Press the "Edit Trend Settings" tool button located on the tool bar. The "Edit Trend Settings" dialog is then shown:



Give the trend chart a name in the "Name" field and a title in the "Title" field. The name you provide is the name that appears in the Trend Chart list of the View menu, as well as Met Manager's "Window" menu. Overtype the default name "New Trend" with "Wind Direction". The "Title" is the information that you want to appear at the top of the trend chart. Set it also to "Wind Direction" if that's the title you want on the chart. Then check the appropriate boxes to filter certain types of data from the trend chart:

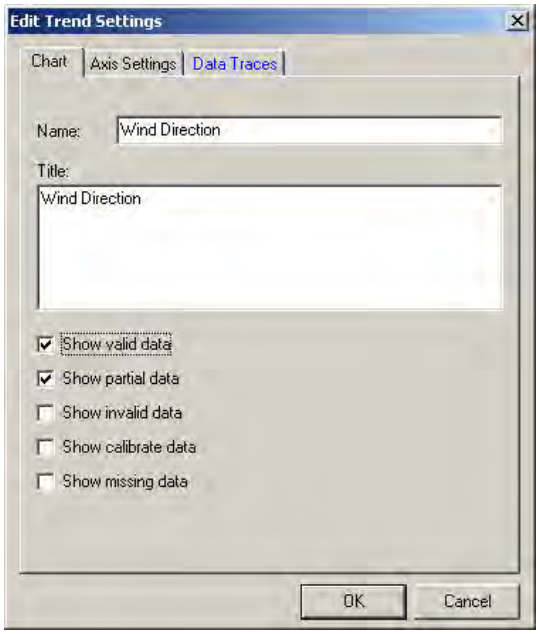
- Check "Show valid data" to display valid data on the chart. *This box is checked for normal operation.*

- Check "Show partial data" to display partial data on the chart. Partial data occurs when some valid samples were acquired over the time interval, but less than three-quarters of the expected data. For example, if the data sample rate is 5 seconds and the data reporting interval is 15 minutes, then valid data will be flagged as "partial" if fewer than 135 samples are acquired over the

interval (a full 15-minute interval would have 180 five-second samples). *This box is checked for normal operation.*

- Similarly, check the remaining boxes to display other types of data. Checking these boxes is useful when diagnosing problems. *These boxes are normally unchecked.*

The following dialog shows the new settings:



Note: Met Manager tags a channel's data, and any parameters derived from that channel, according to the channel's accumulated valid, invalid, calibration, missing, or partial status, based on the following rules:

- If more than three-fourths of the acquired samples are valid, then the channel is tagged as "valid". Samples that are detected by Met Manager as being invalid (i.e., out-of-range), in maintenance mode, undergoing calibration, or are missing are not included in the valid set.

- If at least one valid sample is acquired during the reporting interval, but fewer than three-fourths, then the channel's result is tagged as "partial (p)"

- If the samples acquired during the reporting interval are invalid then the channel's result for the reporting interval is tagged as "invalid (x)". Samples can be invalid because of out-of-range detection, or because the user put the channel into "invalid" maintenance mode.

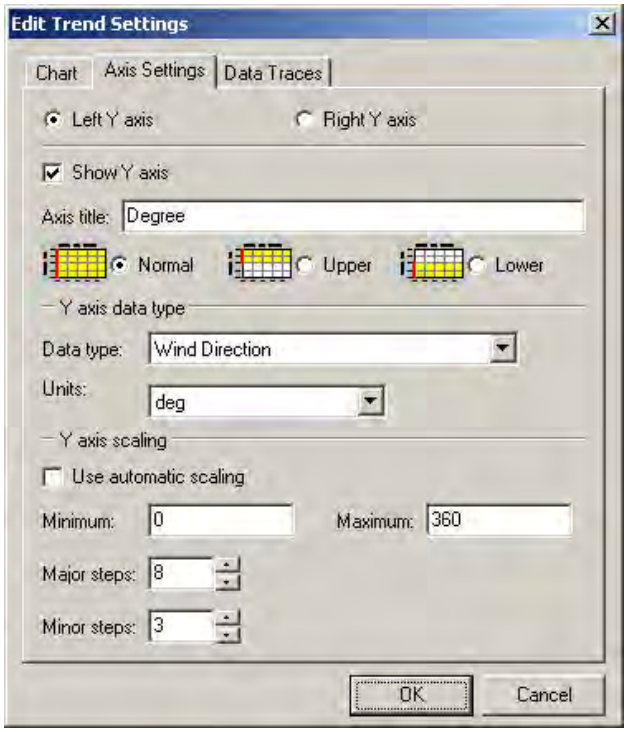
- If the samples acquired during the reporting interval are in calibration mode, then the channel's result for the reporting interval is tagged as "calibration

(c)."

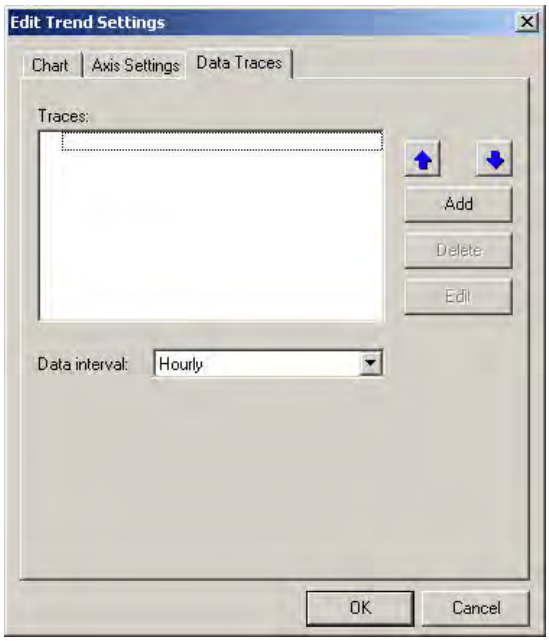
- If all samples acquired during the reporting interval are missing, then the channel's result for the reporting interval is tagged as "missing (m)"

4.8.2 Example of a 0-360 Scalar Wind Direction Trend Chart

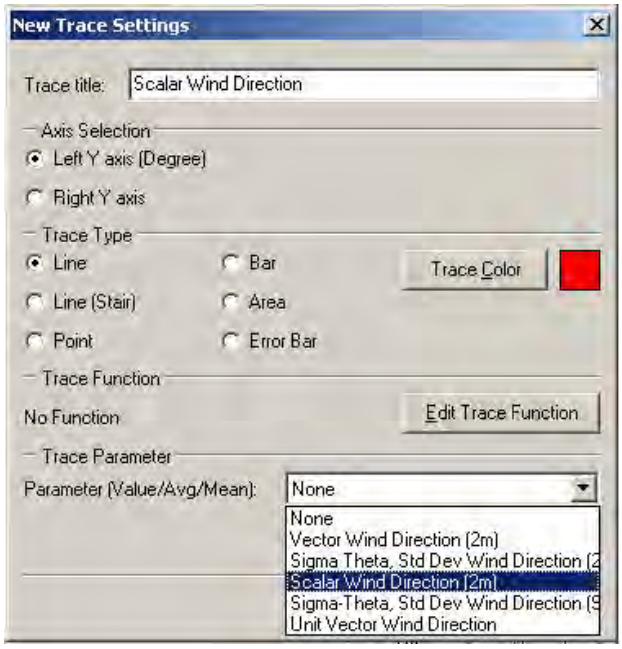
Now let's set up the left vertical axis (Y axis) to show the wind direction parameter's values. Select the "Axis Settings" tab near the top of the dialog. Check the "Show Y axis" box, then set the "Title" of the axis to "Degree". For the axis type, select "Normal" to set up a normal single trend chart. In the "Data type" list box, select the *type* of the parameter, in this case a "wind direction" type. For "Units", select "deg". We want the vertical axis scale to be fixed in the range of 0 to 360 degrees, so uncheck the "Use automatic scaling" box. Set the minimum wind direction value to 0 and the maximum to 360. Specify "Major steps" of 8 to give 8 major graduations of 45 degrees each across the 360 degree range. Specify "Minor steps" of 3 to divide each major graduation into 3 subintervals of 15 degrees each.



Several traces can be added to a trend chart. Let's begin by adding a "scalar wind direction" trace to the wind direction trend chart. Select the "Data Traces" tab near the top of the dialog:



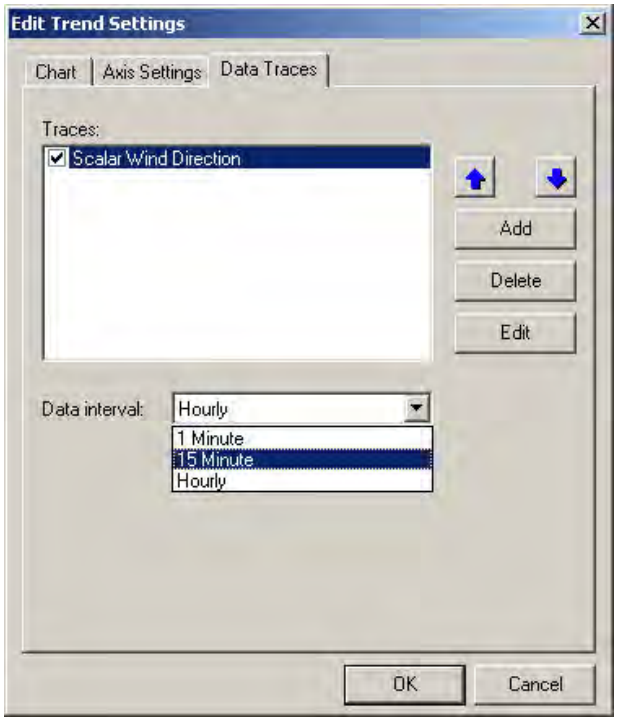
Press the "Add" button to add a new trace to the trend chart. Name the trace title "Scalar Wind Direction". Assign it to the left axis. Pick a trace type of "line" and select a trace color of red. Finally, select the actual parameter to be assigned to the trace. Within the project there are multiple parameters of the "wind direction" type. We are interested in trending the scalar wind direction, so that's the one to select:



(The above figure is an example only; your configuration may be different.)

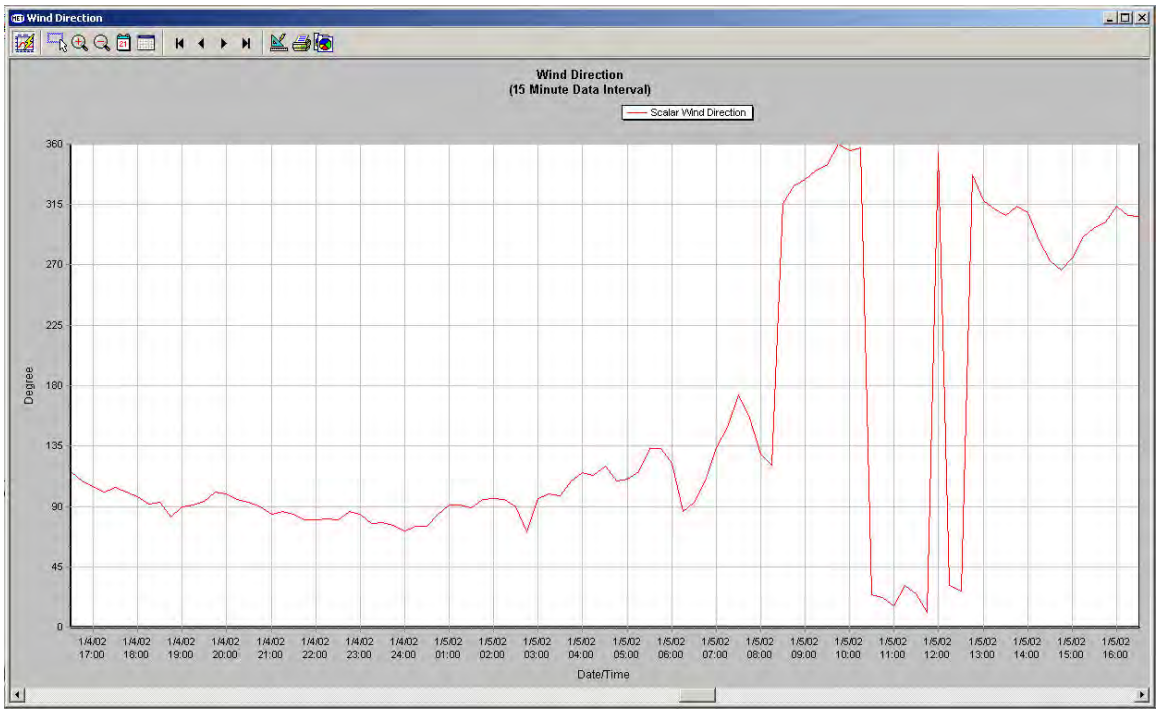
Now it's time to select the data interval. From the "Data Traces" tab, click on the "Data interval" list box to see a list of the data tables that were previously setup in Met

Manager. In the example below, Met Manager was configured to maintain 1 minute, 15 minute, and hourly data tables (in Section 3.8) in the project database. For our example, we want to trend 15-minute data, so we will assign the 15-minute data interval:



Note: In the "Data Traces" tab, you can uncheck the box to the left of the trace title. This will disable the trace. (It's checked by default when a new trace is added.) This is useful when you have several traces assigned to a trend chart, but you want to disable one for some reason. You can always check it later to re-enable it.

Click the OK button to accept the settings. Our example wind direction trend chart is displayed, based on a 0 to 360 degree range:



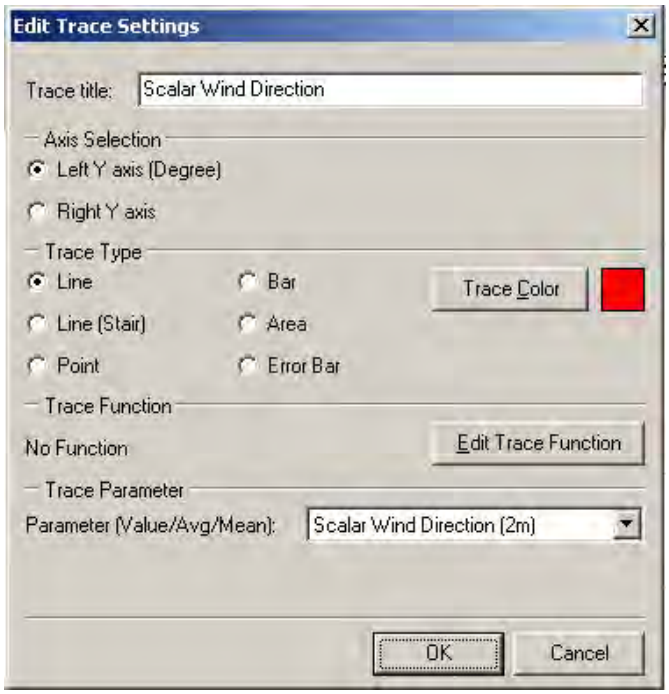
(The above figure is an example only; your configuration may be different.)

Note: Data cannot be trended until it has been acquired.

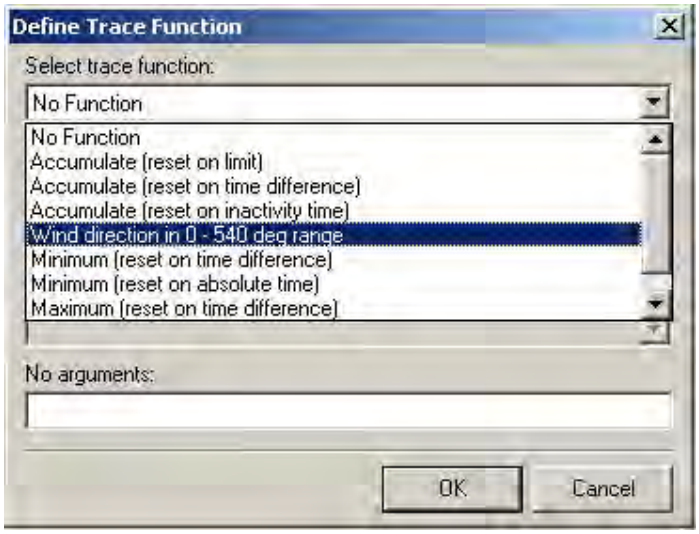
4.8.3 Example of a 0-540 Scalar Wind Direction Trend Chart

The above example shows the wind direction trace jumping back and forth between 0 and 360 degrees. This happens on 0-360 wind systems when the wind direction is from the north. To avoid this, let's change the scale to a 0 to 540 degree range and select a special trace function to map the 0 to 360 degree wind direction to a 0 to 540 degree range.

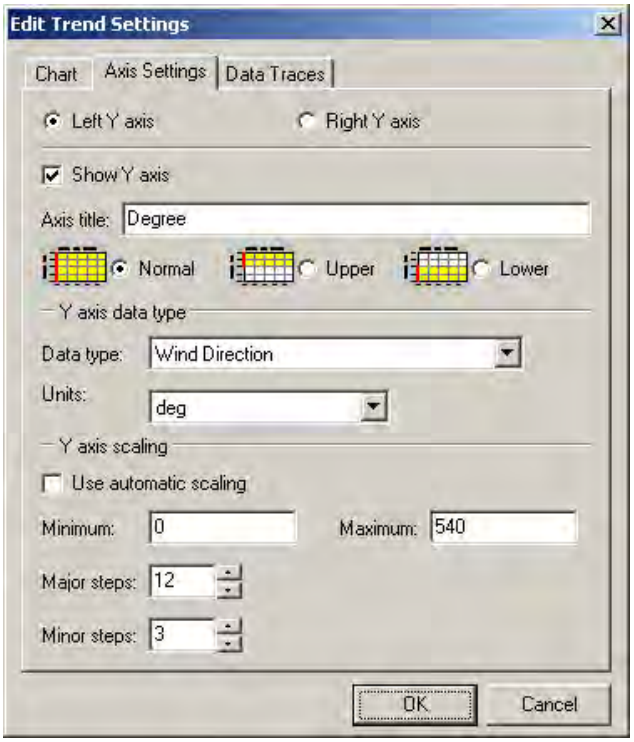
First, select the "Scalar Wind Direction" trace on the "Data Traces" tab, and press the "Edit" button. This brings up the "Edit Trace Settings" dialog:



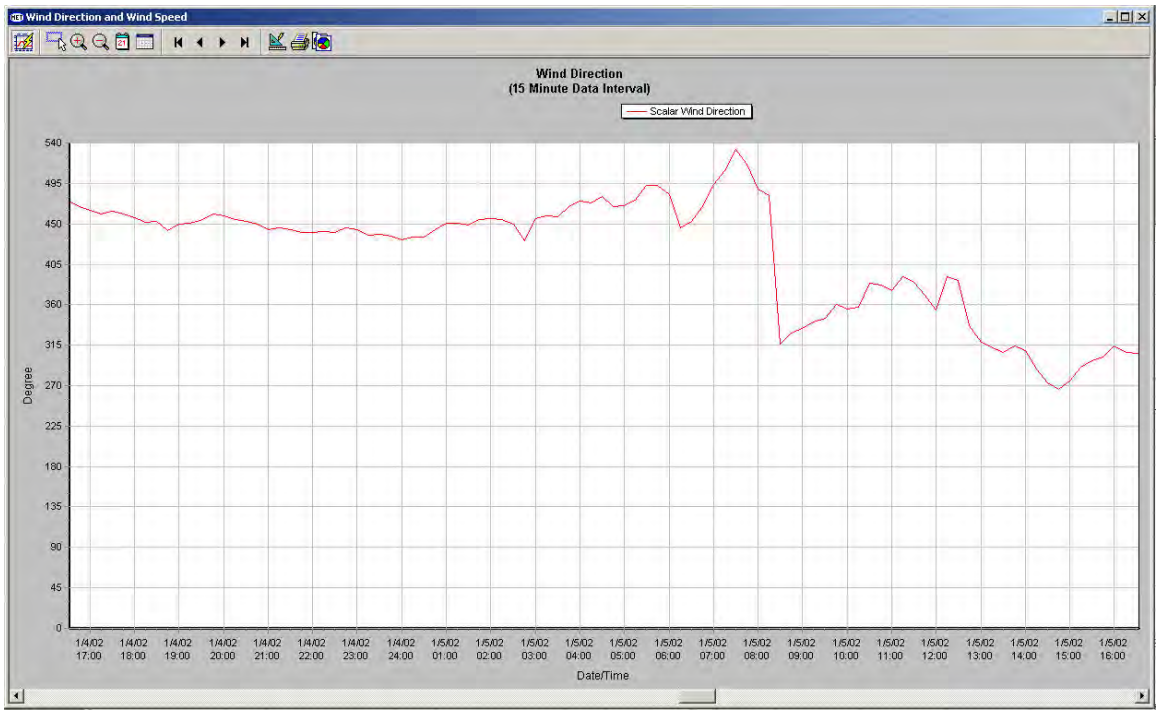
Press the "Edit Trace Function" button, and pick the "Wind direction in 0-540 deg range" trace function from the list box:



Next, change the axis range on the "Axis Settings" tab to match the special trace function of 0 to 540 degrees. Also specify "Major steps" of 12 and "Minor steps" of 3 to give 12 major graduations of 45 degrees each across the range and 3 subintervals of 15 degrees each for each major graduation:



Press the "OK" button to show the wind direction now mapped to a 0 to 540 degree range:



(The above figure is an example only; your configuration may be different.)

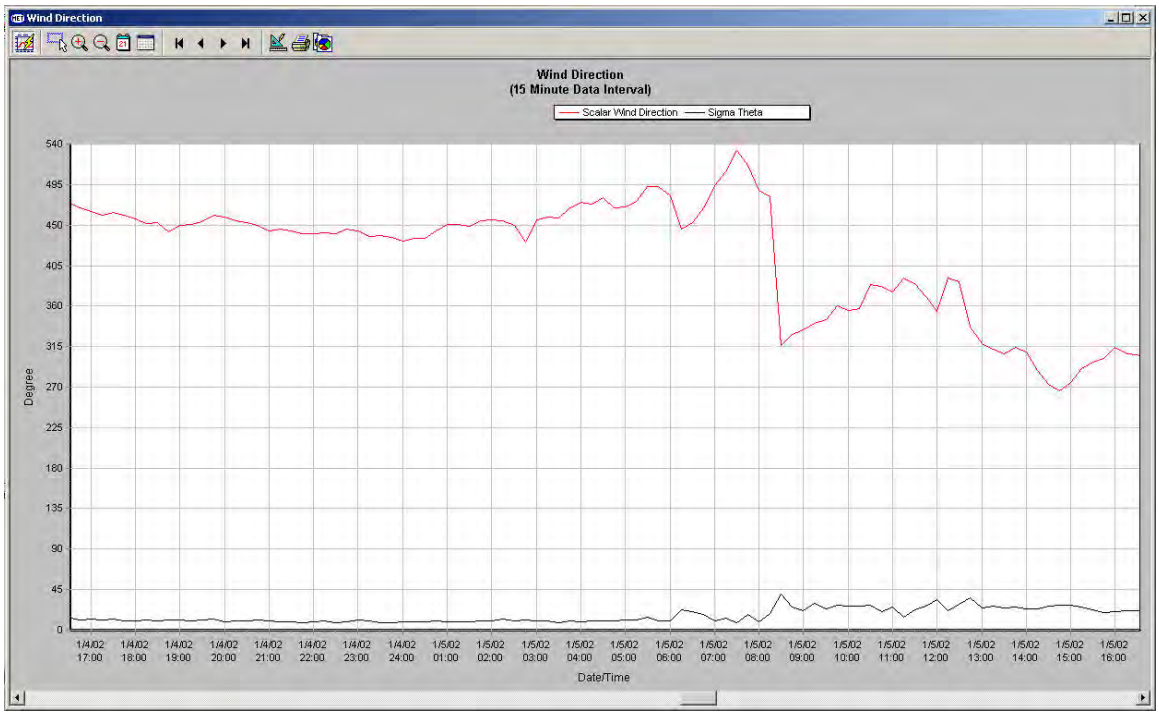
Note: By convention, a calm wind direction is set to 0 degrees and a north wind direction is set to 360 degrees. During calm winds, the wind direction trace will go to zero (unless you have calm wind detection disabled).

4.8.4 Adding Standard Deviation of Wind Direction to the Trend Chart

IMPORTANT: You must have a "Sigma-Theta standard deviation" database parameter already configured in order to create a "Sigma-Theta" trace by using the information in this section. It's also best if some standard deviation data has already been acquired.

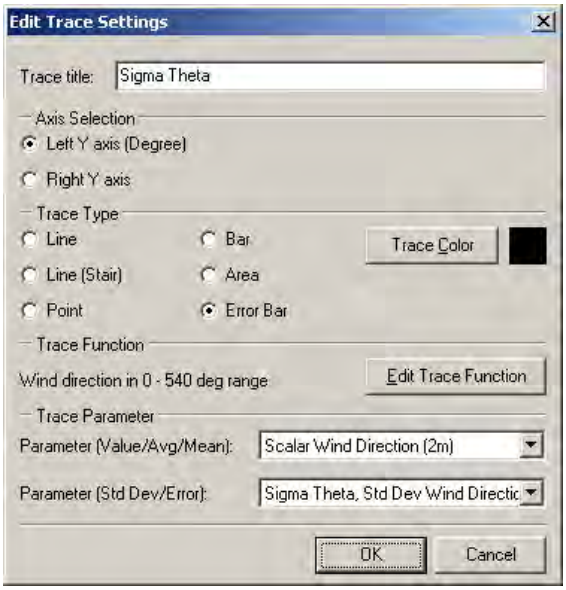
Now let's add a second trace to the trend chart. Since the Y-axis is of the "degree" type (i.e., wind direction), then additional traces assigned to that axis must also be of the same type. Let's add the standard deviation of wind direction, commonly known as "Sigma-Theta". From the "Data Traces" tab, press the "Add" button, name the trace "Sigma Theta" and assign it to the "Left Y axis". Specify the "Trace Type" as a line. Set the trace color to black:

The resulting trend chart shows the standard deviation of the wind direction as a "sigma theta" trace along the bottom of the chart:

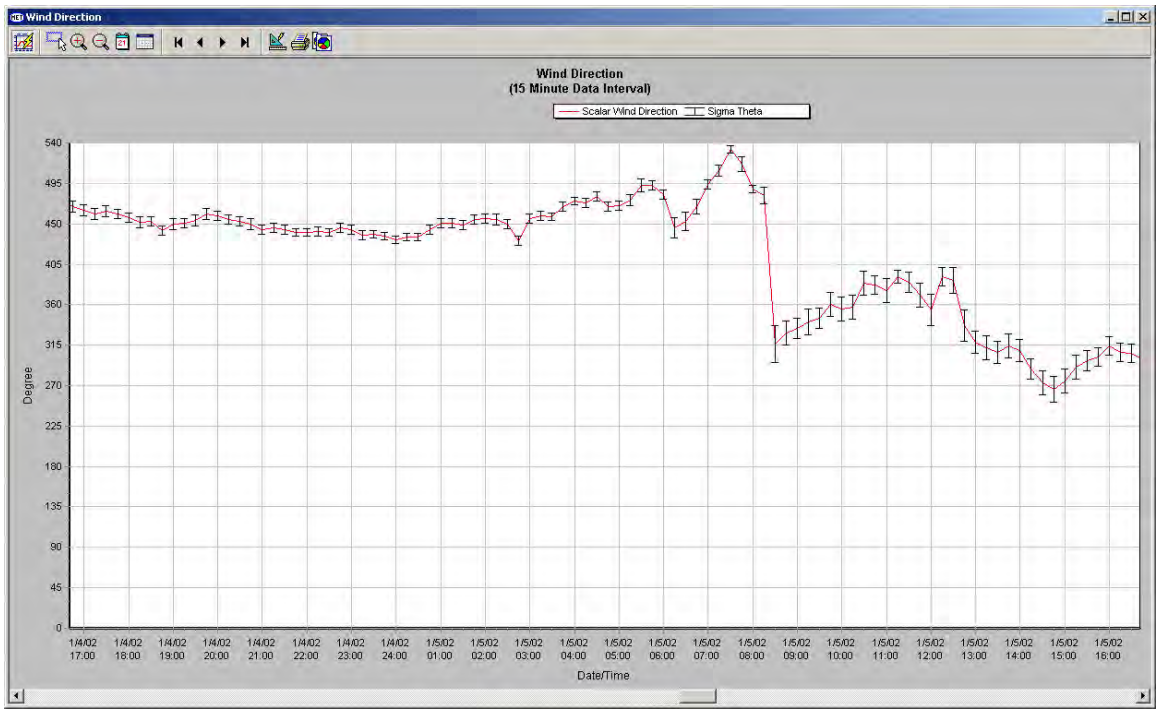


(The above figure is an example only; your configuration may be different.)

Let's center the Sigma Theta trace about the wind direction trace. Select the "Sigma Theta" trace on the "Data Traces" tab. Then press the "Edit" button to change its properties to a "Trace Type" of "Error Bar", "Parameter (Value/Avg/Mean)" to "Scalar Wind Direction", and "Parameter (Std Dev/Error)" to the "Sigma Theta, standard deviation" database parameter. Be sure to press the "Edit Trace Function" button and set the trace function to "Wind direction in 0 - 540 deg range":



This will center the Sigma Theta trace on the Scalar Wind Direction trace as an "error bar", and as illustrated below:



(The above figure is an example only; your configuration may be different.)

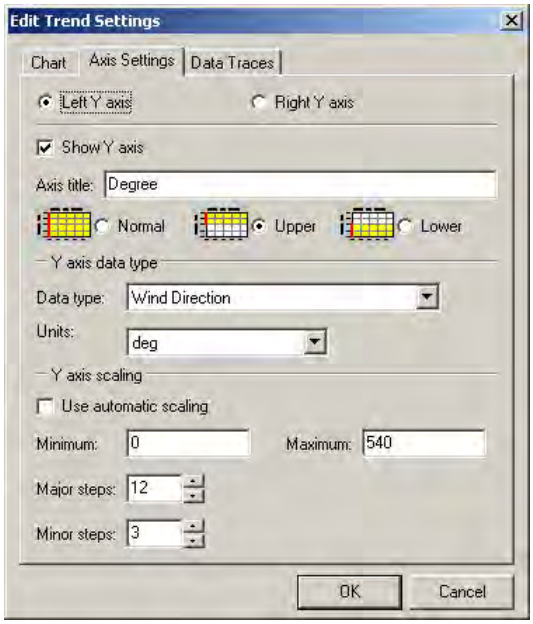
4.8.5 Setting up a Dual Trend Chart with Wind Speed and Wind Direction

IMPORTANT: You must have "wind speed" and "peak wind speed" database parameters already configured in order to create a trend chart by using information in this section. It's also best if some wind speed and peak wind speed data have already been acquired.

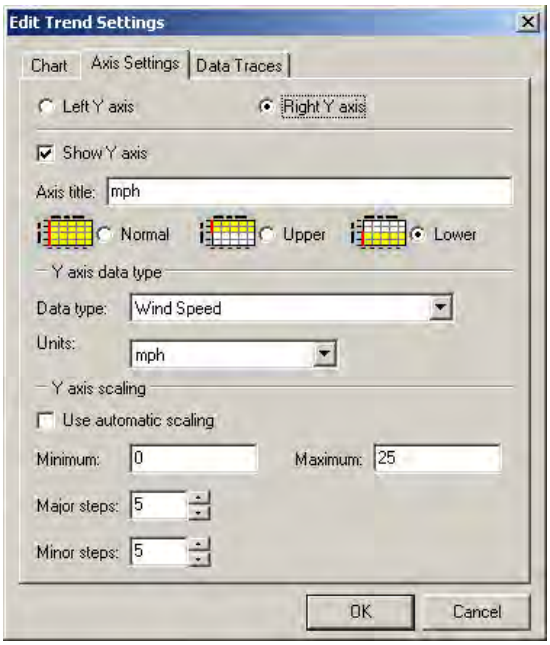
Dual trend charts can be created with one trend chart using one axis (either left or right) and the other trend chart using the other axis. *In this case, each trend chart can use only one axis*. Building on the previous example, let's create an "upper" trend chart that displays scalar wind direction and standard deviation of wind direction (as Sigma-Theta) on its left axis. Let's also create a "lower" trend chart that displays wind speed and peak wind speed on its right axis. The two charts together form a composite "upper/lower" trend chart display.

Begin by editing the Wind Direction trend chart that was previously setup. On its "Chart" tab, rename the chart and its title to "Wind Direction and Wind Speed" because it will become a composite chart:

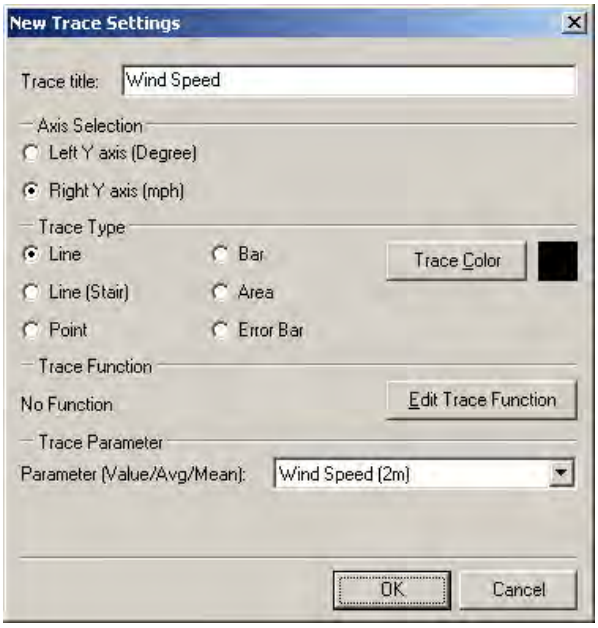
Let's use a *left* Y axis on the upper chart and a new *right* Y axis on the lower chart. Since the Wind Direction chart already uses the left Y axis, let's reassign the left axis display from "normal" to "upper":



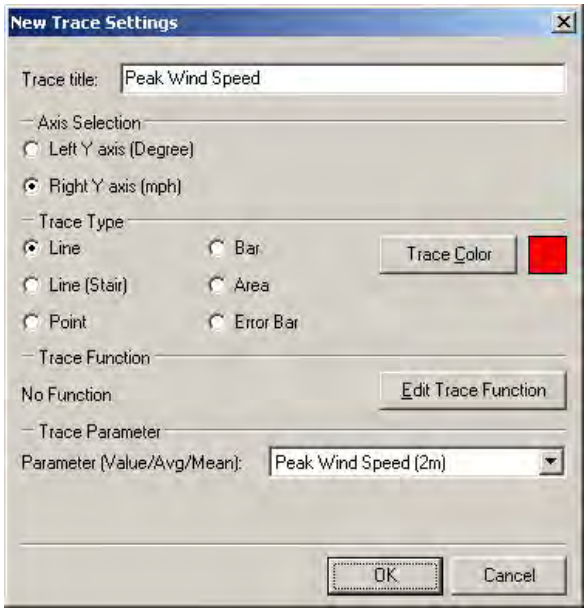
Next let's setup the new right Y axis on the lower chart. On the "Axis Settings" tab, select the *right* axis, check the "Show Y axis" box, provide a title of "mph" for the axis, select "lower" as the display type, set the "Data type" to "Wind Speed", units of "mph", turn off automatic scaling, set the "Minimum" to 0, "Maximum to 25, "Major steps" to 5 and "Minor steps" to 5:



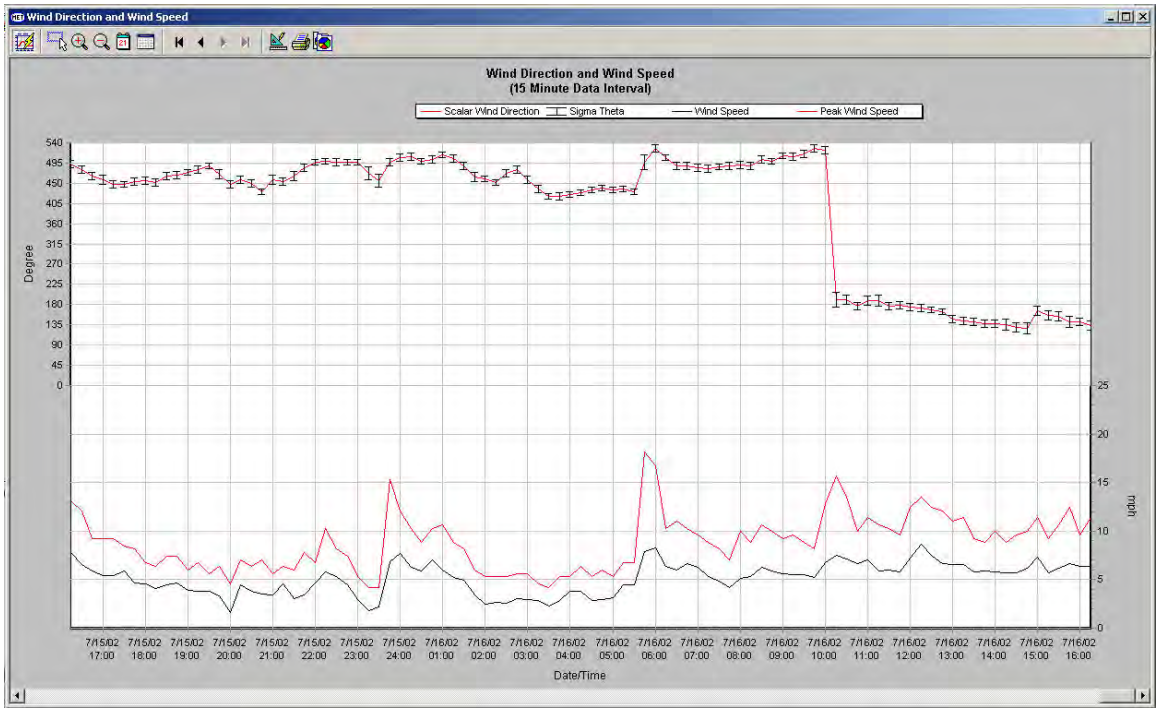
From the "Data Traces" tab, add a new wind speed trace and assign it to the *right* axis. Set the trace type as a line with the color black. Set the "Parameter (Value/Avg/Mean)" list box to "Wind Speed", as this is the database parameter to assign to the trace.



Next from the "Data Traces" tab, add a peak wind speed trace and also assign it to the right axis. Set the trace type as a line with the color red. Set the "Parameter (Value/Avg/Mean)" list box to "Peak Wind Speed":



The final result is shown below:



(The above figure is an example only; your configuration may be different.)

Note: If you have a single trend chart with dual axes, and one axis is setup to use automatic scaling (on the "Axis Setting" tab)", then be sure to set the other axis to also use automatic scaling. That way the software can optimize axis readability with a common grid overlay.

4.8.6 Trace Functions

In the previous examples, the 0-540 wind direction and Sigma-Theta traces required the use of a special trace function to map the 0-360 degree values to a range of 0-540 degrees. All trace functions are explained below:

1. Accumulate (reset on limit). Used to accumulate a parameter's values until a limit is reached, and then the trace is reset to zero. The reset value is specified as a number. For example, this trace function can be used to accumulate the rain parameter until 1.0 inch has accumulated, then the trace is reset to zero.

2. Accumulate (reset on time difference). Used to accumulate a parameter's values until a cyclical time lapse has occurred relative to midnight. The reset value is specified in the format of hours and minutes (hh:mm). For example, this trace function can be use to accumulate the rain parameter cyclically every 8 hours (8:00) beginning at midnight. Every eight hours the trace will reset to zero.

3. Accumulate (reset on inactivity time). Used to accumulate a parameter's values until the parameter value is unchanged for a specified period of time. This period is called the "inactivity time." The inactivity time has a format of hours and minutes (hh:mm). For example, this function can be used to mark rain events when no rain has occurred for a specified time.

4. Wind direction in 0 - 540 deg range. Used to map a 0 to 360 degree wind direction parameter to a 0 to 540 degree range. This is useful for trending a polar parameter (i.e., wind direction) on a rectangular chart and in which you do not want the trace to "paint" when the wind direction is from the north. No argument is required.

5. Minimum (reset on time difference). Used to trace a parameter's minimum value over a cyclical time period relative to midnight. For example, you can use this function to track the minimum ambient temperature every 6 hours.

6. Minimum (reset on absolute time). Used to trace a parameter's minimum value until an absolute reset time has been reached. For example, you can use this trace function to track the minimum ambient temperature until 12:00 noon (standard time) every day.

7. Maximum (reset on time difference). Used to trace a parameter's maximum value over a cyclical time period relative to midnight. For example, you can use this trace function to track the maximum ambient temperature every 8 hours and the maximum daily peak wind speed every 24 hours.

8. Maximum (reset on absolute time). Used to trace a parameter's maximum value until an absolute reset time has been reached. For example, you can use this trace function to track the maximum ambient temperature until 5:00 pm

(17:00 standard time) every day and the maximum daily peak wind speed until midnight (24:00 standard time).

Note: Only one trace function of a given type can be assigned to the same parameter on the same axis. For example, you cannot assign more than one "accumulate (reset on time difference)" trace function to a rain parameter that is setup to use the left axis. However, you can make one assignment to the left axis, and another to the right axis.

IMPORTANT: Some of the arguments to the trace function allow you to set the time with a format of hh:mm (hours:minutes). When setting the "mm" part, do not assign a time value that has higher resolution than the data table interval that drives the trace. For example, with a trace setup to use the hourly data table, the "mm" value should always be "00". Data from the hourly table cannot be resolved to less than an hour. Similarly, suppose you have setup a data trace based on the 15-minute data table. The "mm" value should always be in increments of 15 minutes (i.e., "00", "15", "30", or "45").

4.9 Viewing Trend Charts

4.9.1 Opening a Trend Chart

Once trend charts have been created, they can be opened from the View menu and "Trend Charts" selection. Once opened, they can also be selected from the "Window" menu (see Section 4.18).

4.9.2 Automatically Opening a Trend Chart at Startup

You can define which trend charts you want to automatically open when the software starts up. See Section 4.16.

4.9.3 The Trend Chart Tool Bar

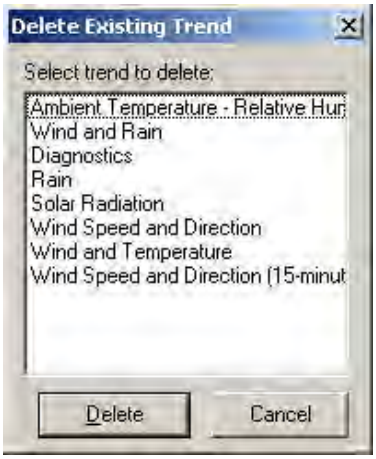
The following tool bar rests above the trend chart:

	The "update trend" tool is used to refresh or freeze the display. When in the depressed position, the trend chart will refresh when new data arrives. When in the out position, the trend chart is frozen and will not be updated with the arrival of new data. The operation of this tool is similar to the "Auto Update" button of the Data View.
	The "zoom" tool is used to define and expand a rectangular area of the trend chart. Position the mouse in the upper left hand corner of an imaginary rectangular area of the trend chart. With the left mouse button pressed, drag the mouse to the lower right corner of the imaginary rectangle and release the mouse button. The rectangular area will expand to fill the chart. To reverse the action, press the

	"zoom" tool again.
	Click the "zoom in date axis" tool to zoom in on the date and time. For example, if the date/time axis grid is in increments of 2 hours, then upon pressing the tool, the date/time axis grid will change to increments of 1 hour.
	Click the "zoom out date axis" tool to zoom out on the date and time. For example, if the date/time axis grid is in increments of 1 hour, then upon pressing the tool, the date/time axis grid will change to increments of 2 hours.
	Click the "day snap" tool to snap the trend chart to a time frame of 1 day.
	Click the "month snap" tool to snap the trend chart to a time frame of 1 month. This is only effective for trend charts that can hold a month of data without being scrolled. These trend charts have data intervals of 15 minutes, 20 minutes, 30 minutes or hourly. Trend charts based on 1-minute, 5-minute, and 10-minute intervals do not normally show a month of data at a time.
	This is a "Data Navigation Toolbar". Click on the first of these buttons to go to the start of the database (start of trace). Click on the last button to go to the end of the database (end of trace). Click on the left pointer to scroll the chart to the left. Click on the right pointer to scroll the chart to the right. You can also scroll the chart by moving the scroll bar located below the trend chart.
	This "edit trend settings" tool button provides access to creating and editing a trend chart.
	Use the "print trend graph" tool to print the trend chart to the printer. **Note**: Before using this button, make sure that the printer has been properly setup. Go to the File menu and "Print Setup" option to review the printer settings. *Configuring your printer or installing its printer driver is outside the scope of this manual*.
	Click on the "copy trend graph image" tool to copy an image of the trend chart to Microsoft Window's clipboard. Once in the clipboard, you can paste the image to a word processor or other program.

4.9.4 Deleting a Trend Chart

To delete a trend chart, go to the View menu, select "Trend Chart" and then "Delete Trend". Select a trend chart to delete and then press the "Delete" button:



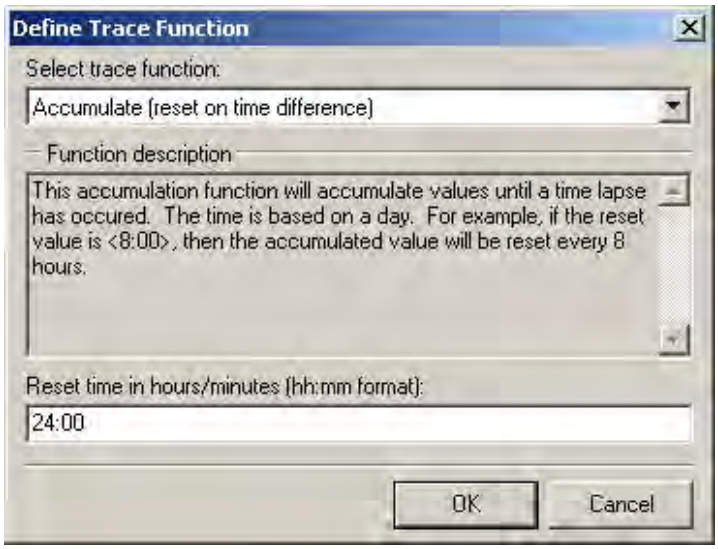
4.10 Additional Examples of Trend Charts

4.10.1 Rainfall

IMPORTANT: You must have a rain database parameter already configured in order to create a rainfall trend chart by using the information in this section. *It's also best if some rain data has already been acquired.*

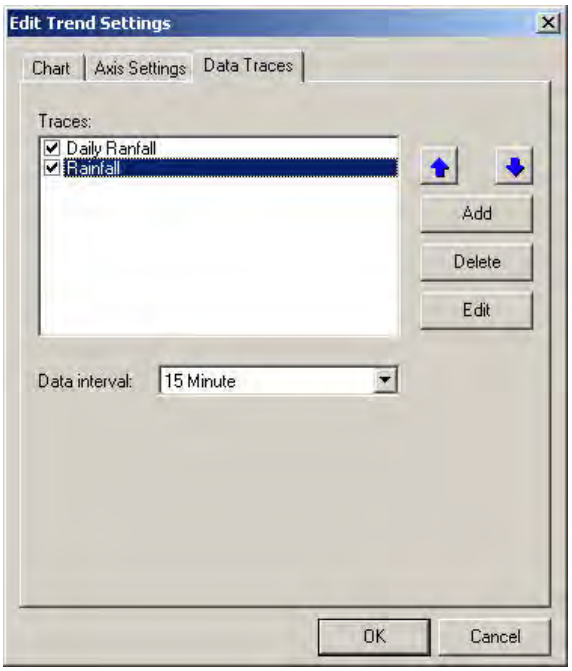
Begin by creating a new "Rain" trend chart with both left and right axes, and based on a 15-minute data interval. Configure the left axis as a "precipitation" data type and with a range of 0 to 0.2 inches with 10 major steps (for increments of 0.02 inches). Create a red "Rainfall" trace by assigning a "rain" database parameter to the left axis and using a "bar" trace type. Set the left axis to a "normal" display type. No special data trace function is required.

Next, configure the right axis as a "precipitation" data type and with a range of 0 to 2 inches and 10 major steps (for increments of 0.2 inches). Create a "Daily Rainfall" trace by assigning the same "rain" database parameter to the right axis but this time using an light blue "area" trace type. Set the right axis to a "normal" display type. Setup a trace function of "accumulate (reset on time difference)" to totalize (cumulate) the 15-minute rainfall values from midnight. The reset time is "24:00" which causes the cumulative trace to reset to zero every 24 hours from midnight.

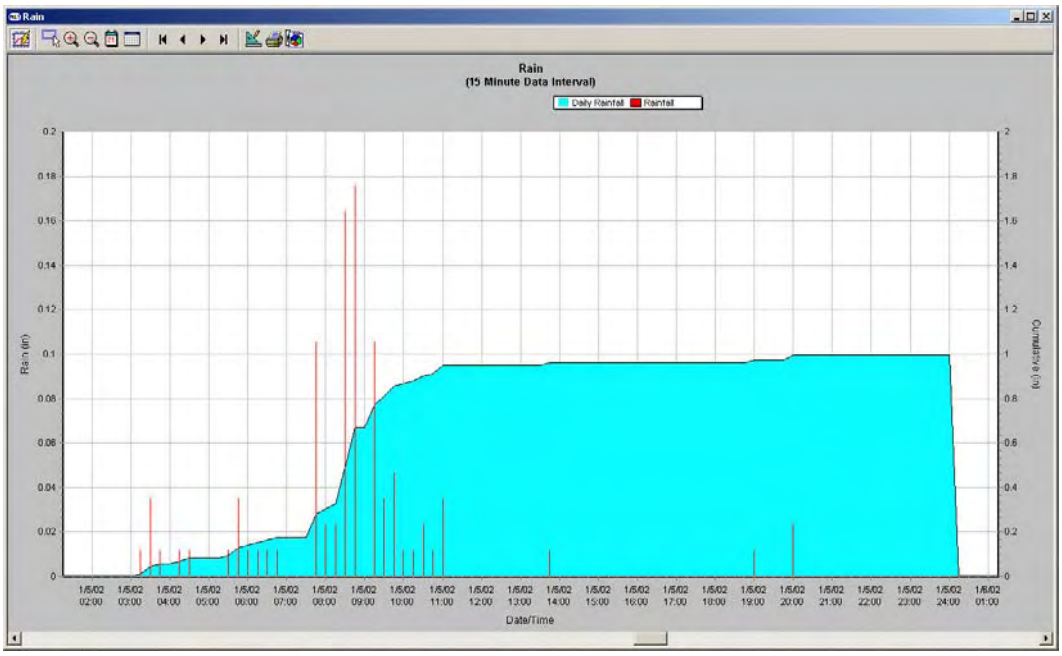


Note: When both the left and right axes are assigned to a "normal" display type, then the resulting trend chart is a single chart with both a left and a right axis. Recall that assigning the left axis to the "upper" display type and the right axis to a "lower" display type (or vice-versa) results in a composite "upper/lower" chart view with both upper and lower trend charts.

On the "Data Traces" tab, use the large up and down arrow buttons to reverse the order of the "Rainfall" trace and the "Daily Rainfall" trace as shown:



Now the Rainfall trace will be drawn last so that it won't be masked by the "area"-type Daily Rainfall trace. The resulting "Rain" trend chart is shown below:



(The above figure is an example only; your configuration may be different.)

4.10.2 Ambient Temperature and Relative Humidity

IMPORTANT: You must have several temperature-type database parameters already configured in order to create a trend chart by using the information in this section. *It's also best if the required data has already been acquired.* For a complete configuration to follow along with this example, the following database parameters are needed: dew point temperature, wet bulb temperature, heat index temperature, wind chill temperature, ambient temperature, and relative humidity. If you don't have one of the parameters, just ignore setting it up in the instructions below.

Begin by creating a new "Ambient Temperature and Relative Humidity" trend chart with both left and right axes, and based on a 15-minute data interval. Configure the left axis as a "temperature" data type and with a range of 20 to 120 °F and 10 major steps (for increments of 10 °F).

Create and assign several temperature-type traces to the left axis of the trend chart (assign a different color to each trace):

1. A "Dewpoint" trace by assigning a "dewpoint" database parameter to the left axis and using a "line" trace type. No special trace function is required.

2. A "Wetbulb" trace by assigning a "wetbulb temperature" database parameter to the left axis and using a "line" trace type. No special trace function is required.

3. A "Heat Index" trace by assigning a "heat index" database parameter to the left axis and using a "line" trace type. No special trace function is required.

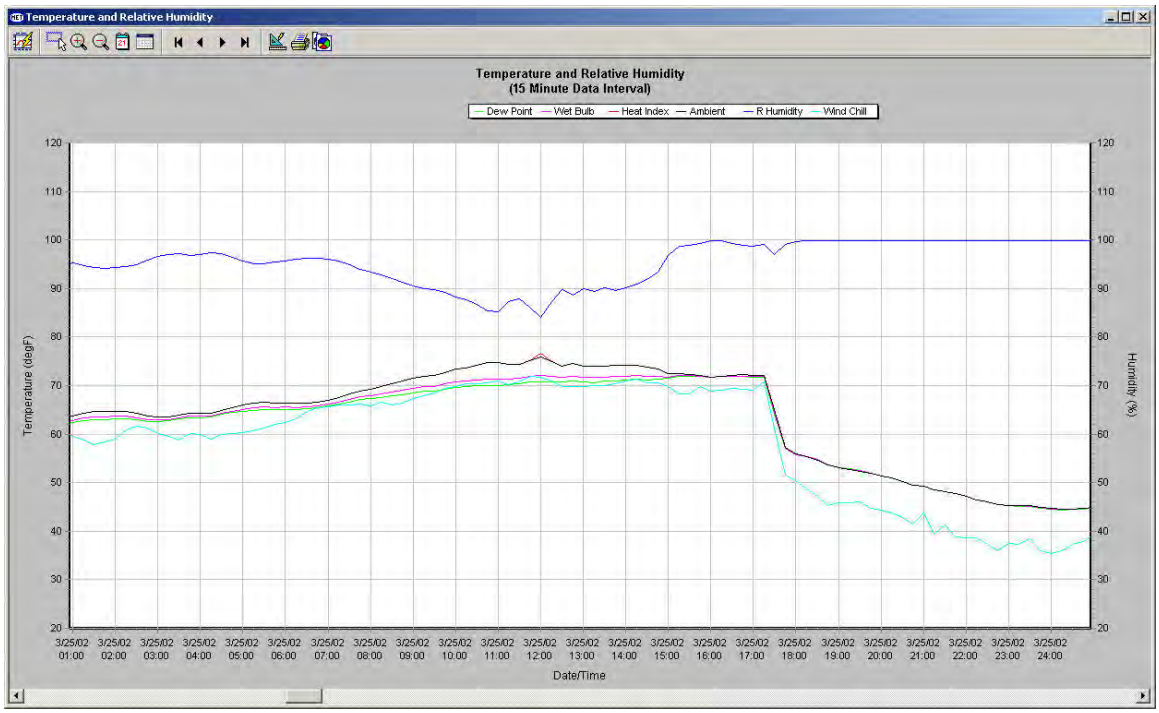
4. A "Wind Chill index" trace by assigning a "wind chill temperature" database parameter to the left axis and using a "line" trace type. No special trace function is required.

5. An "Ambient Temperature" trace by assigning an "ambient temperature" database parameter to the left axis and using a "line" trace type. No special trace function is required.

Next, configure the right axis as a "relative humidity" data type and with a range of 20 to 120% in steps of 10 (for increments of 10%). Create a "Relative Humidity" trace by assigning the "relative humidity" database parameter to the right axis and using a "line" trace type. No special trace function is required.

Note: While relative humidity should never be greater than 100%, we chose to scale it to the same as the temperature scale to make it easy to "read" the temperature traces from either axis.

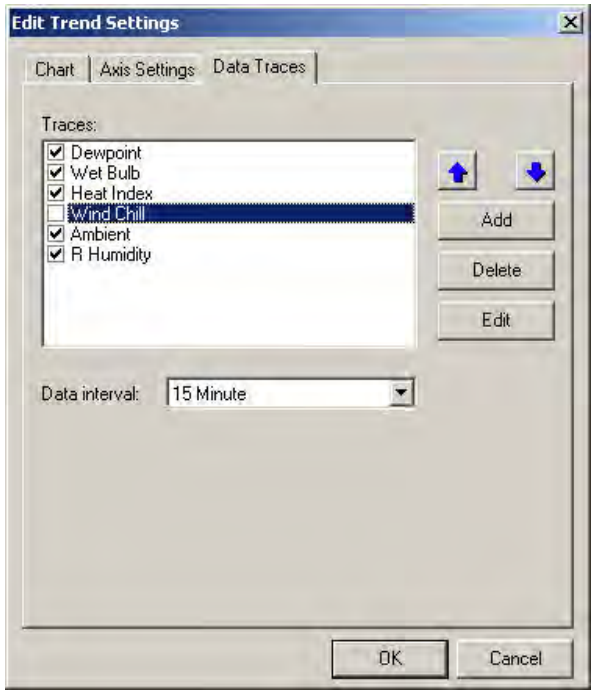
The final trend chart is shown below. By looking at the trend chart you can easily see that a cool front occurred. Because the relative humidity climbed to 100%, it is also likely that rainfall occurred during the same time period.



(The above figure is an example only; your configuration may be different.)

Note: When setting up both a left and right axis for a single "normal" trend chart, it is important to set the scaling and major steps (graduations) so that the grid lines overlay between traces that use the left axis and traces that use the right axis. In the example above, we have chosen the same step sizes for both axes.

You may wish to disable a trace from appearing on the trend chart. Simply uncheck the box to the left of the data trace name. For example, it may be useful to disable the "Heat Index" trace in the winter time and the "Wind Chill" trace in the summer time:



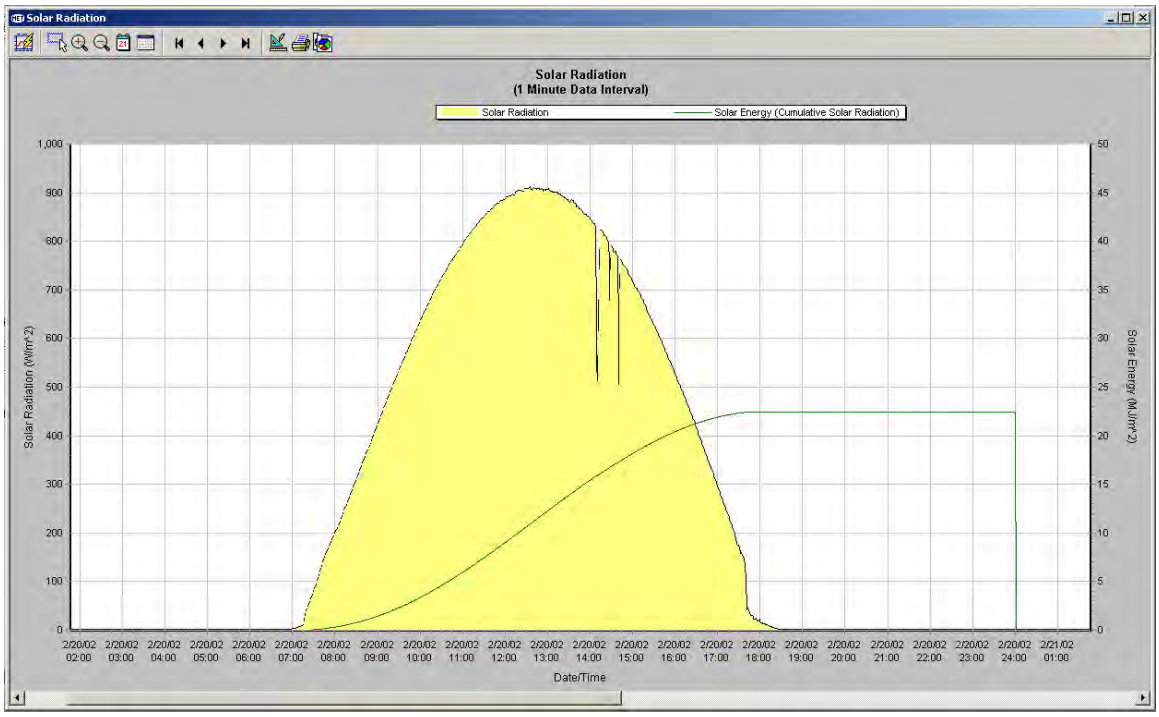
4.10.3 Solar Radiation

IMPORTANT: You must have solar radiation and solar energy database parameters already configured in order to create a trend chart by using the information in this section. It's also best if the required data has already been acquired.

Begin by creating a new "Solar Radiation" trend chart with both left and right axes, and based on a 1-minute data interval. Configure the left axis as a "solar radiation" data type and with a range of 0 to 1000 watts per square meter (W/m^2) with 20 major steps (for increments of 50 W/m^2). Use a yellow "area" trace type. No special trace function is needed for the solar radiation parameter.

Next, configure the right axis as a "solar energy" data type and with a range of 0 to 50 MJ/m^2 and 10 major steps (for increments of 5 MJ/m^2). Create a daily "solar energy" trace by assigning the solar energy parameter to the right axis and with a green "line" trace type. Setup a trace function of "accumulate (reset on time difference)" to totalize (cumulate) the 1-minute solar energy values from midnight. The reset time is "24:00" which causes the cumulative trace to reset to zero every 24 hours from midnight.

The figure below shows the resulting "Solar Radiation" trend chart on a sunny day. Notice the "dips" in the solar radiation trace. These dips were caused by a telephone pole and its overhead wires momentarily casting a shadow on the solar radiation sensor. (It is best to install a solar radiation sensor where it will never receive a shadow; however, it's not always possible.)



(The above figure is an example only; your configuration may be different.)

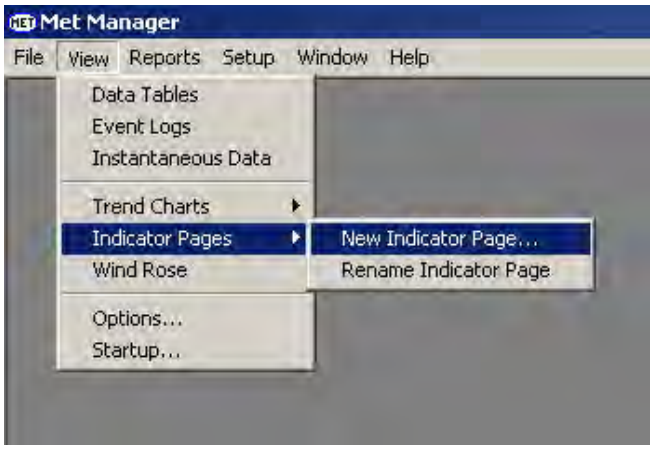
4.11 Creating Indicator Views

4.11.1 Getting Started

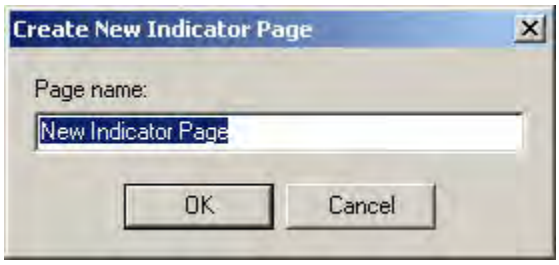
You can easily create one or more Indicator Views for displaying weather data. In this section we will show you how. For instructional purposes, we have setup Met Manager with a "direct-connection" data source, an "instantaneous" sample rate of 5 seconds, and the following database parameters:

- Wind speed
- Scalar wind direction
- Ambient temperature
- Relative humidity
- Barometric pressure
- Rain

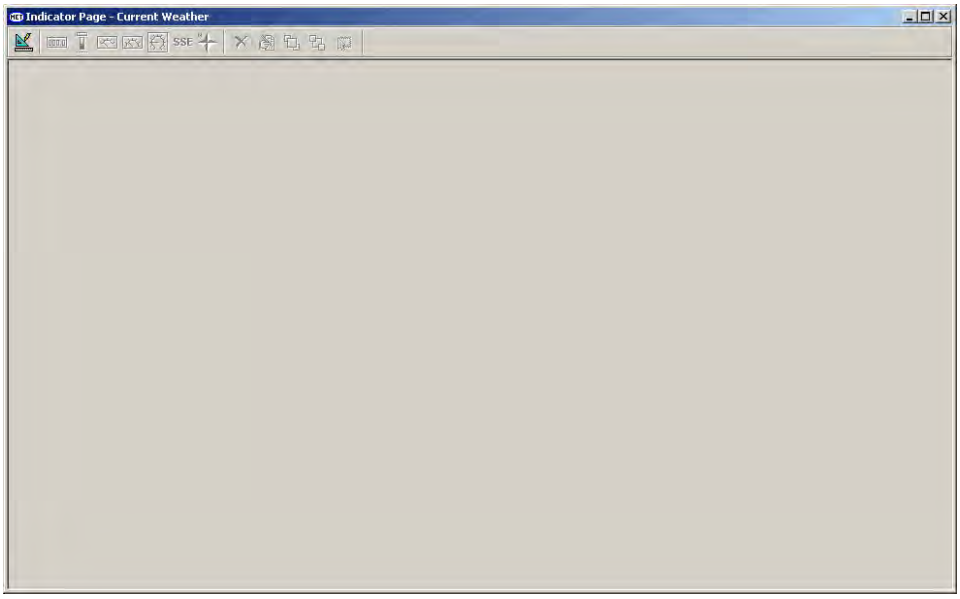
To create a new Indicator View, select "Indicator Pages", then "New Indicator Page" from the View menu:



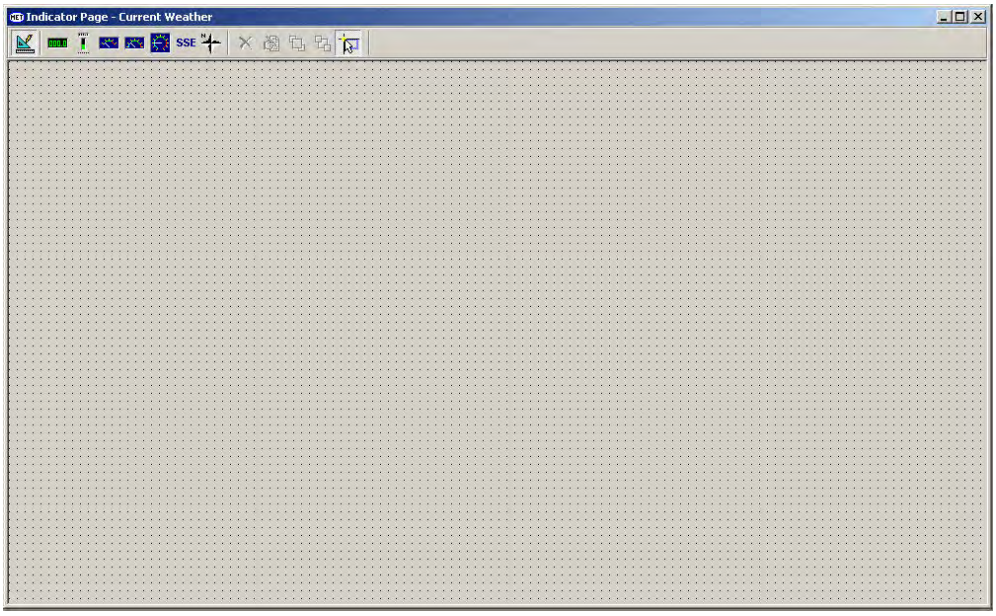
The following dialog is presented to allow you to name the new indicator page. Overtype the default name of "New Indicator Page" with the name that you want to give to the indicator page; for example, "Current Weather" or "Primary Indicators".



After naming the page and clicking the OK button, the following *blank* Indicator View is then displayed:



Press the "Design Mode" tool button to go into design mode for creating a new Indicator View. The design canvas is overlaid with a dotted grid and the remainder of the tool bar becomes active:



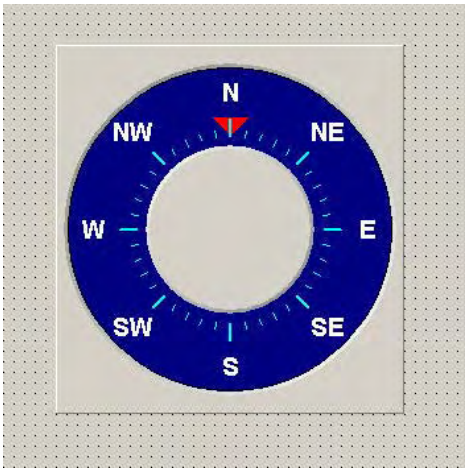
4.11.2 Description of the Tool Bar

The following tool bar rests above the Indicator View:

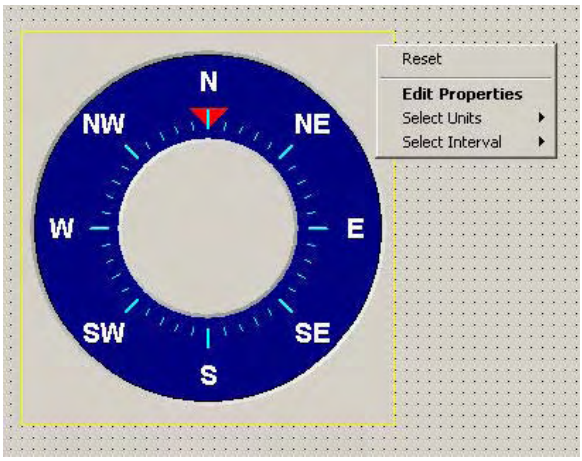
	"Design mode" tool. Used to enable the creation and design of an indicator page.
	"Digital display" tool. Select and drop the tool onto the canvas to add a *digital* indicator to the page.
	"Vertical bar graph" tool. Select and drop the tool onto the canvas to add a *vertical bar graph* indicator to the page.
	"120° meter" tool. Select and drop the tool onto the canvas to add a *120° meter* indicator to the page.
	"180° meter" tool. Select and drop the tool onto the canvas to add a *180° meter* indicator to the page.
	"270° meter" tool. Select and drop the tool onto the canvas to add a *270° meter* indicator to the page.
SSE	"Wind direction label" tool. Select and drop the tool onto the canvas to add a *wind direction sector* indicator to the page.
	"Wind direction indicator" tool. Select and drop the tool onto the canvas to add a *wind direction* indicator to the page.
	"Delete indicator" tool. Used to delete an indicator from the page. Select an existing indicator by clicking on it and then press the tool button.
	"Edit indicator" tool. Used to edit an existing indicator. Select an existing indicator by clicking on it and then press the tool button.
	"Bring to front" tool. Used to bring an indicator to the front when two indicators overlap each other. Select the indicator by clicking on it and then press the tool button.
	"Send to back" tool. Used to place an indicator in the background when two indicators overlap each other. Select the indicator by clicking on it and then press the tool button.
	"Snap" tool. Used to snap an indicator to the background grid. Press the tool to highlight it. Then either select, drag and move an existing indicator, or place a new indicator on the page. The indicator will align with the background grid. This is useful for aligning indicators next to each other.

4.11.3 Creating a Wind Direction Indicator

Let's create a *wind direction* indicator that updates with instantaneous data. To add a new wind direction indicator to the Indicator View, select and drop the "wind direction indicator" tool onto the design canvas.

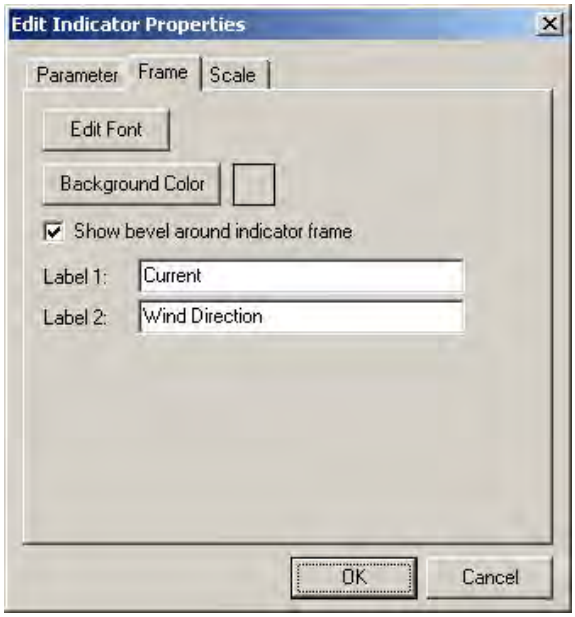


Select the indicator with your mouse and right click on it (or press the "Edit Indicator" tool). This pops up a menu to allow you to edit the indicator's properties:

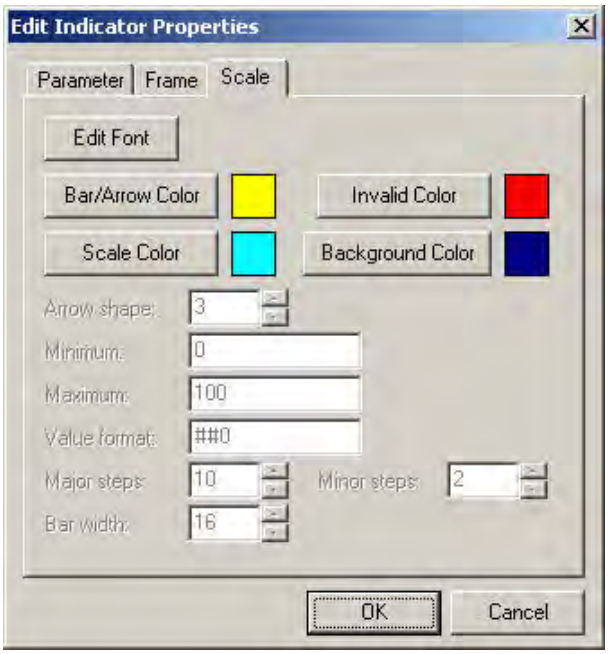


Select the "Edit Properties" menu item. The "Edit Indicator Properties" dialog is then displayed. Set the parameter name to "Scalar Wind Direction" (or other wind direction parameter that your system may be configured with) and with units of "degrees". Select an interval of "instantaneous":

Next, select the "Frame" tab and label the indicator as "Current Wind Direction" on two lines:

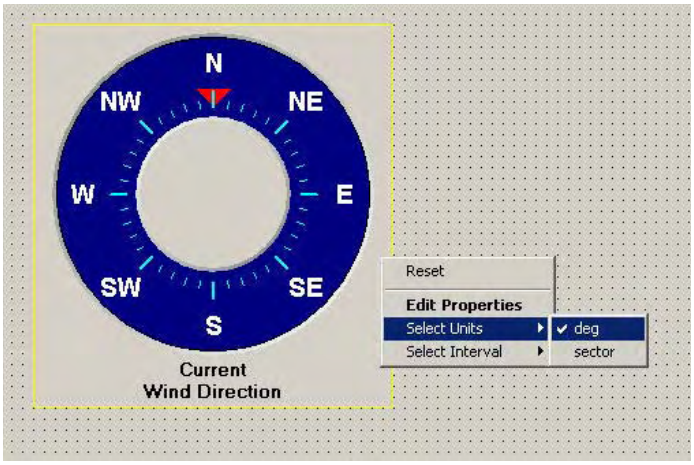


Select the "Scale" tab to review the properties of the indicator's scale and arrow pointer:

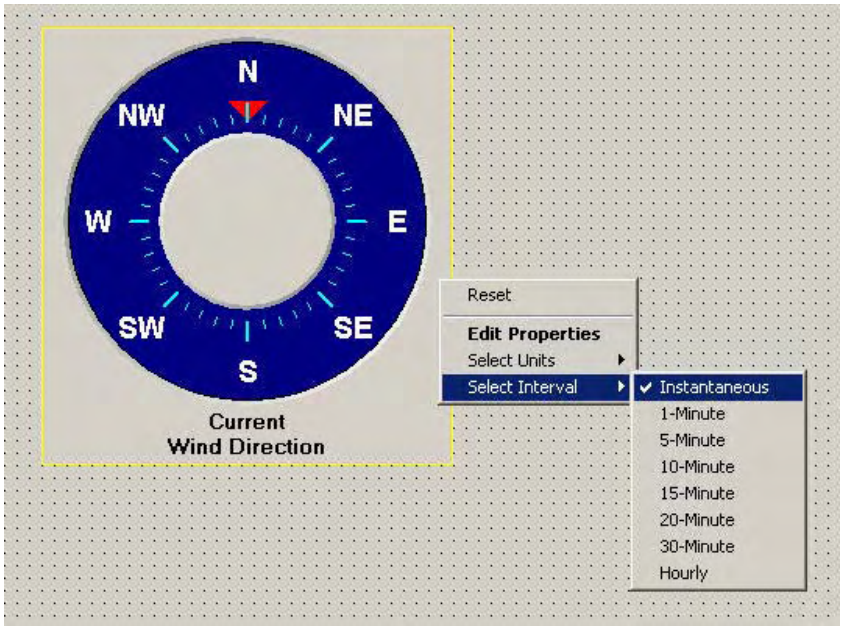


The "Bar/arrow Color" represents the color of the pointer when the indicator is showing "valid" or "partially valid" data. The "Invalid Color" represents the color of the pointer for indicating invalid, missing or calibration data. The "Scale Color" is the color of the major and minor tick-marks on the scale. The "Background Color" is the color of the scale background.

Now that we have assigned a wind direction parameter to the indicator and given the indicator a name (label), let's review our prior assignment of the indicator's unit by right-clicking on the indicator:

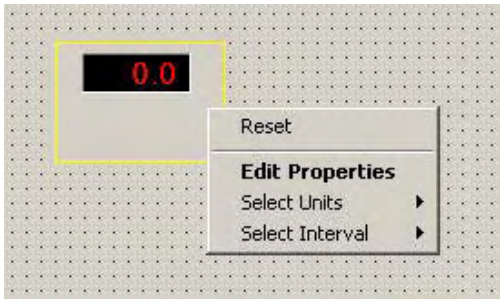


We can also review our prior assignment of the indicator's update interval, or select a new interval:

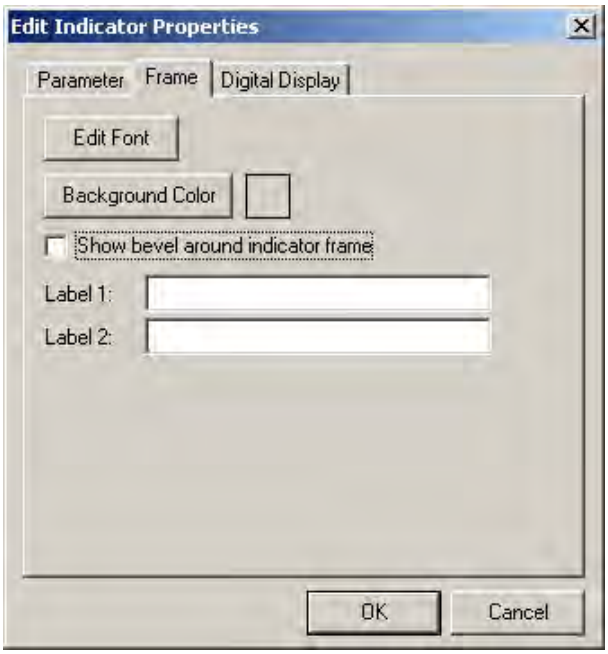


Finally, select the indicator with your mouse and drag it onto the upper left of the design canvas. You can size the indicator by grabbing the sides or a corner with the left mouse button and dragging.

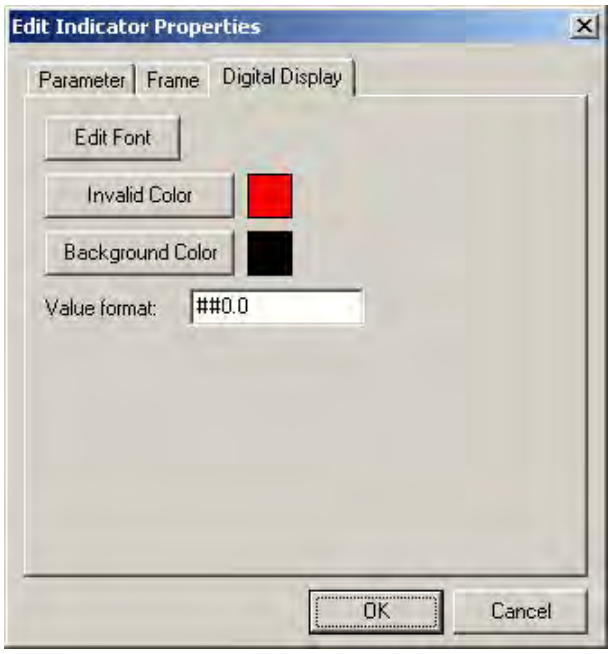
Now let's add a *digital* indicator to the view, to show the current wind direction in degrees. Select and drop a "digital indicator" tool onto the design canvas, and right-click on it to show the pop-up menu:



In the same manner as for the wind direction indicator, select "Edit Properties" and then set the "Parameter" properties to scalar wind direction, units of degrees, and interval of "instantaneous". Select the "Frame" tab and turn off (uncheck) the bevel around the digital indicator frame so that the digital indicator frame will merge with the background of the wind direction indicator. This will allow us to overlay the digital indicator onto the center of the wind direction indicator:



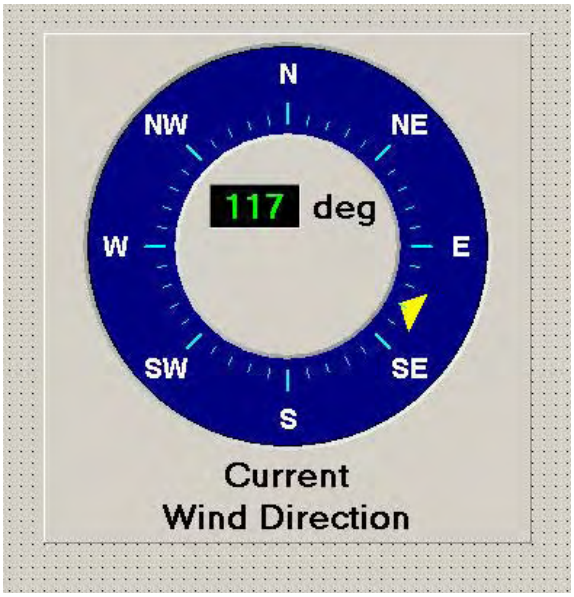
You can define the width and numeric precision of the digital value from the "Digital Display" tab by setting the "Value format" field:



The "##0" part of the field defines the number of display character positions to the *left* of the decimal point. For example, for one position, set that part of the field to "0". For two positions, set it to "#0", three positions to "##0", and so forth. The ".0" part of the field defines the number of display characters to the *right* of the decimal point. For no characters to the right of the decimal point, remove the ".0". For one character, set it to ".0", for two characters set it to ".00", and so on. For the wind direction digital indicator,

let's set the "Value format" to "##0" for a maximum of 3 characters and without any decimal places.

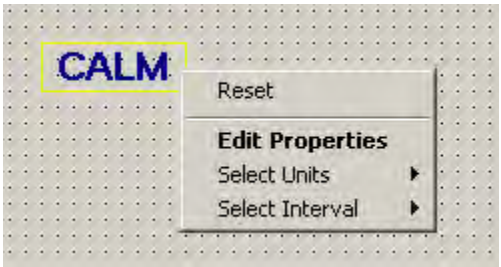
Now let's place the digital indicator onto the wind direction indicator. Select the digital indicator with your left mouse button and drag and drop the digital indicator into the middle of the wind direction indicator:



If needed, resize the digital indicator by grabbing a corner with the left mouse button and then dragging inward (smaller) or outward (larger).

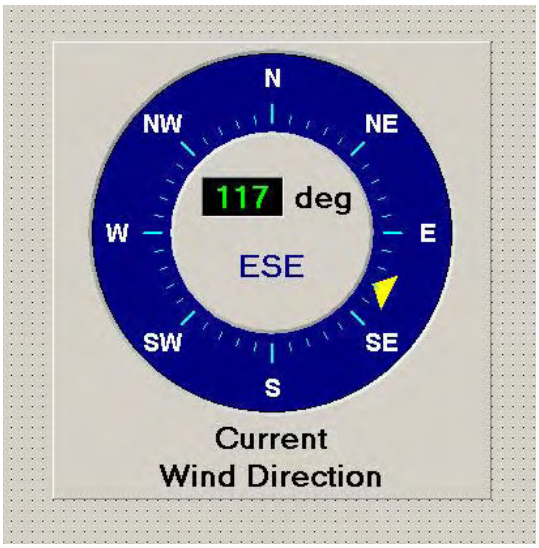
Note: If for some reason the digital indicator goes behind the wind direction indicator when you drop it on to the wind direction indicator, then select the wind direction indicator with your mouse and click the "send to back" tool button. This will force the wind direction indicator behind the digital indicator.

Next, let's add a *wind direction sector* indicator to display the wind direction as a sector. Select and drop the wind direction sector tool onto the design canvas, and then right-click on it:



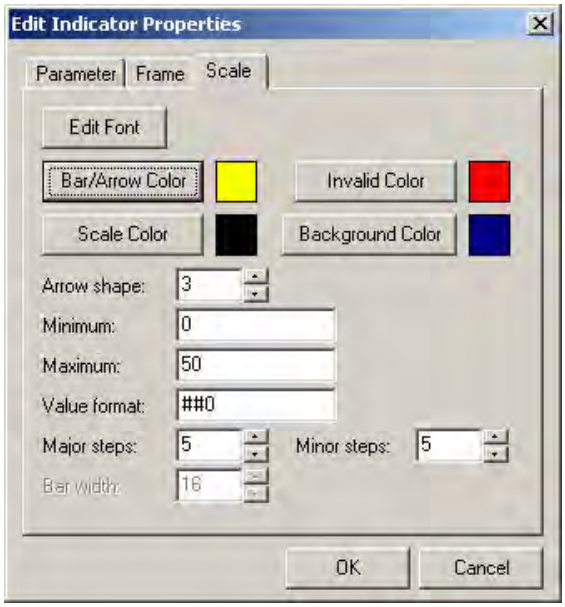
Set the sector indicator's "Parameter" properties to "scalar wind direction", degree units and instantaneous data interval. Similar to the digital indicator, drag the sector indicator

to the middle of the wind direction indicator and just below the digital indicator. The *overall* wind direction indicator is now complete:



4.11.4 Creating a Wind Speed Indicator

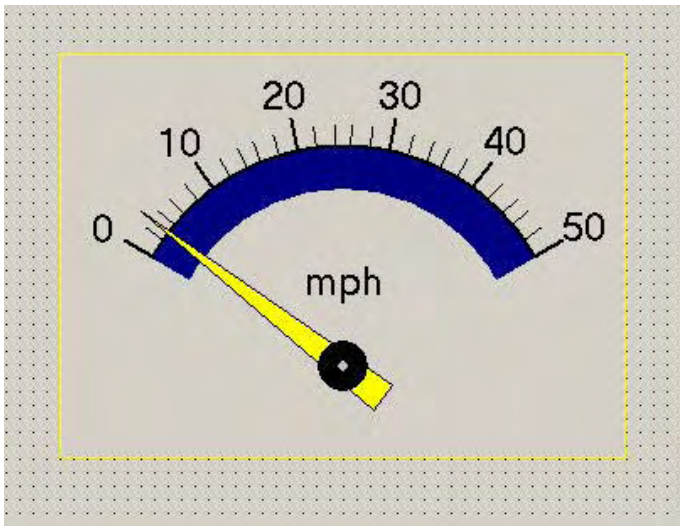
Let's add a *wind speed* indicator to the Indicator View. Select and drop one of the meter tools onto the design canvas. We'll use the 120° meter indicator. Select it, right-click on it, and edit its properties. Set the "Parameter" tab to "wind speed", units of "mph", and interval of "instantaneous." Normally the indicator is named on the "Frame" tab; however, we will not name this indicator as we will later place a digital indicator below it and we will name that one instead. On the "Scale" tab, set the minimum and maximum range. We'll use the range values of 0 to 50:



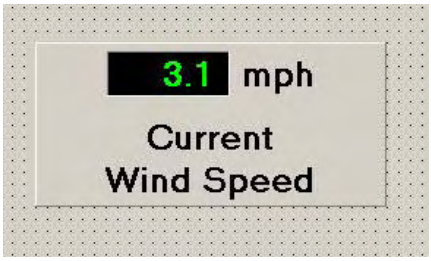
The "Value format" field defines the width and precision of the numeric labels on the meter. For a wider field width, specify more "#" characters at the start. For additional decimal places, add a decimal point and a zero for each additional decimal place desired. For example, for a 6 character value with 2 digits to the right of the decimal point, specify the "Value format" field as "##0.00".

Adjust the "Major steps" and "Minor steps" to your preference. The "Major steps" define the number of intervals or major graduations over the range, in this case 5 intervals over the range of 0 to 50 mph. The "Minor steps" define the number of subintervals between the steps; in this case, 5 subintervals for each step (2 mph per subinterval).

The completed wind speed indicator is shown below:

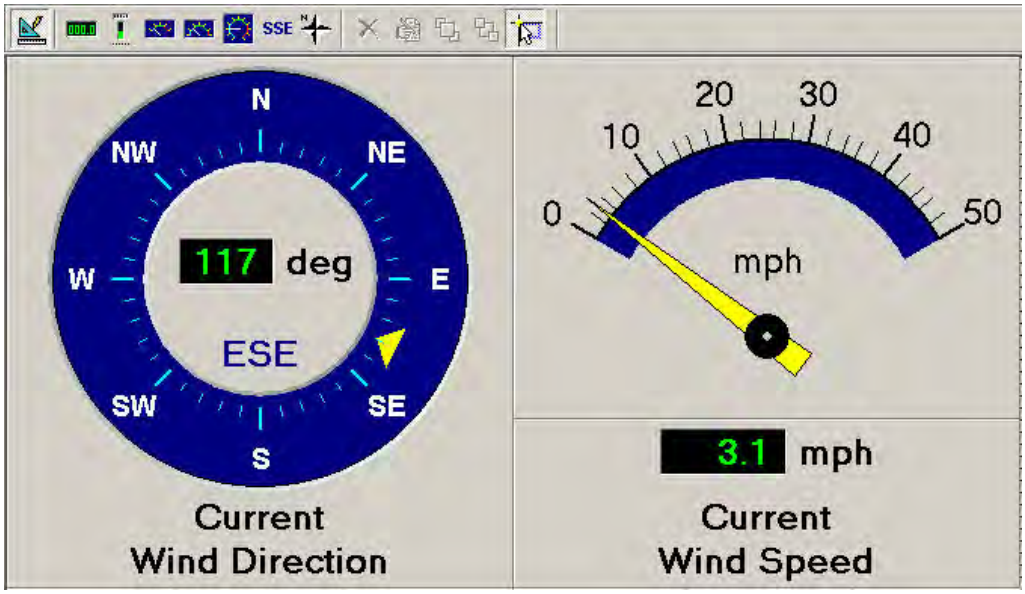


Add a *digital wind speed* indicator. Select and drop a digital indicator tool onto the canvas. Set its parameter, units, and interval properties to the same as the wind speed meter indicator. Name it "Current Wind Speed":



4.11.5 Positioning the Wind Direction and Wind Speed Indicators

Position the wind speed meter indicator next to the wind direction indicator. Position and resize the wind speed digital indicator below the wind speed meter indicator as shown in the figure below:



(The above figure is an example only; your configuration may look different.)

Position controls include the mouse for selecting and moving the indicator (dragging), and the following keys:

- Left, right, up, down arrow keys to move the indicator in the respective direction.

- Control-left, control-right, control-up, and control-down arrow keys for smaller incremental movements. For example, a "control-left arrow key" combination is made by pressing the control key ("Ctrl" on most keyboards) and then simultaneously pressing the left arrow key.

Size controls include the mouse and some keys. With the left button of the mouse, select the indicator, then drag the side or corner of the indicator to resize it. With the keyboard, press the shift-left, shift-right, shift-up, and shift-down arrow keys to "grow" or shrink the indicator in the respective direction.

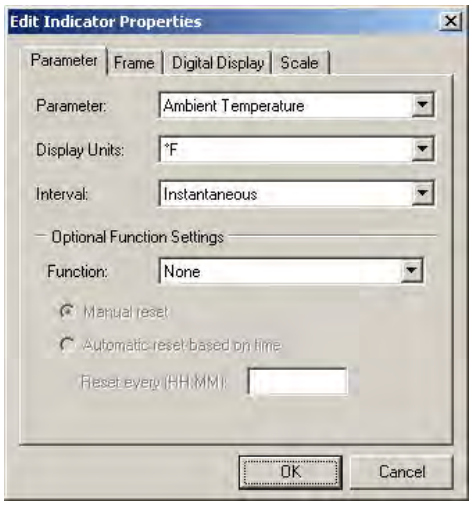
4.11.6 Creating Ambient Temperature Indicators

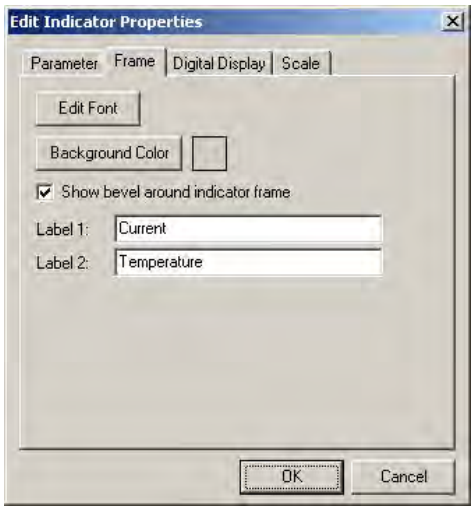
Now let's add three ambient temperature indicators:

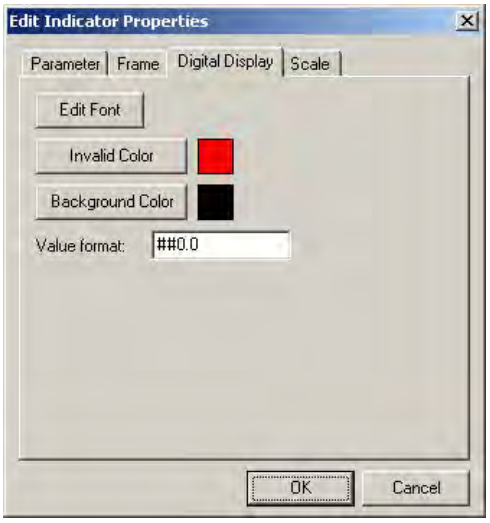
- A current temperature vertical bar graph
- A minimum daily temperature vertical bar graph
- A maximum daily temperature vertical bar graph

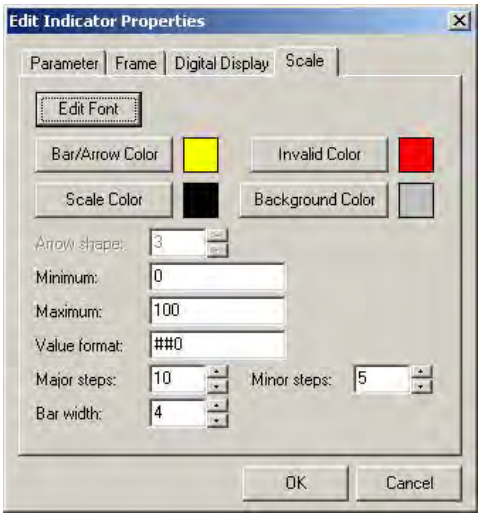
For speed in creating the temperature indicators, select and drop three vertical bar graphs onto the design canvas. For the first "Current Temperature" indicator, set its "Parameter" properties to an "Ambient Temperature" parameter, °F units, "instantaneous" interval, and no special function. From the "Frame" tab, name the indicator "Current

Temperature". From the "Digital Display" tab, set the "Value format" of the digital display indicator to "##0.0" for a "Value format" field width of 5 with one decimal place. From the "Scale" tab, set the scale range for the meter scale from 0 to 100, and with zero decimal places in a "Value format" field width of 3 (##0). Set the "Major steps" to 10 with 5 subinterval "Minor steps". The "Bar width" is the width of the vertical inner scale. To make it skinny (and look like a thermometer), set it to a value of 3 or 4. To fatten it up, set it to a higher value; for example, 16. This example uses 4.





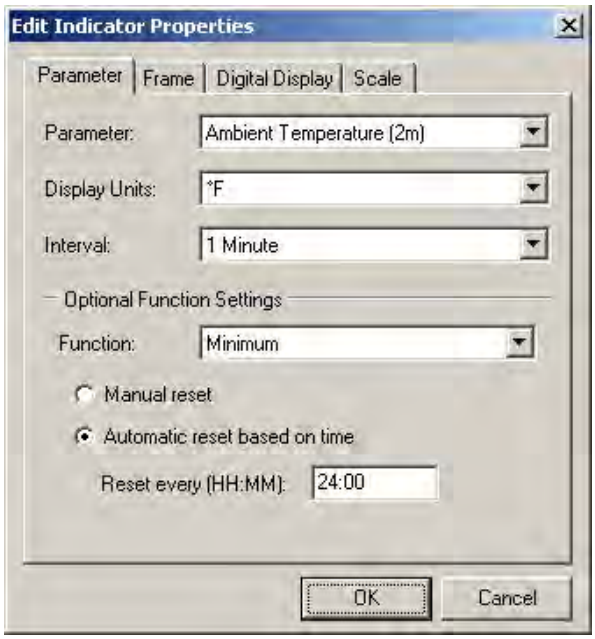




Similar to the wind direction and meter indicators, the "Bar/arrow Color" represents the color of the pointer when the vertical bar graph indicator (in this case temperature) is showing "valid" or "partially valid" data. The "Invalid Color" represents the color of the pointer for indicating invalid, missing or calibration data. The "Scale Color" is the color of the major and minor tick-marks on the scale. The "Background Color" is the color of the scale background (bar part). Experiment with these properties to achieve varying visual effects.

For the second "Minimum Daily Temperature" indicator, set it up the same as the "Current Temperature" indicator but with the following changes:

- On the "Parameter" tab, set the interval to "1 minute". Apply a "Function" of "Minimum" with an auto-reset interval of 24 hours (24:00). This will track the minimum ambient temperature for 24 hours from midnight, and with an update once per minute:



- On the "Frame" tab, name the indicator "Minimum Daily Temperature".

- On the "Scale" tab, set the bar color to blue (to imply cold).

For the third "Maximum Daily Temperature" indicator, set it up the same as the "Minimum Daily Temperature" indicator but with the following changes:

- On the "Parameter" tab, apply a "Function" of "Maximum" with an auto-reset interval of 24 hours (24:00) relative to midnight:

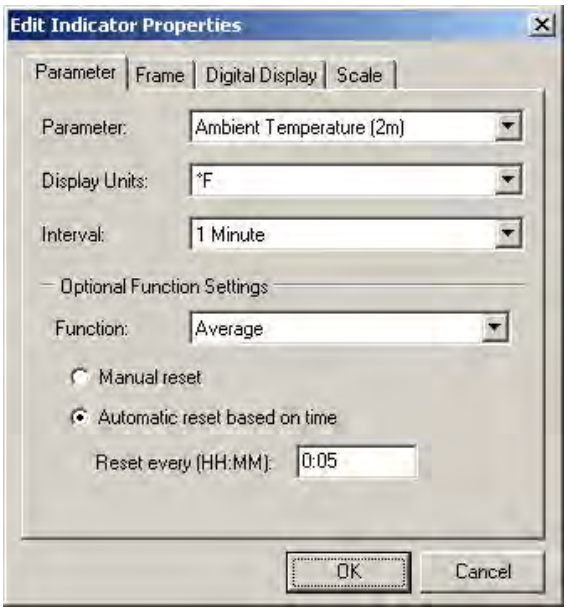
- On the "Frame" tab, name the indicator "Maximum Daily Temperature".

- On the "Scale" tab, set the bar color to red (to imply hot). Note that red may also be used to indicate "invalid" (as well as missing or calibration). This dual-mode use of red is alright because the digital value will also turn red when the indicator's value is invalid.

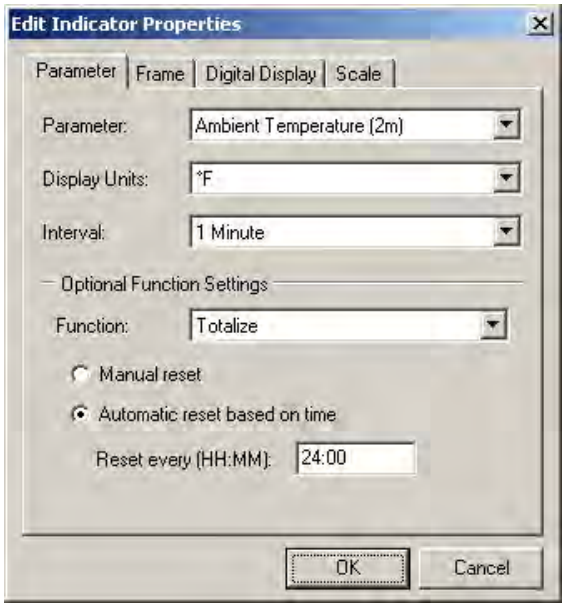
In general, the following special functions (located on the "Parameter" tab) are available to most indicators:

- None - Use the parameter value without applying any special function.

- Average - Average the parameter value. Most parameters are already averaged when sent to the indicator; however, you may wish for the indicator to receive data based on one interval and re-average the data based on another interval. For example, to receive 1-minute values of ambient temperature and re-average them over a 5 minute interval, select the "Average" function with a reset interval of 5 minutes (0:05):



- Totalize - Accumulate the parameter value over a time period relative to midnight. This is useful for summing rainfall data. For example, to accumulate rain over a 24-hour period (relative to midnight), setup the rain indicator's properties as shown below. In the example below, the indicator's update rate is once per minute because a new rain parameter value is sent to the indicator based on the selected "1-minute" interval. Select the "Automatic reset based on time" field to auto-reset the indicator's value to zero when the reset interval has expired.

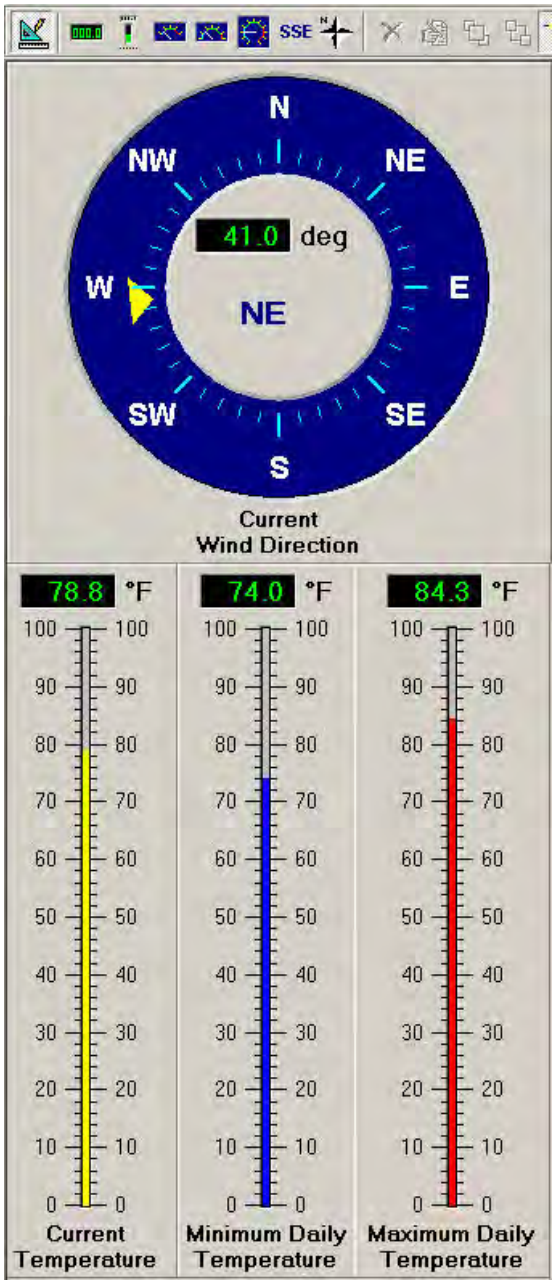


- Minimum - Indicate the minimum value of a parameter over a time interval relative to midnight. For example, if an ambient temperature indicator is set with an interval of "instantaneous", function of "minimum", and auto-reset time of "8:00", then the indicator will update the minimum ambient temperature of the first 8-hour time period (from midnight), will automatically reset, will show the minimum temperature for the next 8-hour period and so forth. The update rate will be the same as the instantaneous sample rate of the data received from the data logger.

- Maximum - Indicate the maximum value of a parameter over a time interval, in the same fashion as the "minimum" function.

Note: In the above cases, if "Manual reset" was selected instead of the "Automatic reset based on time", then the indicator would continue to apply the designated function until reset by the user. This manual reset is accomplished by right-clicking on the indicator and then selecting the "reset" item from the pop-up menu.

Position the ambient temperature indicators below the wind direction indicator:

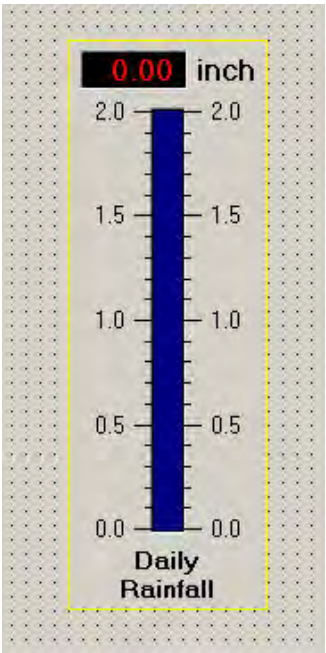


(The above figure is an example only; your configuration may look different.)

4.11.7 Creating Rain Indicators

Now let's add two rain indicators; (1) a vertical bar graph to show the daily total rainfall and (2) a digital indicator to accumulate the rainfall until you manually reset it. Both indicators will be set to update once each minute.

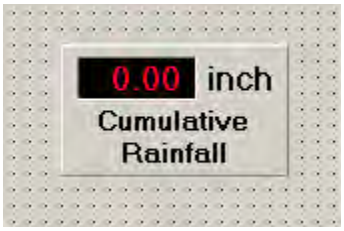
Select and drop a vertical bar graph indicator onto the canvas. Set its "Parameter" properties to "Rain", "inch" unit, "1 minute" interval, "totalize" function, and automatically reset every 24 hours (24:00). On the "Frame" tab, name the indicator "Daily Rainfall". On the "Digital Display" tab set the number of decimal digits to two in a field width of 5 by setting the "value format" to "#0.00". On the "Scale" tab, set the range of the indicator from 0 to 2 inches with a "Value format" of "#0.0" and adjust the "Major steps" to 4 and the "Minor steps" to 5. This allows the indicator to show up to 2 inches of rainfall per day with 4 major graduations and 5 minor graduations for a minor increment of 0.1 inch:



For higher resolution, set the maximum value lower (say 1 inch) and adjust the major and minor steps as needed.

Note: The indicator above will show up to 2 inches of rainfall per day before exceeding the upper limit. However, the digital portion of the indicator will continue to show the total amount of rainfall for the day.

Select and drop a digital indicator onto the canvas. Set its "Parameter" properties to "Rain", "inch" unit, "1 minute" interval, "totalize" function, and "manual reset" function. On the "Frame" tab, name the indicator "Cumulative Rainfall". On the "Digital Display" tab set the number of decimal digits to two by setting the "value format" to "#0.00":



The digital indicator will accumulate rain until manually reset. To manually reset it, right click on it and select the "reset" option.

Note: Currently when started, Met Manager clears all its indicators and starts the rain accumulation from zero. This is also true for minimum, maximum, average, and other types of indicators.

Drag the "Daily Rainfall" bar graph indicator next to the "Maximum Daily Temperature" indicator. Drag the "Cumulative Rainfall" digital indicator below the "Daily Rainfall" bar graph indicator. Adjust the size as needed to fill the space.

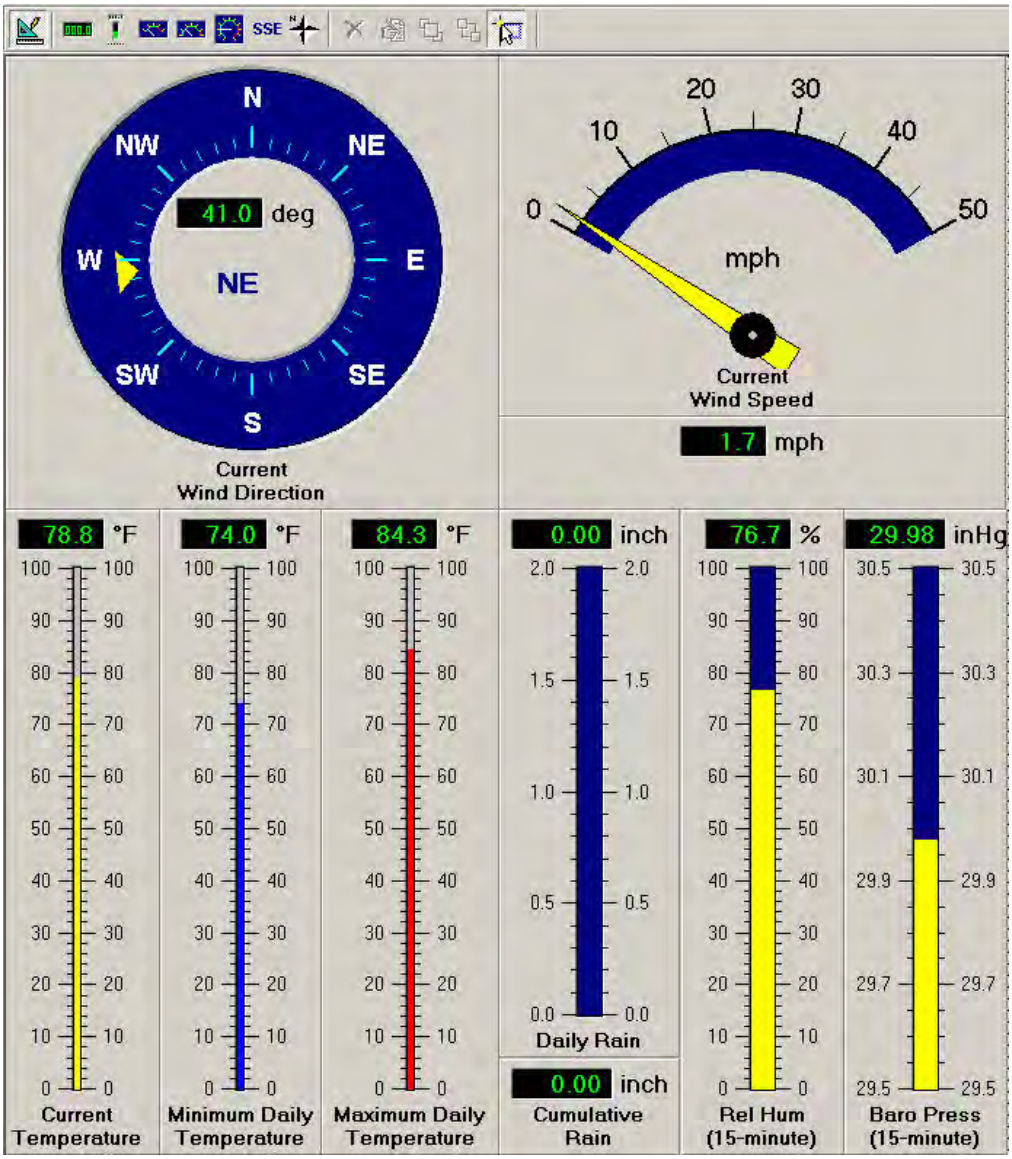
Finally, add two more vertical bar graph indicators; one for relative humidity and the other for barometric pressure. Name the first one "Rel Humidity (15-Minute)". Set this indicator to a "Relative Humidity" parameter, units of "%", function of "None", and interval of 15 minutes. Set the "Value format" on the "Digital Display" tab to show a field width of 3 without any decimal places (##0). On the "Scale" tab, set the bar scale range from 0 to 100. Set the "Major steps" to 10 and "Minor steps" to 5. Place the indicator next to the rain indicator:

Similarly, set up a barometric pressure indicator. Name the indicator "Baro Pressure (15-Minute)". Set the parameter to "Barometric Pressure", units of "inHg", function of "None", and interval of 15 minutes. Set the "Value format" on the "Digital Display" tab to two decimal places with a field width of 5 (#0.00). Similarly, on the "Scale" tab, set the scale's "Value format" to two decimal places with a field width of 5 (#0.00). Set the bar scale range from 29.50 to 30.50. Set the "Major steps" to 5 and "Minor steps" to 4. Place the indicator next to the relative humidity indicator.

Note: Adjust the range on your barometric pressure indicator to reflect the normal barometric pressure variation in your area.

4.11.8 The Final "Current Weather" Indicator View

When finished adding or editing the indicators, press the "design mode" tool to take the Indicator View out of design mode. The following figure shows the new Indicator View:

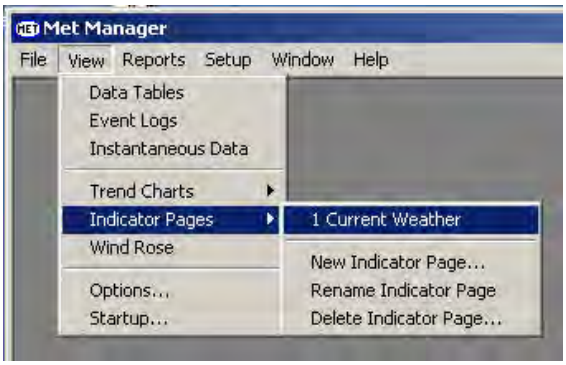


(The above figure is an example only; your configuration may look different.)

4.12 Using Indicator Views

4.12.1 Opening an Indicator View

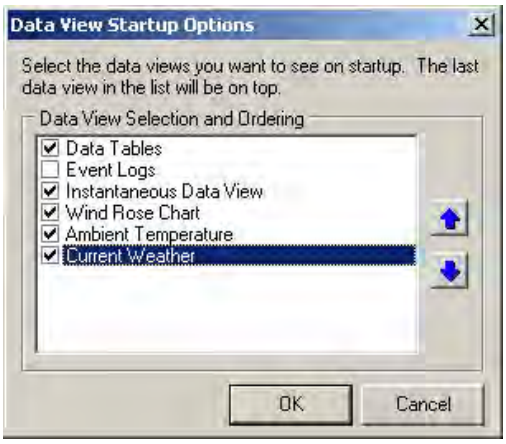
To open an Indicator View, select "Indicator Pages" from the View menu. Then select an Indicator View to display, in this case the one named "Current Weather".



Note: You can display an Indicator View that has already been opened by selecting it from Met Manager's Window menu. See Section 4.18.

4.12.2 Automatically Opening an Indicator View at Startup

To automatically open an Indicator View when Met Manager starts up, set the Indicator View's check box in the "View" menu, "Startup" submenu dialog:



(The above figure is an example only; your configuration may be different.)

Also see Section 4.16 for configuring various startup options.

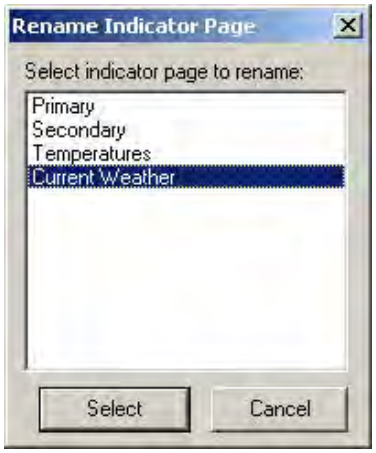
4.12.3 Renaming an Indicator View

An Indicator View can be renamed in two ways:

1. If an Indicator View is the active window then select the "View" menu, "Indicator Pages" submenu, and "Rename Indicator Page" item. The following dialog is then displayed to allow you to rename the Indicator View:

(The above figure is an example only; your configuration may be different.)

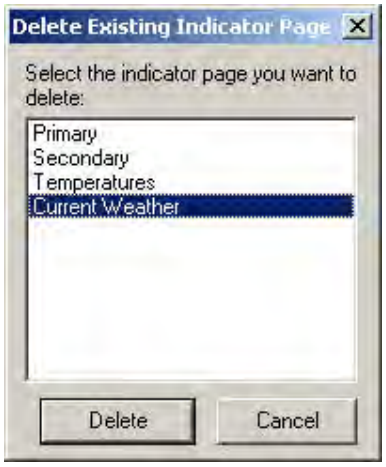
2. If an Indicator View is not the active window then select the "View" menu, "Indicator Pages" submenu, and "Rename Indicator Page" item. The following dialog is then displayed to allow you to rename the Indicator View:



(The above figure is an example only; your configuration may be different.)

4.12.4 Deleting an Indicator View

To delete an Indicator View, select "Indicator Pages" from the "View" menu. Then select the "Delete Indicator Page" item. The following dialog is displayed:



(The above figure is an example only; your configuration may be different.)

Select the indicator page you wish to delete and press the "Delete" button.

Alternatively, delete all indicators from the Indicator View. Select each indicator one at a time and press the delete key; then close the view. This deletes the view.

4.13 Creating a Wind Rose

4.13.1 Getting Started

With Met Manager you can easily create a Wind Rose as explained in this section. For instructional purposes, we have setup Met Manager with a "direct-connection" data source, an "instantaneous" sample rate of 5 seconds, and the following parameters:

- Wind speed
- Scalar wind direction

4.13.2 Description of the Tool Bar

The following tool bar rests above the Wind Rose View:

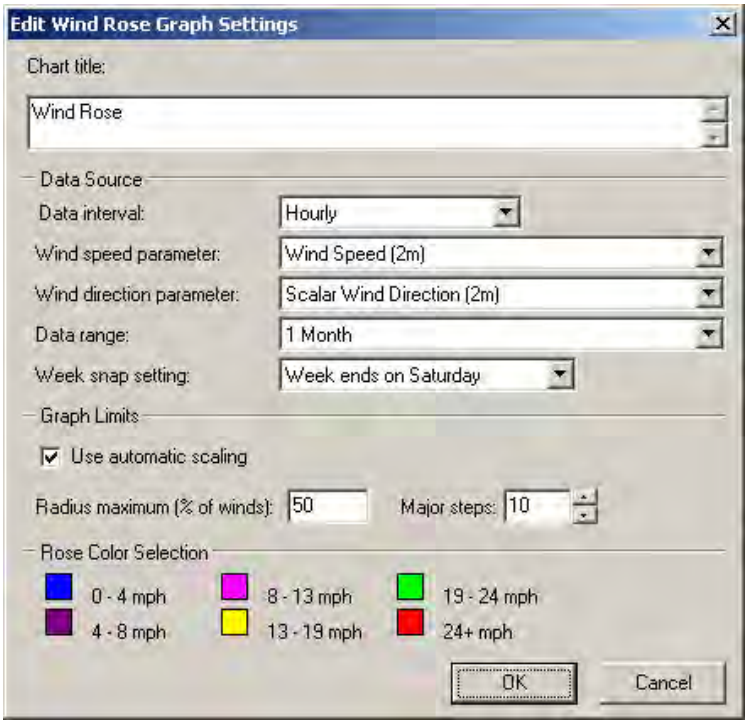
	The "update display" tool is used to refresh or freeze the display. When in the depressed position, the wind rose will refresh when new data arrives. When in the out position, the wind rose is frozen and will not be updated with the arrival of new data. The operation of this tool is similar to the "Auto Update" button of the Data View.
	Click the "day snap" tool to snap the wind rose to a time frame of 1 day.
	Click the "month snap" tool to snap the wind rose to a time frame of 1 month.
	Click the "edit" tool button to edit the properties of a wind rose.
	Use the "print" tool to print the wind rose to the printer. **Note**: Before using this button, make sure that the printer has been properly setup. Go to the File menu and "Print Setup" option to review the printer settings. *Configuring your printer or installing its printer driver is outside the scope of Met Manager*.
	Click on the "copy image" tool to copy an image of the wind rose to Microsoft Window's clipboard. Once in the clipboard, you can paste the image to a word processor or other program.

The "Data Navigator" tool bar button adjusts the data set being sent to the wind rose:

	Go to the beginning of the database
	For monthly wind roses, set the wind rose to the previous month. For weekly wind roses, set the wind rose to the previous week. For daily wind roses, set the wind rose to the previous day. For other wind roses, set the wind rose to the previous interval specified in the "data range" property
	For monthly wind roses, set the wind rose to the previous day. For weekly wind roses, set the wind rose to the previous day. For daily or other wind roses, set the wind rose to the previous hour
	Snap the wind rose to the beginning of the interval specified in the "data range property" of the wind rose. For example, if the data range is one month, then pressing this button will snap the wind rose to the first day of the month.
	For monthly wind roses, set the wind rose to the next day. For weekly wind roses, set the wind rose to the next day. For daily or other wind roses, set the wind rose to the next hour
	For monthly wind roses, set the wind rose to the next month. For weekly wind roses, set the wind rose to the next week. For daily wind roses, set the wind rose to the next day. For other wind roses, set the wind rose to the next interval specified in the "data range" property
	Go to the end of the database

4.13.3 Creating a Wind Rose

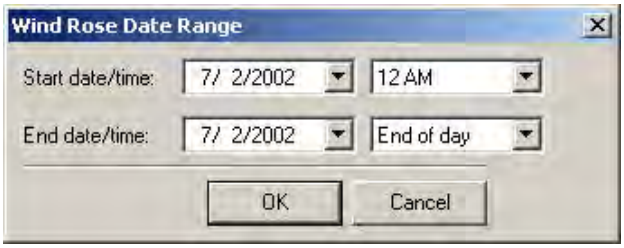
To create a wind rose, select "Wind Rose" from the View menu. The first time you do this in a new project, the "Edit Wind Rose Graph Settings" dialog below will automatically appear since Met Manager knows that the wind speed and wind direction parameters need to be assigned. Otherwise press the "Edit" tool button. The dialog is shown below:



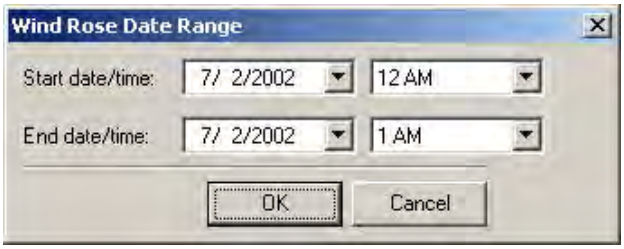
(The above figure is an example only; your configuration may be different.)

Select a data interval for the wind rose. *For wind roses, this interval is normally the hourly interval.* Assign the wind speed and wind direction parameters. In this example, these parameters are wind speed and scalar wind direction.

Pick a data range from the "Data range" list box. Choices are 1, 3, 6, 8, and 12 hours, 1 day, monthly and custom. "Custom" allows you to generate a wind rose over a date and time range that you define:



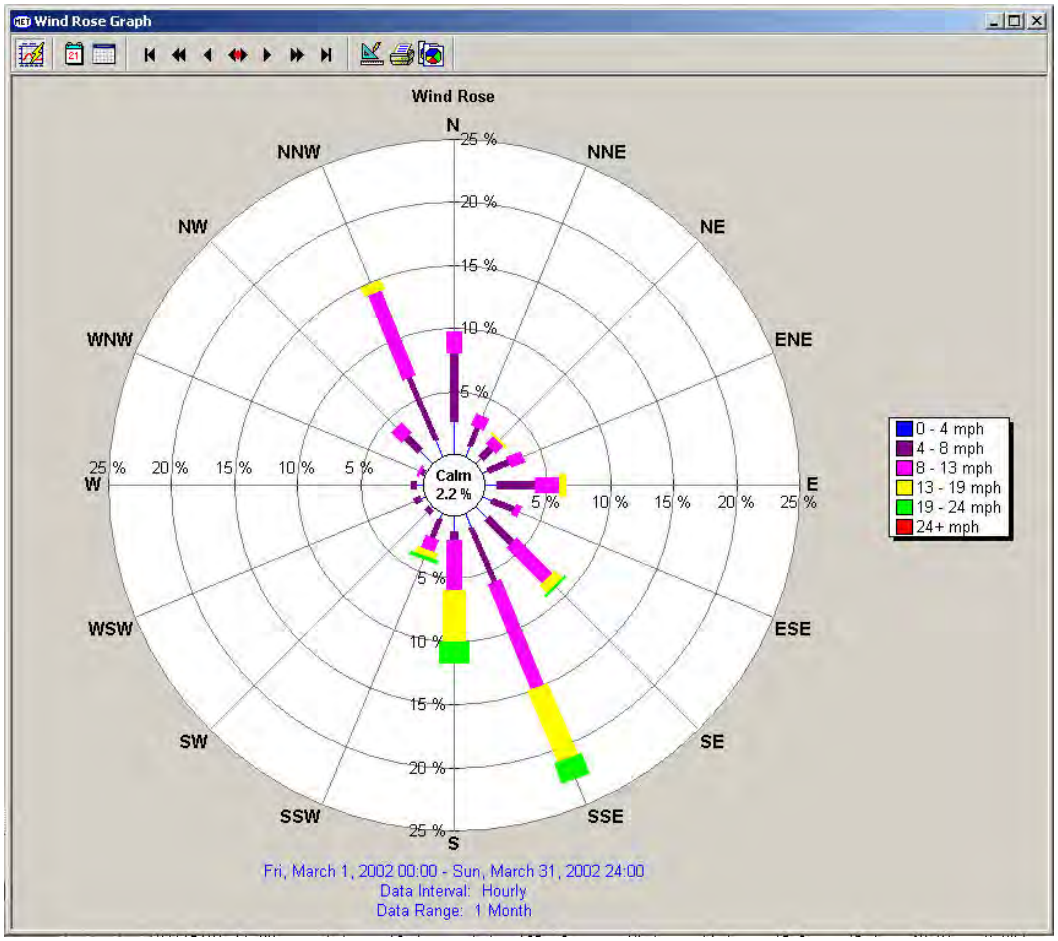
The above start and end date/time ranges define one day beginning at 12 am (time 00:00) on 7/2/2002 and ending at midnight on 7/2/2002. To generate a wind rose for the first hour of the day, specify:



Check the "Use automatic scaling" box to have Met Manager automatically adjust the grid size, or uncheck this box and specify a graph maximum in percent. For example, a setting of 50% will scale the wind rose graph radius to show a maximum of 50% of the winds along any given radius. Set the "Major steps" to be the number of major graduations along the radius.

You can click on the "Rose Color Selection" fields to change the color of the various sub-ranges of the wind speed. Also, you can name the wind rose in the "Chart title" box.

An example of a wind rose is shown below:



(The above figure is an example only; your configuration may be different.)

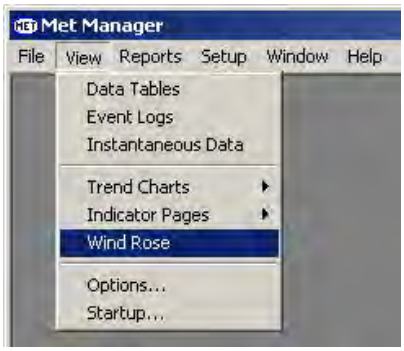
4.13.4 Editing a Wind Rose

To edit a wind rose, open it (e.g., from the View menu), then click the "Edit" tool button . Edit the properties as needed.

4.14 Viewing Wind Roses

4.14.1 Opening a Wind Rose View

To view a Wind Rose, select "Wind Rose" from the View menu to open it:



Note: You can display a Wind Rose that has already been opened by selecting it from Met Manager's Window menu. See Section 4.18.

4.14.2 Automatically Opening a Wind Rose View at Startup

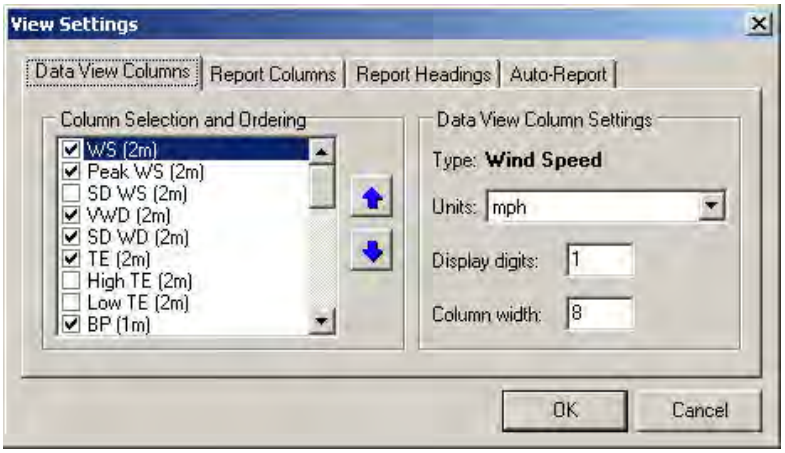
To automatically open a Wind Rose View that you've created, set its check box in the View menu, "Startup" dialog. Also see Section 4.16 for configuring various startup options.

(The above figure is an example only; your configuration may be different.)

4.15 Configuring Data Table View and Report Options

4.15.1 Configuring the Options

To configure Data View and report options, select "Options" from the View menu. The following dialog will be presented:



(The above figure is an example only; your configuration may be different.)

4.15.2 Configuring the Data View Columns

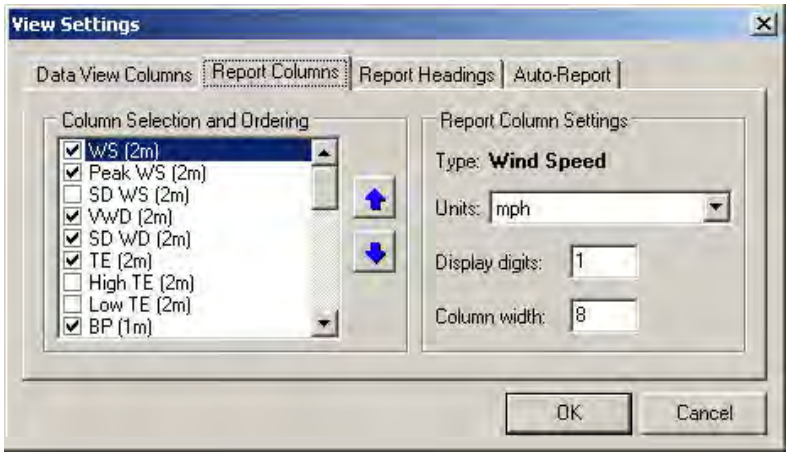
You can decide which database parameters will be visible on the Data View and their column order. From the above figure, check the parameter if you want it to be in the Data View. To reposition a parameter's column order on the display, select the parameter with your mouse and then use the up and down arrows to move the parameter in the list.

You can also set the units, number of display digits, and column width for each parameter. These settings only affect the Data View.

4.15.3 Configuring the Report Columns

Similar to the Data View, you can decide which database parameters will be visible in the "data table listing" type of reports and their column order. These reports include the Data Table Report and the Daily Summary Report.

Select the "Report Columns" tab. Then check the parameter if you want it to show up in the listing. To reposition a parameter's column order within the listing, select the parameter with your mouse and then use the up and down arrows to reorder the parameter.

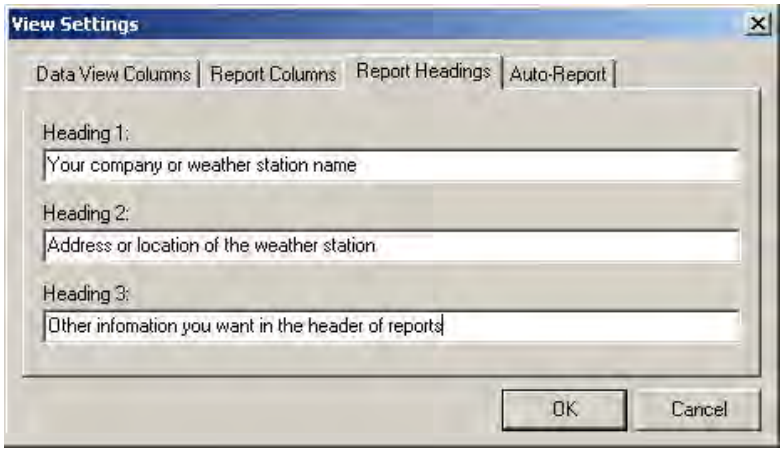


(The above figure is an example only; your configuration may be different.)

Note: The report listing is printed in "landscape" orientation to maximize the number of columns that can be fit in the report. However, Met Manager currently allows formatting of only one report (of the "data table listing" type). Thus, you must decide which are the most important parameters for listing in the report. Uncheck the least important parameters.

4.15.4 Configuring the Report Header

To configure a header that will show up on all reports, select the "Report Headings" tab. Then define entries for each heading line:

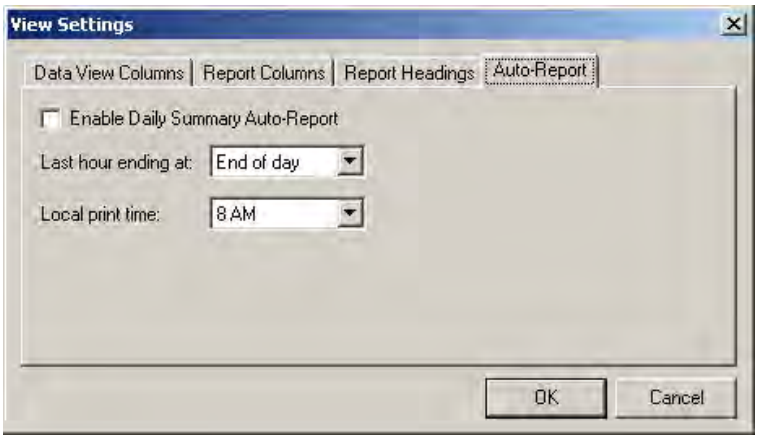


(The above figure is an example only; your configuration may be different.)

Each line of the heading is centered within the header area of the reports.

4.15.5 Setting up an Auto Report

If you have a printer connected to the computer, you can set up Met Manager to automatically generate a Daily Summary Report. Select the "Auto-Report" tab.



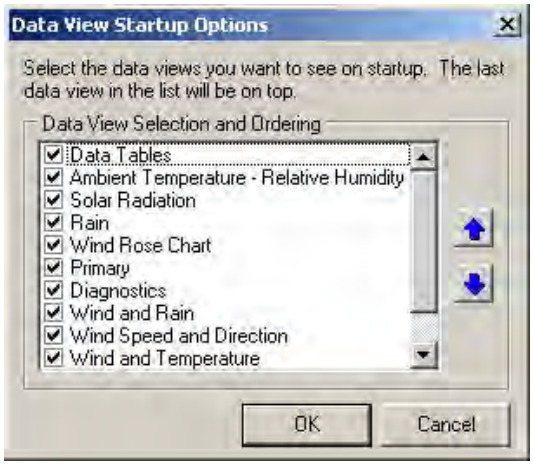
Check the "Enable Daily Summary Auto-Report" box to enable an auto report.

Some facilities may want to generate a Daily Summary Report on a schedule that does not end at midnight. You can do this by specifying the last hour of the report in the "Last hour ending at" field.

You can also specify the local time that the report is to print.

4.16 Configuring Startup Options

Many views may be defined for a Met Manager project including the Data View, Event Log View, Instantaneous View, multiple Trend Chart Views, multiple Indicator Views, and a Wind Rose View. To avoid having to manually open these views when Met Manager first starts, you can configure some startup options. Select "Startup" from the View menu to show the following dialog:



(The above figure is an example only; your configuration may be different.)

Check the various views that you want Met Manager to automatically load when the program is first started. You can also select a view (from the list) with your mouse and then use the up and down arrow keys to reorder it. This ordering affects the order that the views are opened as well as the order of the list of views located in the Windows menu (see Section 4.18). In the above example, the last view in the list titled "Wind and Temperature" will be the view on top following startup.

4.17 Generating Reports

4.17.1 Getting Started

To generate reports, select the "Reports" menu:

Then select individual reports from the menu:

1. Data Tables Report. Generates a columnar listing of a subset of one of the available data tables.

2. Daily Summary Report. Generates a daily summary listing for a specified date of the hourly data table.

3. Daily Rainfall Report. Generates a multi-column report of rainfall for every day in the chosen date range.

4. Monthly Parameter Report. Generates a monthly diurnal variation report for a chosen database parameter and for a chosen month.

5. Monthly Wind Frequency Report. Generates a monthly wind frequency report.

6. Monthly Data Recovery Report. Calculates the monthly percent of data recovery for all database parameters.

7. Chill Hour Report. Generates a multi-column report of daily chill hours and accumulated chill hours for every day in the chosen date range.

8. Chill Unit Report. Generates a multi-column report of daily chill units and accumulated chill units for every day in the chosen date range.

9. Growing Degrees Report. Generates a multi-column report of daily growing degree days or hours (user-specified) and accumulated degree days (or hours) for every day in the chosen date range.

10. Evapotranspiration Report. Generates a multi-column report of daily reference or crop evapotranspiration (user-specified) and accumulated evapotranspiration for every day in the chosen date range.

11. Heating Degrees Report. Generates a multi-column report of daily heating degree days and accumulated heating degree days for every day in the chosen date range.

12. Cooling Degrees Report. Generates a multi-column report of daily cooling degree days and accumulated cooling degree days for every day in the chosen date range.

Each of the reports is explained in the following sections.

4.17.2 Description of the Tool Bar

The following tool bar rests above the report when being previewed:

	Show entire page
	Zoom to page width
	Zoom in the report
	Zoom out the report
	Go to first page of the report
	Go to previous page of the report
	Go to next page of the report

	Go to last page of the report
	Print the report view to the printer. **Note**: Before using this button, make sure that the printer has been properly setup. Go to the File menu and "Print Setup" option to review the printer settings. *Configuring your printer or installing its printer driver is outside the scope of Met Manager*.
Close	Close the report view

4.17.3 Data Tables Report

To run the Data Tables Report, select it from the "Reports" menu. Then pick the data table of interest and define the start and end date and time range:

The above date range specifies one day beginning on January 5, 2002.

An example of a Data Table Report is shown below:

Met Manager Report System — Report Generated 4/17/2002 9:47:43 AM

Your company or weather station name
Address or location of the weather station
Other information you want in the header of reports

Data Table

Date/Time CST	WS (mph) 2 m	Peak WS (mph) 2 m	VWD (sector) 2 m		SD WD (deg) 2 m	TE (°C) 2 m	BP (inHg) 1 m	Rain (inch) 1 m	RH (%) 2 m	SR (W/m^2) 2 m	SE (MJ/m^2) 2 m
01/05/02 01:00	8.5	13.9	82	E	12	10.0	30.01	0.00	97.2	0	0.0000
01/05/02 02:00	9.4	15.3	92	E	10	10.4	29.97	0.00	98.4	0	0.0000
01/05/02 03:00	8.9	14.6	89	E	15	10.8	29.95	0.00	98.5	0	0.0000
01/05/02 04:00	11.5	22.8	107	ESE	12	10.9	29.91	0.06	99.9	0	0.0000
01/05/02 05:00	14.5	21.7	113	ESE	11	11.7	29.84	0.02	99.5	0	0.0000
01/05/02 06:00	8.4	19.2	125	SE	14	12.0	29.85	0.06	99.9	0	0.0000
01/05/02 07:00	13.0	28.9	114	ESE	26	13.9	29.79	0.04	99.5	0	0.0000
01/05/02 08:00	12.0	21.0	152	SSE	20	14.6	29.82	0.13	99.2	2	0.0063
01/05/02 09:00	9.0	18.2	339	NNW	71	11.7	29.86	0.36	99.9	2	0.0072
01/05/02 10:00	6.0	13.2	350	N	28	10.0	29.90	0.20	99.9	10	0.0350
01/05/02 11:00	5.5	12.1	16	NNE	27	10.5	29.91	0.08	99.9	52	0.1874
01/05/02 12:00	4.8	11.0	20	NNE	28	10.9	29.89	0.00	99.9	92	0.3311
01/05/02 13:00	3.1	6.4	359	N	40	11.5	29.88	0.00	99.9	202	0.7283
01/05/02 14:00	5.1	9.6	310	NW	26	12.7	29.85	0.01	96.4	343	1.2340
01/05/02 15:00	5.8	12.1	276	W	27	12.8	29.85	0.00	94.4	88	0.3152
01/05/02 16:00	6.8	13.2	302	WNW	24	12.5	29.85	0.00	91.6	104	0.3735
01/05/02 17:00	5.5	11.4	303	WNW	21	12.3	29.88	0.00	91.9	38	0.1373
01/05/02 18:00	6.5	15.0	307	NW	24	11.2	29.91	0.00	93.5	1	0.0030
01/05/02 19:00	6.6	14.6	312	NW	24	10.7	29.96	0.01	92.6	0	0.0000
01/05/02 20:00	7.8	16.7	313	NW	24	9.5	29.99	0.02	94.2	0	0.0000
01/05/02 21:00	8.9	17.1	309	NW	21	8.7	30.02	0.00	93.9	0	0.0000
01/05/02 22:00	8.9	17.1	314	NW	23	8.5	30.03	0.00	85.4	0	0.0000
01/05/02 23:00	5.9	13.9	311	NW	24	7.5	30.05	0.00	86.0	0	0.0000
01/05/02 24:00	4.1	8.2	295	WNW	25	6.4	30.04	0.00	89.6	0	0.0000

Data Table — Page 1

4.17.4 Daily Summary Report

To run the Daily Summary Report, select it from the "Reports" menu. Then define the end date and time.

The "end time" allows a 24-hourly daily report that is not midnight-to-midnight. Some industrial facilities use this feature.

An example of a Daily Summary Report is shown below:

Met Manager Report System — Report Generated 4/17/2002 9:50:27 AM

Your company or weather station name
Address or location of the weather station
Other information you want in the header of reports

Daily Summary Report - January 5, 2002

Date/Time CST	WS (mph) 2 m	Peak WS (mph) 2 m	VWD (sector) 2 m		SD WD (deg) 2 m	TE (°C) 2 m	BP (inHg) 1 m	Rain (inch) 1 m	RH (%) 2 m	SR (W/m^2) 2 m	SE (MJ/m^2) 2 m
01/05/02 01:00	8.5	13.9	82	E	12	10.0	30.01	0.00	97.2	0	0.0000
01/05/02 02:00	9.4	15.3	92	E	10	10.4	29.97	0.00	98.4	0	0.0000
01/05/02 03:00	8.9	14.6	89	E	15	10.8	29.95	0.00	98.5	0	0.0000
01/05/02 04:00	11.5	22.8	107	ESE	12	10.9	29.91	0.06	99.9	0	0.0000
01/05/02 05:00	14.5	21.7	113	ESE	11	11.7	29.84	0.02	99.5	0	0.0000
01/05/02 06:00	8.4	19.2	125	SE	14	12.0	29.85	0.06	99.9	0	0.0000
01/05/02 07:00	13.0	28.9	114	ESE	26	13.9	29.79	0.04	99.5	0	0.0000
01/05/02 08:00	12.0	21.0	152	SSE	20	14.6	29.82	0.13	99.2	2	0.0063
01/05/02 09:00	9.0	18.2	339	NNW	71	11.7	29.86	0.36	99.9	2	0.0072
01/05/02 10:00	6.0	13.2	350	N	28	10.0	29.90	0.20	99.9	10	0.0350
01/05/02 11:00	5.5	12.1	16	NNE	27	10.5	29.91	0.08	99.9	52	0.1874
01/05/02 12:00	4.8	11.0	20	NNE	28	10.9	29.89	0.00	99.9	92	0.3311
01/05/02 13:00	3.1	6.4	359	N	40	11.5	29.88	0.00	99.9	202	0.7283
01/05/02 14:00	5.1	9.6	310	NW	26	12.7	29.85	0.01	96.4	343	1.2340
01/05/02 15:00	5.8	12.1	276	W	27	12.8	29.85	0.00	94.4	88	0.3152
01/05/02 16:00	6.8	13.2	302	WNW	24	12.5	29.85	0.00	91.6	104	0.3735
01/05/02 17:00	5.5	11.4	303	WNW	21	12.3	29.88	0.00	91.9	38	0.1373
01/05/02 18:00	6.5	15.0	307	NW	24	11.2	29.91	0.00	93.5	1	0.0030
01/05/02 19:00	6.6	14.6	312	NW	24	10.7	29.96	0.01	92.6	0	0.0000
01/05/02 20:00	7.8	16.7	313	NW	24	9.5	29.99	0.02	94.2	0	0.0000
01/05/02 21:00	8.9	17.1	309	NW	21	8.7	30.02	0.00	93.9	0	0.0000
01/05/02 22:00	8.9	17.1	314	NW	23	8.5	30.03	0.00	85.4	0	0.0000
01/05/02 23:00	5.9	13.9	311	NW	24	7.5	30.05	0.00	86.0	0	0.0000
01/05/02 24:00	4.1	8.2	295	WNW	25	6.4	30.04	0.00	89.6	0	0.0000
Minimum:	3.1	6.4	16	NNE	10	6.4	29.79	0.00	85.4	0	0.0000
Maximum:	14.5	28.9	359	N	71	14.6	30.05	0.36	99.9	343	1.2340
Average:	7.8	15.3	221	SW	24	10.9	29.92		95.9	39	
Total:								1.00			3.3583

Daily Summary Report - January 5, 2002 — Page 1

Technical Note: The above report is generated from the hourly data table. That's why you do not specify a particular data interval.

4.17.5 Daily Rainfall Report

To run the Daily Rainfall Report, select it from the "Reports" menu. Then pick the rain parameter (in case you have more than one) and define the start and end dates:

An example of an abbreviated Daily Rainfall Report is shown below:

Met Manager Report System — Report Generated 8/23/2002 7:45:26 PM

Your Company or Weather Station Name
Address or Location of the Weather Station
Other Information You Want in the Header of Reports

Daily Rainfall Report

Date Range: January 01, 2002 to March 31, 2002

Date	Rain (in)	Date	Rain (in)	Date	Rain (in)
01/01/2002	0.00	02/10/2002	0.00	03/22/2002	0.00
01/02/2002	0.00	02/11/2002	0.00	03/23/2002	0.00
01/03/2002	0.00	02/12/2002	0.00	03/24/2002	0.00
01/04/2002	0.00	02/13/2002	0.00	03/25/2002	0.19
01/05/2002	1.00	02/14/2002	0.00	03/26/2002	0.01
01/06/2002	0.01	02/15/2002	0.00	03/27/2002	0.00
01/07/2002	0.00	02/16/2002	0.00	03/28/2002	0.00
01/08/2002	0.00	02/17/2002	0.00	03/29/2002	0.00
01/09/2002	0.00	02/18/2002	0.00	03/30/2002	0.23
01/10/2002	0.01	02/19/2002	0.09	03/31/2002	0.01
01/11/2002	0.08	02/20/2002	0.01	Total Rain:	2.79
01/12/2002	0.00	02/21/2002	0.14		
01/13/2002	0.00	02/22/2002	0.00		
01/14/2002	0.00	02/23/2002	0.00		
01/15/2002	0.00	02/24/2002	0.00		
01/16/2002	0.00	02/25/2002	0.00		
01/17/2002	0.00	02/26/2002	0.00		
01/18/2002	0.02	02/27/2002	0.00		
01/19/2002	0.16	02/28/2002	0.00		
01/20/2002	0.00	03/01/2002	0.15		

Technical Note: The above report is generated from the hourly data table.

4.17.6 Monthly Parameter Report

To run a Monthly Parameter Report, select it from the "Reports" menu. Then pick the database parameter of interest and the month and year:

An example of a Monthly Parameter Report for rain is shown below:

Met Manager Report System — Report Generated 4/17/2002 9:57:07 AM

Your company or weather station name
Address or location of the weather station
Other information you want in the header of reports

Monthly Parameter Report - January 2002

Rain (inch) - 1 meters

Hour of the Day

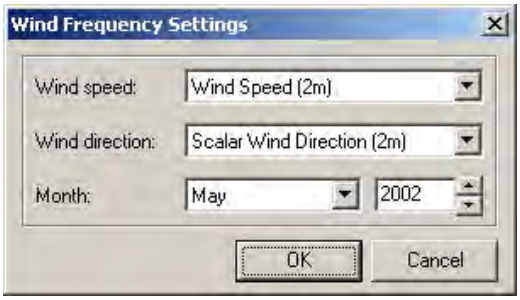
Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Min	Max	Total
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.06	0.02	0.06	0.04	0.13	0.36	0.20	0.08	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.02	0.00	0.00	0.00	0.00	0.00	0.36	1.00
6	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
11	0.00	0.00	0.02	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.08
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.01	0.02
19	0.00	0.01	0.00	0.00	0.00	0.01	0.11	0.00	0.00	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.16
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02
24	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.01	0.00	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.09
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	m	m	m	0.00	0.00	0.00
29	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m			
30	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m			
31	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m			
Min:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
Max:	0.00	0.01	0.02	0.06	0.02	0.06	0.11	0.13	0.36	0.20	0.08	0.00	0.02	0.01	0.01	0.00	0.01	0.00	0.01	0.02	0.00	0.00	0.01	0.01		0.36	
Tot:	0.00	0.02	0.02	0.12	0.04	0.07	0.15	0.13	0.38	0.25	0.11	0.00	0.02	0.02	0.01	0.00	0.01	0.00	0.01	0.02	0.00	0.00	0.01	0.01			1.41

Monthly Parameter Report - January 2002 — Page 1

Technical Note: The above report is generated from the hourly data table. The m's denote missing data.

4.17.7 Monthly Wind Frequency Report

To run a Monthly Wind Frequency Report, select it from the "Reports" menu. Then pick the wind speed and wind direction database parameters of interest and the month and year. The example below uses wind speed and scalar wind direction database parameters:



Met Manager Report System — Report Generated 8/14/2002 9:37:58 PM

Your company or weather station name
Address or location of the weather station
Other information you want in the header of reports

Monthly Wind Frequency Distribution Report - May 2002

Sector	Wind Speed Interval (mph) 0 - 4 %	4 - 8 %	8 - 13 %	13 - 19 %	19 - 24 %	24+ %	Total (%)	Mean (mph)
NNE	0.825	1.788	0.000	0.000	0.000	0.000	2.613	4.501
NE	1.100	1.376	1.238	0.000	0.000	0.000	3.714	6.344
ENE	0.275	1.788	0.688	0.000	0.000	0.000	2.751	6.941
E	1.100	0.963	1.238	0.000	0.000	0.000	3.301	6.007
ESE	1.926	1.926	0.825	0.000	0.000	0.000	4.677	5.180
SE	3.026	7.978	10.591	2.613	0.000	0.000	24.209	8.280
SSE	1.238	7.978	11.142	9.216	0.275	0.000	29.849	10.742
S	0.825	3.439	3.164	1.651	0.000	0.000	9.078	8.904
SSW	0.413	0.275	0.275	0.000	0.000	0.000	0.963	5.498
SW	0.275	0.000	0.000	0.000	0.000	0.000	0.275	2.547
WSW	0.138	0.000	0.000	0.000	0.000	0.000	0.138	1.934
W	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
WNW	0.275	0.275	0.000	0.000	0.000	0.000	0.550	3.570
NW	1.238	0.413	0.000	0.000	0.000	0.000	1.651	3.143
NNW	1.651	2.201	0.000	0.000	0.000	0.000	3.851	4.517
N	1.376	0.963	0.000	0.000	0.000	0.000	2.338	3.748
CALM	10.041						10.041	
Total (%):	15.681	31.962	29.161	13.480	0.275	0.000	100.000	
Mean (mph)	2.625	6.028	10.183	15.398	19.109	0.000		7.480

Number of hours in reporting period: 744
Overall data recovery: 97.7 %
One hourly observation: 0.138 %

Report generated using: WS (2 m)
Scalar WD (2 m)

Technical Note: The above report is generated from the hourly data table.

4.17.8 Monthly Data Recovery Report

To run a Monthly Data Recovery Report, select it from the "Reports" menu. Then define the month and year of interest:

An example of a Monthly Data Recovery Report is shown below:

Met Manager Report System — Report Generated 7/31/2002 9:28:09 PM

Your Company or Weather Station Name
Address or Location of the Weather Station
Other Information You Want in the Header of Reports

Monthly Data Recovery - April 2002

Parameter Name	Parameter Type	Units	Level	Valid Hours	Recovery
WS	Wind Speed	mph	2 meters	720	100.0 %
Gust	Wind Speed	mph	2 meters	720	100.0 %
SD_WS	Wind Speed	mph	2 meters	720	100.0 %
VWD	Wind Direction	sector	2 meters	720	100.0 %
SD_WD	Wind Direction	deg	2 meters	720	100.0 %
TE	Temperature	°F		720	100.0 %
High TE	Temperature	°F	2 meters	720	100.0 %
Low TE	Temperature	°F	2 meters	720	100.0 %
BP1	Pressure	inHg	1 meters	720	100.0 %
Rain	Precipitation	inch	1 meters	720	100.0 %
RH	Humidity	%	2 meters	720	100.0 %
LO_RH	Humidity	%	2 meters	720	100.0 %
BV	Voltage	volt		720	100.0 %
BoxTE	Temperature	°F		720	100.0 %
SR	Solar Radiation	W/m^2	2 meters	720	100.0 %
SE	Solar Energy	MJ/m^2	2 meters	720	100.0 %
DP	Temperature	°F	2 meters	720	100.0 %
WetBTE	Temperature	°F	2 meters	720	100.0 %
WindChill	Temperature	°F	2 meters	720	100.0 %
HeatIndex	Temperature	°F	2 meters	720	100.0 %
SE (Calc)	Solar Energy	MJ/m^2		720	100.0 %
Wind Chill (New)	Temperature	°F	2 meters	720	100.0 %
VWS	Wind Speed	mph	2 meters	720	100.0 %
Scalar WD	Wind Direction	deg	2 meters	720	100.0 %
Sigma-Theta (STI)	Wind Direction	deg	2 meters	720	100.0 %
UVWD	Wind Direction	deg		720	100.0 %
Rain Rate	Precipitation Rate	inch/hr	1 meters	720	100.0 %
TE Rate	Temperature Rate	°F/hr	2 meters	715	99.3 %
BP Chg	Pressure	inHg	1 meters	715	99.3 %

Number of hours in reporting period: 720
Overall data recovery: 100.0 %

Monthly Data Recovery - April 2002 — Page 1

Technical Note: The above report is generated from the hourly data table.

4.17.9 Chill Hour Report

To run a Chill Hour Summary Report, select it from the "Reports" menu. Then select a chill hour database parameter from the drop-down list, and define the date range of interest. Units of "CH" stand for "Chill Hours."

An example Chill Hour Summary Report is shown below:

Met Manager Report System — Report Generated 12/9/2002 9:59:24 PM

Chill Hour Summary Report

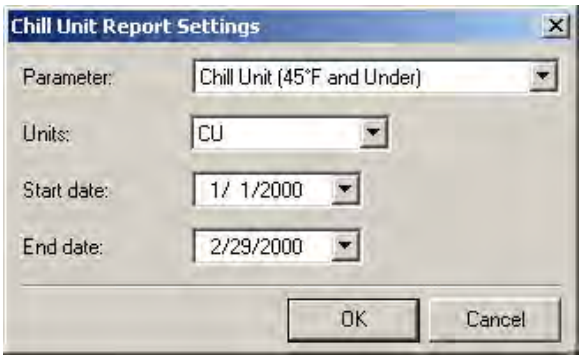
Chill Hour (32-45) (CH(32-45))
January 01, 2000 to February 29, 2000

Temperature Parameter: [3] Temperature
Base Temperature: 45 °F

Date (mm/dd/yyyy)	Chill Hour (CH)	Cumulative Chill Hour (CH)	Date (mm/dd/yyyy)	Chill Hour (CH)	Cumulative Chill Hour (CH)
01/01/2000	4.00	4.00	02/11/2000	0.00	138.00
01/02/2000	0.00	4.00	02/12/2000	0.00	138.00
01/03/2000	0.00	4.00	02/13/2000	0.00	138.00
01/04/2000	10.00	14.00	02/14/2000	0.00	138.00
01/05/2000	4.00	18.00	02/15/2000	0.00	138.00
01/06/2000	0.00	18.00	02/16/2000	0.00	138.00
01/07/2000	0.00	18.00	02/17/2000	0.00	138.00
01/08/2000	0.00	18.00	02/18/2000	0.00	138.00
01/09/2000	0.00	18.00	02/19/2000	0.00	138.00
01/10/2000	2.00	20.00	02/20/2000	0.00	138.00
01/11/2000	0.00	20.00	02/21/2000	0.00	138.00
01/12/2000	0.00	20.00	02/22/2000	0.00	138.00
01/13/2000	0.00	20.00	02/23/2000	0.00	138.00
01/14/2000	0.00	20.00	02/24/2000	0.00	138.00
01/15/2000	0.00	20.00	02/25/2000	0.00	138.00
01/16/2000	0.00	20.00	02/26/2000	0.00	138.00
01/17/2000	0.00	20.00	02/27/2000	0.00	138.00
01/18/2000	0.00	20.00	02/28/2000	0.00	138.00
01/19/2000	0.00	20.00	02/29/2000	0.00	138.00
01/20/2000	0.00	20.00			
01/21/2000	0.00	20.00			
01/22/2000	0.00	20.00			

4.17.10 Chill Unit Report

To run a Chill Unit Summary Report, select it from the "Reports" menu. Then select a chill unit database parameter from the drop-down box, and define the date range of interest. Units of "CU" stand for "Chill Units."



An example Chill Unit Summary Report is shown below:

Met Manager Report System — Report Generated 12/9/2002 10:02:59 PM

Chill Unit Summary Report

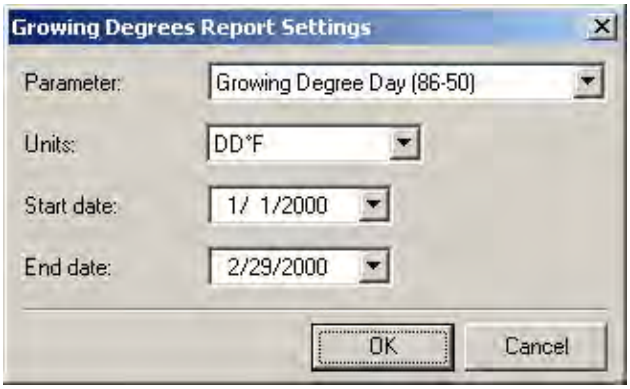
Chill Unit (45°F and Under) (CU(<=45))
January 01, 2000 to February 29, 2000

Method: Chill Unit (45°F and Under)
Temperature Parameter: [3] Temperature

Date (mm/dd/yyyy)	Chill Unit (CU)	Cumulative Chill Unit (CU)	Date (mm/dd/yyyy)	Chill Unit (CU)	Cumulative Chill Unit (CU)
01/01/2000	4.00	4.00	02/11/2000	0.00	143.00
01/02/2000	0.00	4.00	02/12/2000	0.00	143.00
01/03/2000	0.00	4.00	02/13/2000	0.00	143.00
01/04/2000	10.00	14.00	02/14/2000	0.00	143.00
01/05/2000	9.00	23.00	02/15/2000	0.00	143.00
01/06/2000	0.00	23.00	02/16/2000	0.00	143.00
01/07/2000	0.00	23.00	02/17/2000	0.00	143.00
01/08/2000	0.00	23.00	02/18/2000	0.00	143.00
01/09/2000	0.00	23.00	02/19/2000	0.00	143.00
01/10/2000	2.00	25.00	02/20/2000	0.00	143.00
01/11/2000	0.00	25.00	02/21/2000	0.00	143.00
01/12/2000	0.00	25.00	02/22/2000	0.00	143.00
01/13/2000	0.00	25.00	02/23/2000	0.00	143.00
01/14/2000	0.00	25.00	02/24/2000	0.00	143.00
01/15/2000	0.00	25.00	02/25/2000	0.00	143.00
01/16/2000	0.00	25.00	02/26/2000	0.00	143.00
01/17/2000	0.00	25.00	02/27/2000	0.00	143.00
01/18/2000	0.00	25.00	02/28/2000	0.00	143.00
01/19/2000	0.00	25.00	02/29/2000	0.00	143.00
01/20/2000	0.00	25.00			
01/21/2000	0.00	25.00			
01/22/2000	0.00	25.00			

4.17.11 Growing Degrees Report

To run a Growing Degrees Report (day or hour), select it from the "Reports" menu. Then select a growing degree day or growing degree hour database parameter from the drop-down list, select the units, and define the date range of interest. Units include DD°C (degree days in °C), DD°F (degree days in °F), DH°C (degree hours in °C), and DH°F (degree hours in °F).



An example Growing Degrees Summary Report (in units of DD°F) is shown below:

Met Manager Report System — Report Generated 12/9/2002 10:04:31 PM

Growing Degrees Summary Report

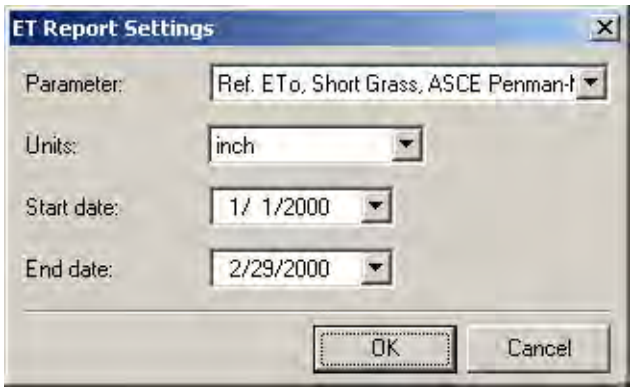
Growing Degree Day (86-50) (GDD(86-50))
January 01, 2000 to February 29, 2000

Method: Integration
Temperature Parameter: [3] Temperature
Base Temperature: 50 °F
Ceiling Temperature: 86 °F

Date (mm/dd/yyyy)	Growing Degrees (DD°F)	Cumulative GD (DD°F)	Date (mm/dd/yyyy)	Growing Degrees (DD°F)	Cumulative GD (DD°F)
01/01/2000	13.2	13.2	02/09/2000	9.8	363.5
01/02/2000	22.9	36.2	02/10/2000	16.5	380.0
01/03/2000	19.9	56.1	02/11/2000	19.1	399.1
01/04/2000	0.9	57.0	02/12/2000	17.6	416.7
01/05/2000	3.0	59.9	02/13/2000	19.8	436.5
01/06/2000	9.4	69.3	02/14/2000	15.4	451.9
01/07/2000	10.6	79.9	02/15/2000	20.4	472.3
01/08/2000	9.5	89.3	02/16/2000	21.3	493.6
01/09/2000	9.4	98.7	02/17/2000	23.0	516.6
01/10/2000	10.1	108.8	02/18/2000	23.3	539.9
01/11/2000	15.2	124.0	02/19/2000	8.9	548.8
01/12/2000	21.8	145.8	02/20/2000	7.1	555.9
01/13/2000	21.0	166.8	02/21/2000	11.6	567.5
01/14/2000	7.6	174.4	02/22/2000	17.3	584.8
01/15/2000	11.2	185.6	02/23/2000	18.5	603.3
01/16/2000	15.4	201.0	02/24/2000	19.4	622.7
01/17/2000	16.3	217.2	02/25/2000	22.1	644.8
01/18/2000	16.2	233.5	02/26/2000	15.4	660.2
01/19/2000	18.8	252.3	02/27/2000	10.5	670.7
01/20/2000	9.7	262.0	02/28/2000	11.7	682.4
01/21/2000	5.2	267.1	02/29/2000	18.6	701.0
01/22/2000	16.6	283.8			
01/23/2000	15.7	299.5			

4.17.12 Evapotranspiration Report

To run a reference or crop Evapotranspiration Report, select it from the "Reports" menu. Then select a crop or reference evapotranspiration database parameter from the drop-down list. Select units of inch or mm, and define the date range of interest.



An example Evapotranspiration Summary Report is shown below:

Met Manager Report System — Report Generated 12/9/2002 10:07:47 PM

Evapotranspiration Summary Report

Ref. ETo, Short Grass, ASCE Penman-Monteith (Integration) (Ref ETo)
January 01, 2000 to February 29, 2000

Method: Integration
Wind Speed Parameter: [1] Wind Speed
Temperature Parameter: [3] Temperature
Solar Radiation Parameter: [7] Solar Radiation
Relative Humidity Parameter: [6] Relative Humidity

Date (mm/dd/yyyy)	Ref ET (inch)	Cumulative Ref ET (inch)	Date (mm/dd/yyyy)	Ref ET (inch)	Cumulative Ref ET (inch)
01/01/2000	0.09	0.09	02/08/2000	0.15	3.84
01/02/2000	0.09	0.18	02/09/2000	0.14	3.99
01/03/2000	0.08	0.26	02/10/2000	0.16	4.14
01/04/2000	0.13	0.39	02/11/2000	0.12	4.25
01/05/2000	0.13	0.53	02/12/2000	0.12	4.38
01/06/2000	0.02	0.55	02/13/2000	0.09	4.46
01/07/2000	0.05	0.60	02/14/2000	0.17	4.63
01/08/2000	0.05	0.64	02/15/2000	0.16	4.79
01/09/2000	0.09	0.73	02/16/2000	0.09	4.87
01/10/2000	0.14	0.87	02/17/2000	0.10	4.98
01/11/2000	0.12	0.99	02/18/2000	0.09	5.07
01/12/2000	0.09	1.08	02/19/2000	0.15	5.21
01/13/2000	0.09	1.17	02/20/2000	0.17	5.38
01/14/2000	0.13	1.30	02/21/2000	0.18	5.56
01/15/2000	0.13	1.42	02/22/2000	0.13	5.69
01/16/2000	0.12	1.55	02/23/2000	0.12	5.80
01/17/2000	0.13	1.67	02/24/2000	0.18	5.98
01/18/2000	0.13	1.80	02/25/2000	0.11	6.09
01/19/2000	0.14	1.94	02/26/2000	0.08	6.16
01/20/2000	0.14	2.07	02/27/2000	0.19	6.36
01/21/2000	0.04	2.11	02/28/2000	0.19	6.55
01/22/2000	0.10	2.21	02/29/2000	0.10	6.65
01/23/2000	0.08	2.30			
01/24/2000	0.13	2.43			

4.17.13 Heating Degrees Report

To run a Heating Degrees Report, select it from the "Reports" menu. Then select a heating degree day database parameter from the drop-down list, select the units, and define the date range of interest. Units include DD°C (degree days in °C), DD°F (degree days in °F), DH°C (degree hours in °C), and DH°F (degree hours in °F). Be sure to specify DD°F or DD°C for common heating degree day units.

An example Heating Degrees Summary Report (in units of DD°F) is shown below:

Met Manager Report System — Report Generated 12/9/2002 10:09:00 PM

Heating Degrees Summary Report

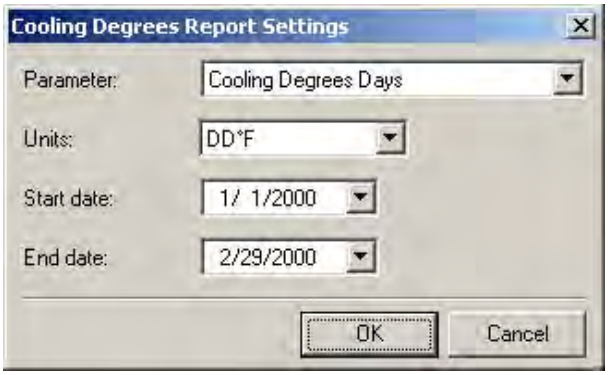
Heating Degree Days (HDD)
January 01, 2000 to February 29, 2000

Method: Integration
Temperature Parameter: [3] Temperature
Base Temperature: 65 °F

Date (mm/dd/yyyy)	Heating Degrees (DD°F)	Cumulative HD (DD°F)	Date (mm/dd/yyyy)	Heating Degrees (DD°F)	Cumulative HD (DD°F)
01/01/2000	7.5	7.5	02/10/2000	2.8	385.8
01/02/2000	0.0	7.5	02/11/2000	1.0	386.8
01/03/2000	0.9	8.4	02/12/2000	1.0	387.8
01/04/2000	18.4	26.8	02/13/2000	0.6	388.4
01/05/2000	19.2	46.0	02/14/2000	3.5	391.9
01/06/2000	5.6	51.6	02/15/2000	0.7	392.6
01/07/2000	4.6	56.2	02/16/2000	0.0	392.6
01/08/2000	5.5	61.7	02/17/2000	0.0	392.6
01/09/2000	6.5	68.2	02/18/2000	0.0	392.6
01/10/2000	8.8	77.0	02/19/2000	6.5	399.1
01/11/2000	4.0	81.0	02/20/2000	8.9	408.0
01/12/2000	0.0	81.0	02/21/2000	5.6	413.6
01/13/2000	0.2	81.2	02/22/2000	1.8	415.4
01/14/2000	7.6	88.8	02/23/2000	0.5	415.9
01/15/2000	6.8	95.6	02/24/2000	1.1	417.0
01/16/2000	3.5	99.1	02/25/2000	0.0	417.0
01/17/2000	3.1	102.2	02/26/2000	2.2	419.2
01/18/2000	3.4	105.6	02/27/2000	7.3	426.5
01/19/2000	1.0	106.6	02/28/2000	6.7	433.1
01/20/2000	5.4	112.0	02/29/2000	1.8	434.9
01/21/2000	9.9	121.9			
01/22/2000	2.5	124.4			
01/23/2000	2.7	127.2			

4.17.14 Cooling Degrees Report

To run a Cooling Degrees Report, select it from the "Reports" menu. Then select a cooling degree day database parameter from the drop-down list, select the units, and define the date range of interest. Units include DD°C (degree days in °C), DD°F (degree days in °F), DH°C (degree hours in °C), and DH°F (degree hours in °F). Be sure to specify DD°F or DD°C for common cooling degree day units.



An example Cooling Degrees Summary Report (in units of DD°F) is shown below:

Met Manager Report System — Report Generated 12/9/2002 10:10:27 PM

Cooling Degrees Summary Report

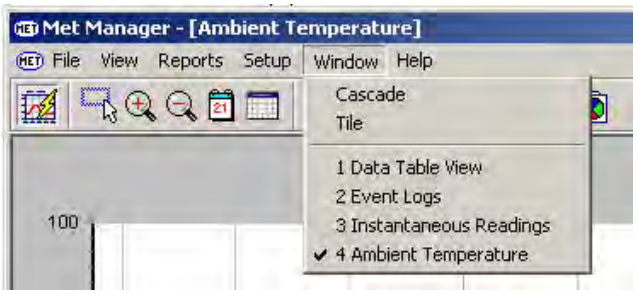
Cooling Degrees Days (CDD)
January 01, 2000 to February 29, 2000

Method: Integration
Temperature Parameter: [3] Temperature
Base Temperature: 65 °F

Date (mm/dd/yyyy)	Cooling Degrees (DD°F)	Cumulative CD (DD°F)	Date (mm/dd/yyyy)	Cooling Degrees (DD°F)	Cumulative CD (DD°F)
01/01/2000	4.0	4.0	02/10/2000	4.3	77.2
01/02/2000	7.9	12.0	02/11/2000	5.1	82.3
01/03/2000	5.8	17.8	02/12/2000	3.6	85.8
01/04/2000	0.0	17.8	02/13/2000	5.4	91.2
01/05/2000	0.0	17.8	02/14/2000	3.9	95.1
01/06/2000	0.0	17.8	02/15/2000	6.1	101.2
01/07/2000	0.1	17.9	02/16/2000	6.3	107.6
01/08/2000	0.0	17.9	02/17/2000	8.0	115.6
01/09/2000	0.9	18.8	02/18/2000	8.3	123.9
01/10/2000	3.1	21.9	02/19/2000	0.3	124.2
01/11/2000	4.2	26.0	02/20/2000	0.7	124.9
01/12/2000	6.8	32.8	02/21/2000	3.3	128.2
01/13/2000	6.2	39.0	02/22/2000	4.1	132.3
01/14/2000	0.1	39.1	02/23/2000	4.0	136.3
01/15/2000	2.5	41.6	02/24/2000	5.5	141.8
01/16/2000	3.9	45.4	02/25/2000	7.1	148.9
01/17/2000	4.4	49.8	02/26/2000	2.6	151.5
01/18/2000	4.6	54.4	02/27/2000	2.4	153.9
01/19/2000	4.9	59.3	02/28/2000	2.5	156.4
01/20/2000	0.1	59.4	02/29/2000	5.4	161.9
01/21/2000	0.0	59.4			
01/22/2000	4.1	63.5			

4.18 Window Menu

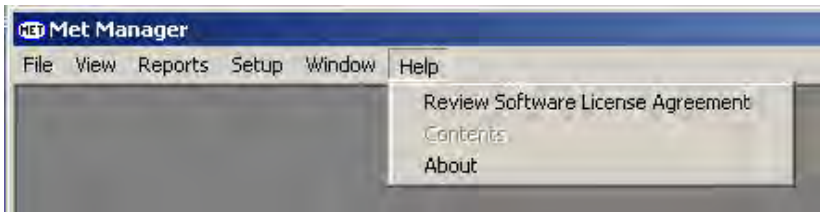
The Window menu shows various views that have been opened:



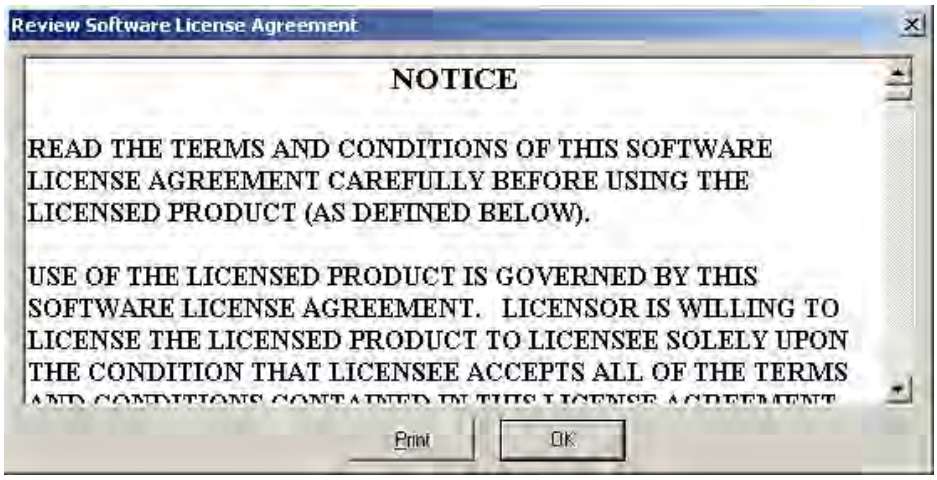
From this menu, you can cascade or tile the various views, and can easily choose an opened view to display.

4.19 Help Menu

The Help menu currently includes the following choices:



Select "Review Software License Agreement" to review and print the agreement:

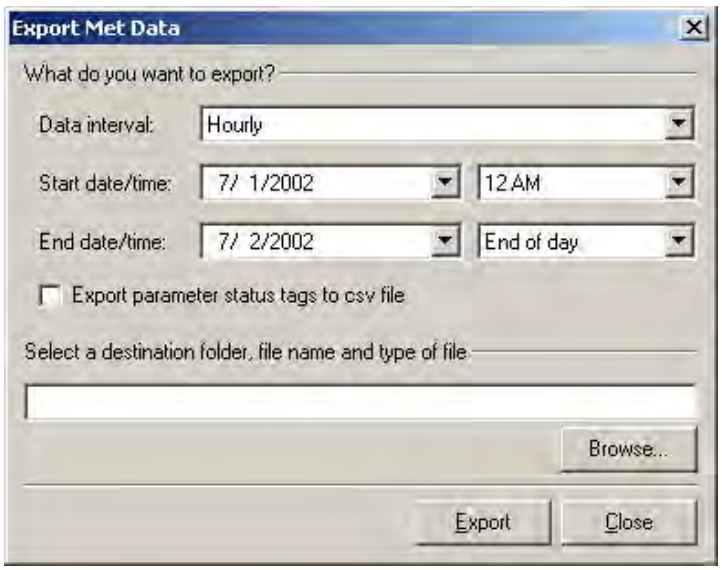


Select "About" from the Help menu to review the version of the software and the software Licensor's name and contact information.

4.20 Exporting Data

Subsets of the project data tables can be exported for offline analysis or other use. Export file types include text-based comma-separated variable (CSV), Paradox, and dBase.

To export data, select "Export" from the File menu. The following export dialog is then presented:



Select the data interval of interest from the "Data interval" list box. Met Manager will export its data from the corresponding data table. Then select the start and end dates and times.

If you are generating a CSV file, then check the "Export parameter status tags to csv file" box to export the data values with status tags that represent valid (0), partially valid (1), invalid (2), calibration (3), or missing (4) status. *This option applies only to CSV files since parameter status tags are always exported to Paradox and dBase file types.* Recall that "partially valid" means that at least one sample was acquired for the data interval, but fewer than three-quarters of the possible number of samples (as defined by the sample data rate).

Click on the "Browse" button to locate a place on your computer to save the export file:

You can also select a type of data file to export from the "Save as type" list box. File types include CSV, Paradox, and dBase. The default file type is "CSV File" format.

Upon successful export, a message similar to the one below is displayed.

In the example below, an exported CSV file was imported into a Microsoft Excel spreadsheet. The first line of the header identifies whether or not the exported file includes the parameter status tags. The second line identifies each exported parameter's database tag (DB1, DB2, etc.). The third line is the "column name" of the database parameter. The fourth line is the measurement height (level) of the parameter above (or below) the ground in meters. The fifth line is the exported units. These units are the standard default ones used in the project database, and are assigned by Met Manager.

Weather Data.csv

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Export with parameter status tags (0=valid,1=partial,2=invalid,3=calibrate,4=missing)												
2		DB1		DB2		DB3		DB4		DB5		DB6	
3	Date/Time	WS	Status	Gust	Status	SD_WS	Status	VWD	Status	SD_WD	Status	TE	Status
4		2		2		2		2		2			
5		mph		mph		mph		deg		deg		°C	
6	7/1/2002 1:00	3.69	0	6.72	0	0.97	0	87.00	0	14.09	0	25.27	0
7	7/1/2002 2:00	3.22	0	6.72	0	1.24	0	80.00	0	14.13	0	25.20	0
8	7/1/2002 3:00	2.61	0	6.00	0	1.21	0	94.00	0	14.12	0	25.37	0
9	7/1/2002 4:00	3.44	0	7.07	0	1.12	0	100.00	0	13.09	0	25.71	0
10	7/1/2002 5:00	3.08	0	6.36	0	1.25	0	91.00	0	16.87	0	25.85	0
11	7/1/2002 6:00	2.87	0	5.28	0	0.83	0	74.00	0	13.45	0	25.52	0
12	7/1/2002 7:00	4.18	0	7.79	0	1.40	0	86.00	0	14.12	0	26.00	0
13	7/1/2002 8:00	5.02	0	9.22	0	1.28	0	96.00	0	15.66	0	26.90	0
14	7/1/2002 9:00	6.20	0	11.01	0	1.41	0	117.00	0	17.92	0	28.10	0
15	7/1/2002 10:00	7.65	0	12.08	0	1.51	0	127.00	0	15.33	0	29.15	0
16	7/1/2002 11:00	7.40	0	12.80	0	1.59	0	134.00	0	15.53	0	29.72	0
17	7/1/2002 12:00	8.18	0	13.87	0	1.70	0	130.00	0	16.66	0	30.53	0
18	7/1/2002 13:00	8.32	0	13.51	0	1.71	0	129.00	0	18.27	0	31.47	0
19	7/1/2002 14:00	9.77	0	15.66	0	1.96	0	135.00	0	16.43	0	31.27	0
20	7/1/2002 15:00	9.35	0	14.95	0	2.06	0	142.00	0	16.00	0	31.05	0
21	7/1/2002 16:00	7.89	0	14.23	0	1.72	0	143.00	0	16.04	0	30.22	0
22	7/1/2002 17:00	7.95	0	13.51	0	1.72	0	146.00	0	17.41	0	29.97	0
23	7/1/2002 18:00	6.34	0	11.37	0	1.52	0	144.00	0	16.20	0	29.46	0
24	7/1/2002 19:00	4.76	0	8.15	0	1.17	0	157.00	0	13.49	0	28.53	0
25	7/1/2002 20:00	2.13	0	4.21	0	1.00	0	118.00	0	23.46	0	27.22	0
26	7/1/2002 21:00	3.15	0	7.07	0	1.42	0	123.00	0	15.76	0	26.91	0
27	7/1/2002 22:00	3.00	0	7.79	0	1.46	0	127.00	0	15.17	0	26.63	0
28	7/1/2002 23:00	3.21	0	6.36	0	1.23	0	125.00	0	16.56	0	26.37	0
29	7/2/2002 0:00	2.37	0	5.64	0	1.59	0	132.00	0	14.35	0	25.96	0
30	7/2/2002 1:00	0.00	0	0.00	0	0.00	0	0.00	0	14.00	0	25.45	0
31	7/2/2002 2:00	0.06	0	2.78	0	0.35	0	0.00	0	15.75	0	25.12	0

(The above figure is an example only; your configuration may be different.)

Recall that the status tags have the following meanings:

0 = valid (at least three-fourths of the samples were acquired)
1 = partially valid (at least one, but fewer than three-fourths of the samples were acquired)
2 = invalid
3 = calibration
4 = missing (no samples acquired)

Note: The "date" field is exported with a format of "m/d/yyyy h:mm". The individual parameter fields are exported in scientific notation.

Note: In the example above, and from within the Excel spreadsheet, the header cells were centered and the individual parameter "value" cells were centered and formatted as "numbers" with a fixed format of 2 decimal places.

Below is an example of data that was exported without status tags:

Weather Data2.csv

	A	B	C	D	E	F	G	H	I	J	K
1	Export without parameter status tags										
2		DB1	DB2	DB3	DB4	DB5	DB6	DB7	DB8	DB9	DB10
3	Date/Time	WS	Gust	SD_WS	VWD	SD_WD	TE	High TE	Low TE	BP1	Rain
4		2	2	2	2	2		2	2	1	1
5		mph	mph	mph	deg	deg	°C	°C	°C	inHg	inch
6	7/1/2002 1:00	3.69	6.72	0.97	87.00	14.09	25.27	25.47	25.14	30.00	0.00
7	7/1/2002 2:00	3.22	6.72	1.24	80.00	14.13	25.20	25.44	24.99	29.98	0.00
8	7/1/2002 3:00	2.61	6.00	1.21	94.00	14.12	25.37	25.63	25.14	29.98	0.00
9	7/1/2002 4:00	3.44	7.07	1.12	100.00	13.09	25.71	26.08	25.44	29.98	0.00
10	7/1/2002 5:00	3.08	6.36	1.25	91.00	16.87	25.85	26.04	25.63	29.98	0.00
11	7/1/2002 6:00	2.87	5.28	0.83	74.00	13.45	25.52	25.74	25.33	29.99	0.00
12	7/1/2002 7:00	4.18	7.79	1.40	86.00	14.12	26.00	26.35	25.52	30.00	0.00
13	7/1/2002 8:00	5.02	9.22	1.28	96.00	15.66	26.90	27.60	26.19	30.01	0.01
14	7/1/2002 9:00	6.20	11.01	1.41	117.00	17.92	28.10	28.83	27.41	30.01	0.00
15	7/1/2002 10:00	7.65	12.08	1.51	127.00	15.33	29.15	29.66	28.60	30.01	0.00
16	7/1/2002 11:00	7.40	12.80	1.59	134.00	15.53	29.72	30.18	29.33	30.02	0.00
17	7/1/2002 12:00	8.18	13.87	1.70	130.00	16.66	30.53	31.17	29.96	30.01	0.00
18	7/1/2002 13:00	8.32	13.51	1.71	129.00	18.27	31.47	32.29	30.54	30.00	0.00
19	7/1/2002 14:00	9.77	15.66	1.96	135.00	16.43	31.27	31.98	30.59	29.98	0.00
20	7/1/2002 15:00	9.35	14.95	2.06	142.00	16.00	31.05	32.31	30.37	29.97	0.00
21	7/1/2002 16:00	7.89	14.23	1.72	143.00	16.04	30.22	30.59	29.99	29.96	0.00
22	7/1/2002 17:00	7.95	13.51	1.72	146.00	17.41	29.97	30.20	29.72	29.95	0.00
23	7/1/2002 18:00	6.34	11.37	1.52	144.00	16.20	29.46	29.87	29.11	29.95	0.00
24	7/1/2002 19:00	4.76	8.15	1.17	157.00	13.49	28.53	29.25	27.87	29.96	0.00
25	7/1/2002 20:00	2.13	4.21	1.00	118.00	23.46	27.22	27.94	26.61	29.96	0.00
26	7/1/2002 21:00	3.15	7.07	1.42	123.00	15.76	26.91	27.07	26.58	29.96	0.00
27	7/1/2002 22:00	3.00	7.79	1.46	127.00	15.17	26.63	27.03	26.26	29.97	0.00
28	7/1/2002 23:00	3.21	6.36	1.23	125.00	16.56	26.37	26.57	26.19	29.98	0.00
29	7/2/2002 0:00	2.37	5.64	1.59	132.00	14.35	25.96	26.38	25.47	29.97	0.00
30	7/2/2002 1:00	0.00	0.00	0.00	0.00	14.00	25.45	25.66	25.22	29.96	0.00
31	7/2/2002 2:00	0.06	2.78	0.35	0.00	15.75	25.12	25.52	24.80	29.95	0.00

(The above figure is an example only; your configuration may be different.)

CAUTION: Be sure to review the exported data and remove any questionable data before using it in an analysis.

4.21 Setting up a Printer

To setup the printer (or to review its settings), select "Print Setup" from the File menu. Then make printer configuration changes as needed.

Note: Met Manager uses a standard Windows printer interface dialog. *Configuration of your printer is outside the scope of the Met Manager program*. If you are having difficulty printing with your printer, contact the printer manufacturer or your printer supplier. You may need to update your printer driver.

4.22 Exiting the Program

To shut down Met Manager, select "Exit" from the File menu or press the "close program" button in the upper right of Met Manager's display window. If Met Manager is connected to a data source, then the following message is displayed:

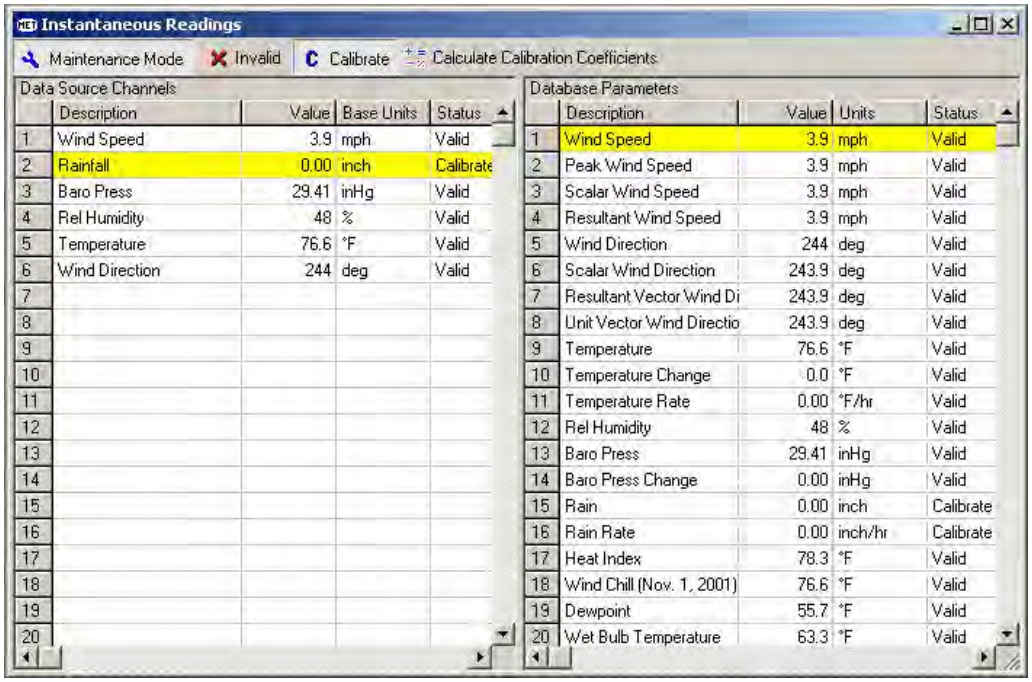
Press the Yes button if you wish to exit. Otherwise press the No button.

Note: If Met Manager was connected to a data source when shut down, then Met Manager will automatically open its last active project folder and data source when restarted (unless a command line option directs Met Manager to do something else). Refer to Appendix D on *optional* program startup command line options.

5 MAINTENANCE AND CALIBRATION

5.1 Setting the Status of a Channel

To activate special maintenance functions, select the View menu, then the Instantaneous View submenu. Then press the "Maintenance Mode" button from the Instantaneous View:



To set a Data Source Channel to invalid or calibrate status (or to return it to valid status), select the channel of interest (in the left-hand column) with your mouse. Then press the "Invalid" or "Calibrate" button. That channel, and all parameters derived from that channel will be tagged with the new status. This is important to filter bad or questionable data or channels undergoing a calibration, to keep that data out of the "valid" data set.

Note: When Met Manager detects that a sensor's value is out-of-range, then Met Manager automatically flags the data as invalid until the sensor is back in range. The range of valid values is configured with the Data Source Parameters editor from the Setup menu. See Section 3.6.

5.2 Calibration

5.2.1 Overview of the Calibration Process

With Met Manager you can set the calibration coefficients of each weather sensor in the following ways:

1. Two-point Method. For each of two points, enter the "as found" measurement of a sensor channel in base units and the corresponding measurement of the calibration standard in the same base units. Met Manager then calculates a new calibration slope and offset for the channel. (The "as found" measurement readings must be taken from Met Manager's display in "base units")

2. Corrective Slope and Offset Method. Enter in "corrective" slope and offset values that you calculated outside of Met Manager. These slope and offset values correct "as found" measurements in base units to values of the calibration standard in the same base units. Met Manager then calculates a new calibration slope and offset for the channel.

3. Recovery Method. Enter in a calibration slope and offset from a prior calibration report. This allows you to recover the calibration of the channel if you have to replace your hard disk, or if you relocate the Met Manager software to another computer.

Methods 1 and 2 above are discussed in Section 5.2.2. Method 3 is discussed in Section 5.2.3. For an overview of the calibration process, see Appendix E.

5.2.2 Calibrating Sensor-based Channels

To calibrate one or more sensor-based channels, follow these steps:

1. Locate and review any manufacturer-supplied instructions for calibrating the sensors of interest. Use appropriate calibration standards and ensure that the environment will not negatively impact the calibration. For example, do not calibrate a rain gage while it is raining.

   Note: This User's Manual does not provide instructions for applying a calibration standard; only for creating the calibration coefficients when the sensor is appropriately stimulated with, or compared to a calibration standard.

2. Go to the Instantaneous Data view located on the View menu (see Section 5.1).

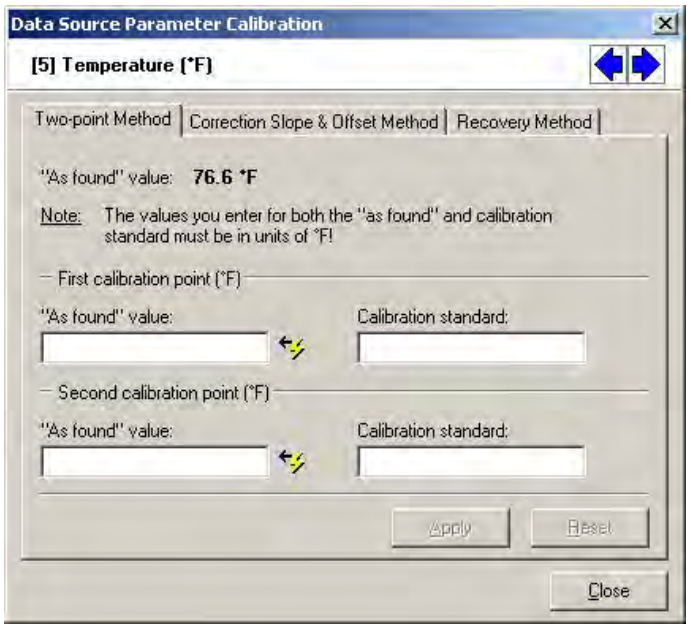
3. Press the "Maintenance Mode" button from the Instantaneous View.

4. With your mouse, select a Data Source Channel that you wish to calibrate. This channel is located in the left column of the Instantaneous View. Press the "Calibrate" button to flag the channel as being in calibration mode. This keeps calibration data out of the "valid" data set.

5. Repeat step 4 for <u>each</u> channel that you will be calibrating. When you finish with this step, each channel to be calibrated should have a status of

"Calibrate".

6. With your mouse, select the first sensor to be calibrated from the left hand column of the Instantaneous View. Then press the "Calculate Calibration Coefficients" button to show the "Calibration Calculator":



(The above figure is an example only; your configuration may be different.)

You have two methods to choose from: Two-point Method (step 7), or Correction Slope and Offset Method (step 8).

7. <u>Two-point Method:</u>

   a. For the first calibration point (see the figure above), enter the "As found" value response from the sensor (as shown on the Instantaneous View).

   [*Only if you have a direct-connection (i.e., real-time) to the data logger may you instead press the* *button. Met Manager will then fill the value in for you.*]

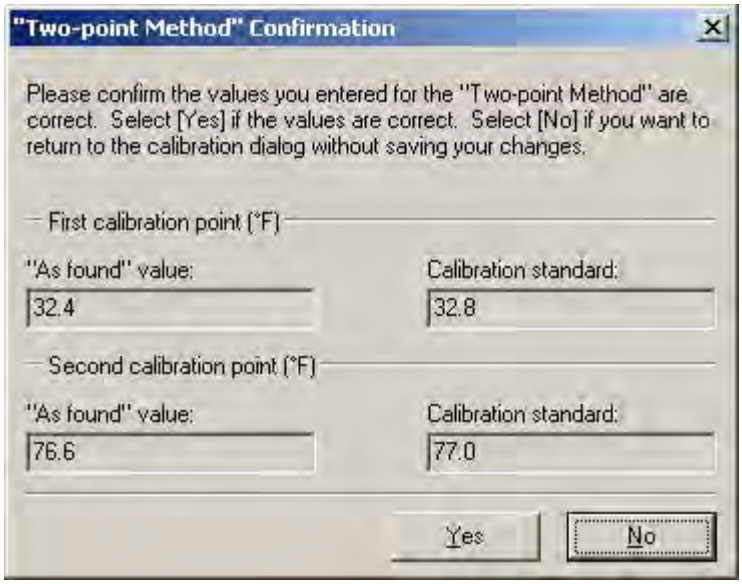
CAUTION: The *"as found"* value you enter MUST be that value that Met Manager converted to base units after receiving it from the data logger (or other data source). **<u>Failure to follow this rule will result in a faulty calibration.</u>** You can view the "as found" value on the left-hand side of the Instantaneous View next to the "Base Unit" column. Alternatively, use the View menu, Options item to set a column of the Data View to Base Units. Then view the appropriate time-averaged (or totalized) "as found" value within the Data View.

b. Next enter the value of the calibration standard in the "Calibration standard" field and in base units as shown near the top of the Calibration Calculator display. This value MUST be taken over the same time period as the "as found" reading.

> **CAUTION:** Be sure to enter the value of the calibration standard in the "Calibration standard" field and in base units as shown near the top of the Calibration Calculator display. Make sure that the value of the calibration standard is obtained over the same time period as the "as found" reading. **Failure to follow these rules will result in a faulty calibration.**

c. Repeat steps 7(a) and 7(b) for the second calibration point.

d. Press the "Apply" button to activate the new calibration for the channel. You will then get a confirmation message similar to the following:



(The above figure is an example only for illustration purposes.)

Press "Yes" to confirm the values you entered; otherwise press "No".

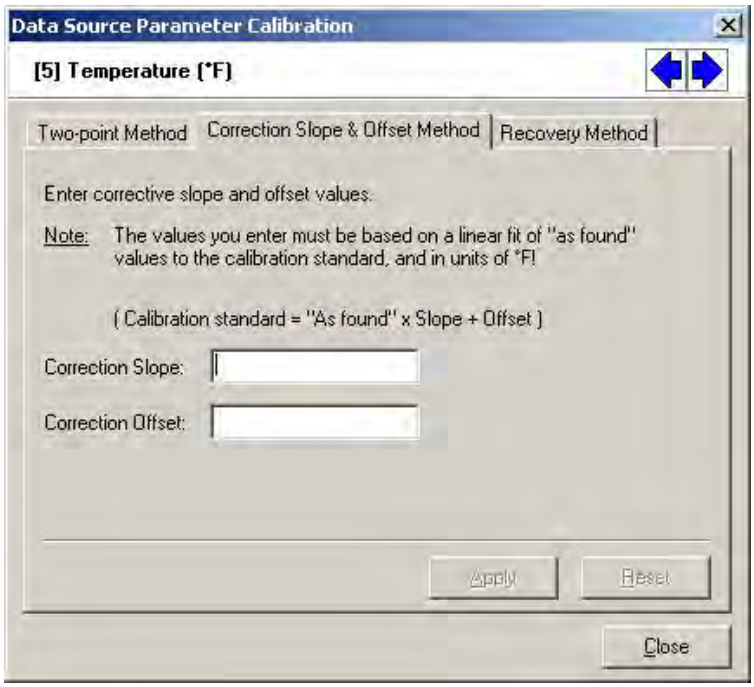
> **CAUTION**: If the values are not correct, then press "No". You might think that you can press "Yes", and then if incorrect, just go back and re-enter the values for the two points. However, doing so will create an invalid calibration because the new slope and offset values that were created (when you pressed "Yes") will now affect the new "as found" values of the two points. *Instead you will have to (a) repeat the entire two-point calibration for the channel all over again, or (b) enter in the recovery slope and offset from the prior calibration (see Section 5.2.3) and then re-enter the two-point "as found" and "calibration standard" values.*

e. Remove the calibration standard and restore the sensor to its normal operating state.

f. To select another channel to calibrate with the Two-point Method, press the back or forward arrow in the upper right corner of the Calibration Calculator. Then repeat step 7 in its entirety.

8. Correction Slope and Offset Method:

To use the "Correction Slope and Offset Method", select the "Correction Slope and Offset" tab near the top of the Calibration Calculator. A figure similar to the following will then be displayed:



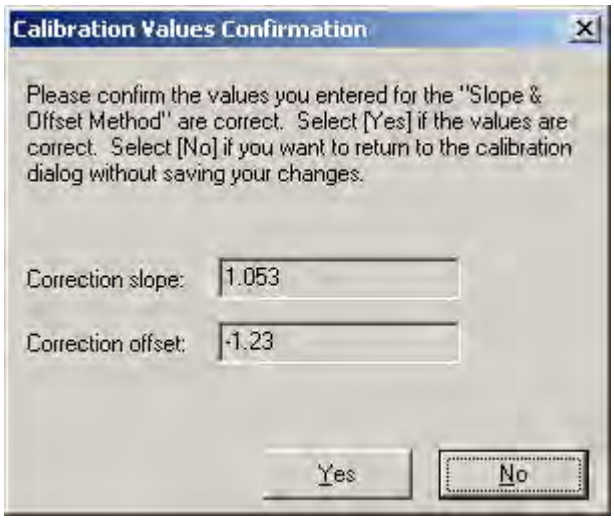
a. Enter "correction" slope and offset values that you obtained somehow off-line. These values convert "as found" readings (in base units) to match the calibration standard (also in base units) by the following relationship:

Calibration Standard Value = ("As found value" x Slope) + Offset

For the first calibration point (see the figure above), enter the "As found" value response from the sensor (as shown on the Instantaneous View).

> **CAUTION**: The values you enter MUST obey the above equation and must have been derived from "as found" and calibration standard measurements, both in base units, where the base units are identified near the top of the Calibration Calculator. **Failure to follow this rule will result in a faulty calibration.**

b. Press the "Apply" button to activate the new calibration for the channel. You will then get a confirmation message similar to the following:



(The above figure is an example only for illustration purposes.)

Press "Yes" to confirm the values you entered; otherwise press "No".

> **CAUTION**: If the values are not correct, then press "No". You might think that you can press "Yes", and then if incorrect, just go back and re-enter the "correction" slope and offset values. However, doing so will create an invalid calibration because the new composite "calibration" slope and offset values that were created (when you pressed "Yes") will now affect the new "correction" values since these values are based on "as found" measurements. Remember that the slope and offset values you entered on the "Correction Slope and Offset" tab are "corrective" values; not composite calibration values. *Instead you will have to (a) repeat the entire calibration for the channel all over again, or (b) on the "Recovery" tab, enter in the recovery slope and offset from the prior calibration (see Section 5.2.3) and then on the "Correction Slope and Offset" tab, re-enter the "correction" slope and offset values.*

c. Remove the calibration standard and restore the sensor to its normal operating state.

d. To select another channel to calibrate with the Correction Slope and Offset Method, press the back or forward arrow in the upper right corner of the Calibration Calculator. Then repeat step 8 in its entirety.

9. Restore Channel to Normal Operating Mode:

   If you have a direct connection (real-time) to the data logger, then review current data values reported by Met Manager for the channel just calibrated. Ensure that the reported values are representative of the sensor measurements and reflect the new calibration coefficients. For example, let's suppose that you just calibrated the ambient temperature sensor at two points, and in degrees Fahrenheit. You know that the outside temperature is about 70 to 75 °F, yet the sensor, following calibration, is reporting 157 °F. Something is wrong. During calibration, you may have entered the standard values in °C instead of °F. Or perhaps the sensor was not properly restored to its normal operating state.

   If you periodically capture the data from the data logger, wait until the logger has logged some data in its internal memory. Then instruct Met Manager to capture the data in the usual way. Review the captured data to ensure that the reported values are representative of the sensor measurements and reflect the new calibration coefficients. If not, then your calibration may have been in error.

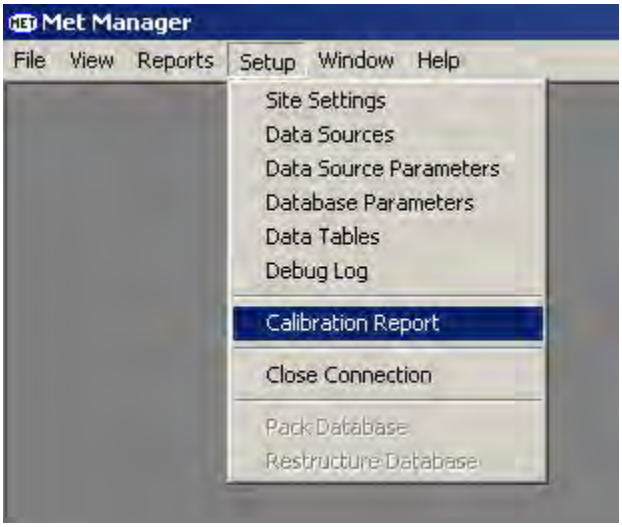
10. Once you are sure that the calibration was completed successfully, take the sensor channel out of calibration mode. With the sensor channel selected, click on the "Calibrate" button so that it is no longer depressed. The status of

the sensor should return to "valid." Verify that it does.

11. Repeat steps 9 and 10 for each channel that you calibrated.

12. Generate a Calibration Summary Report:

    To review and print a Calibration Summary Report, select "Calibration Report" from the Setup menu:



An example Calibration Summary Report is shown below:

Met Manager Report System — Report Generated 9/5/2002 10:27:23 AM

Calibration Summary Report

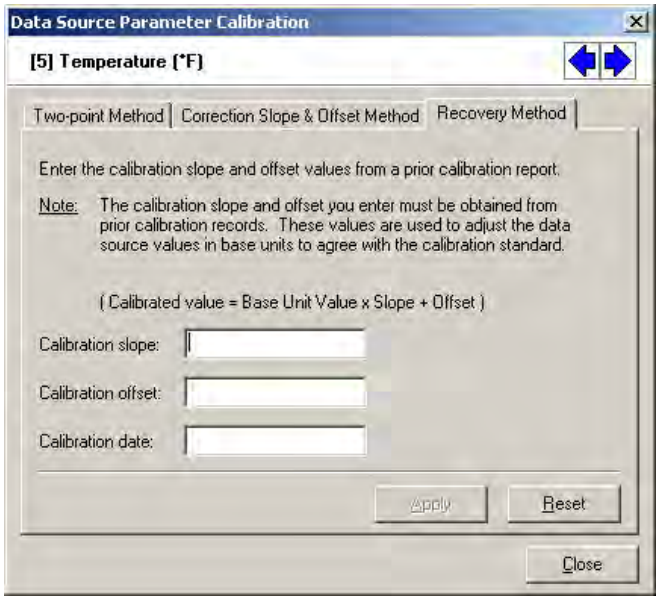
Parameter Name	Units	Height	Slope	Offset	Date
[1] Wind Speed	mph	2 meters	1.001	0.02	9/05/2002
[2] Rainfall	inch	1 meters	1.0	0.0	9/05/2002
[3] Baro Press	inHg	1 meters	0.9995	0.05	9/05/2002
[4] Rel Humidity	%	2 meters	0.9832	-1.56	9/05/2002
[5] Temperature	°F	2 meters	1.053	-0.8088	9/05/2002
[6] Wind Direction	deg	2 meters	1.0002	0.0003	9/05/2002

(The above figure is an example only for illustration purposes.)

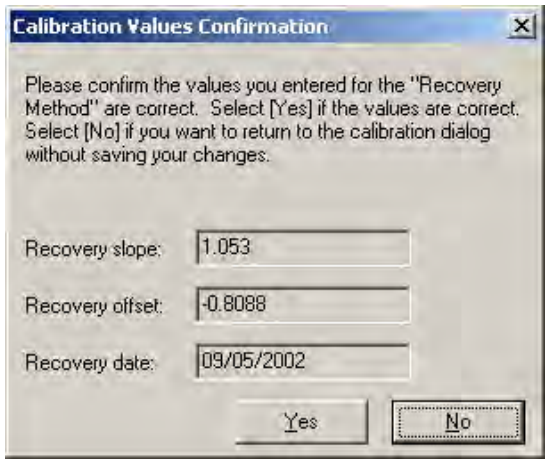
This report documents the new calibration slope and offset coefficients and date of calibration. Also, if you ever have to recover the coefficients because of a computer failure, you will need this report. Otherwise you may have to repeat the calibration.

5.2.3 Recovering Calibration Coefficients

You may need to recover Met Manager's calibration coefficients because of a computer hardware failure or other reason. To do so, first locate a hardcopy printout of the Calibration Summary Report for the prior calibration. Second, review the Data Source Parameters from the "Setup" menu to ensure that the base unit conversion slope and offsets values are correct and that the "base unit" is the same as printed on the prior calibration report. Third, go to the Calibration Calculator by pressing the "Maintenance" button on the Instantaneous Data View (of the "View" menu). Finally, enter the calibration slope and offset values from the prior Calibration Summary Report into the "Recovery Method" tab of the Calibration Calculator:



After you enter the values, press the "Apply" button. A confirmation screen similar to the following will then appear:



(The above figure is an example only for illustration purposes.)

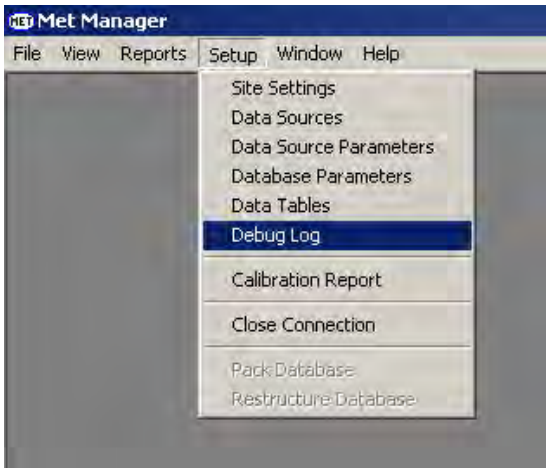
If the values are correct then press "Yes". Otherwise press "No" and re-enter the values.

5.3 Activating a Debug Log

Sometimes it is useful to capture the raw data records that are being received by Met Manager from a direct-connect type of data logger. To capture the received data to a text file, follow these steps:

1. Connect to the direct-connect data source. An active connection must be made prior to turning on the debug log. Thus the data source must be of the type "direct connect".

2. Select "Debug Log" from the Setup menu to turn it on:

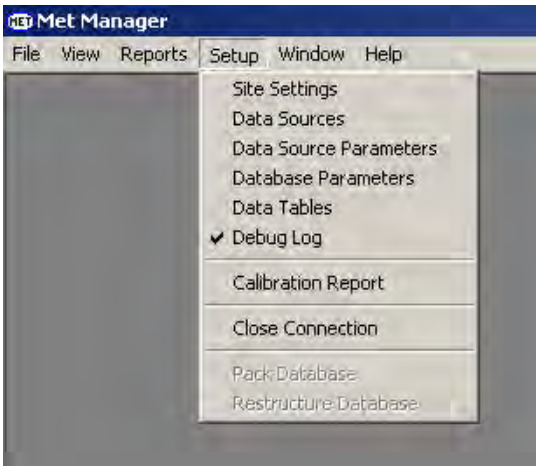


3. Specify the path and name of the log file that will hold the raw data. You can specify any filename you wish. The default name is "datacomm.log" and is located on the project path. For example:

(The above figure is an example only; your configuration may be different.)

If you do not wish to use the default project path name (c:\weather data" in this example), then you will have to create the path folder (and subfolders if any) with Microsoft Windows File Explorer (or similar software) prior to enabling the debug log function. You can also specify a file name other than "datacomm.log" and Met Manager will create it.

The debug log is a date/time stamped text file that contains records received by Met Manager from the data source. These records are the raw data from the data source and do not reflect Met Manager's application of calibration coefficients or unit conversions. To see if the log is enabled, go to the Setup menu. If a check mark is in front of the "Debug Log" submenu selection, then it is enabled. To disable the log simply select the "Debug Log" menu item again. Closing the connection will also disable the debug log.



You can review the contents of the debug file with a text editor program such as Microsoft's Notepad. However, if the file is large, then you may have to use a word processor or other program to review it.

CAUTION: The size of the debug log text file can grow very large and very fast depending on the frequency of raw data received from the data source. For example, if data is received by Met Manager every second, then a new data line is added to the "debug log" file every second. *Be sure to turn off (disable) the "debug log" feature if you no longer need it.*

Note: If you close down and then restart Met Manager, you will need to re-enable the debug log capability as its active state is not maintained by Met Manager.

5.4 Packing the Project Database

The project database must be periodically packed so that deleted records are permanently removed from the database. For instance, if a 1-minute table is "wrapped" at seven (7) days, the records deleted from the table by the wrap function still remain in the database file even though they are not visible to the application. Even when a wrap is used, the wrap function does not reduce the actual size of the file. *To reduce the file size and permanently remove the deleted records, the database must be periodically packed.*

Below is a recommended pack schedule; use the minimum pack schedule (maximum frequency) that applies to your particular data table configuration.

Data Table Interval (with "Delete data older than" option set)	**Pack Schedule**
1 Minute Data Table	Every 1 month
5 Minute Data Table	Every 3 months
10 Minute Data Table	Every 6 months
15 Minute Data Table	Every 6 months
20 Minute Data Table	Every 6 months
30 Minute Data Table	Every 6 months
Hourly Data Table	Once a year

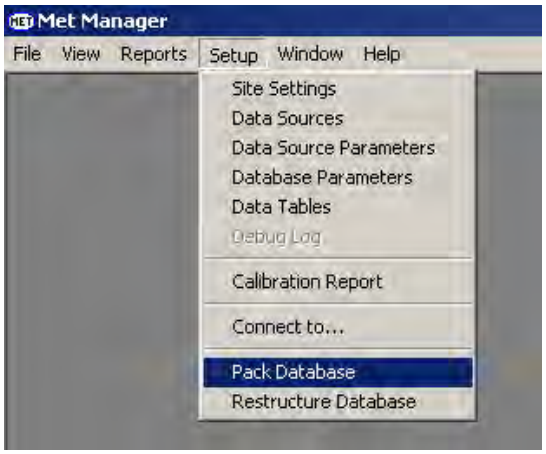
Note: You do not have to pack data tables that are setup with the "Keep data indefinitely" option (since these data tables are not wrapped). See Section 3.8.

Note: When a pack is performed, *all* the data tables within the project database are packed. That's why the pack schedule should be the *minimum* period (maximum frequency) of the data tables assigned to the project.

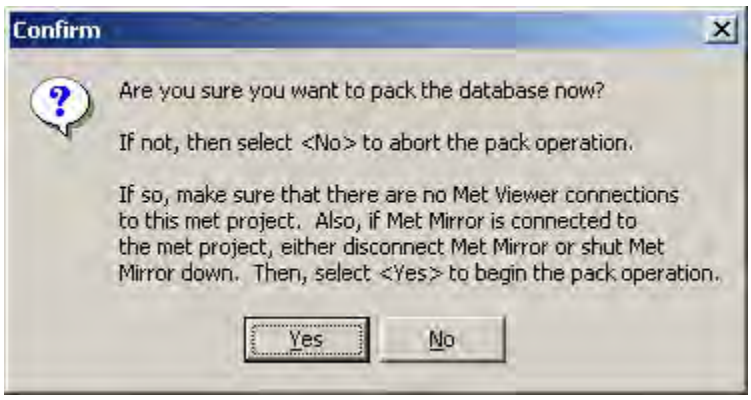
IMPORTANT: Before packing, insure that there are no active connections (other than Met Manager) to the database. This includes connections by Met Viewer, Met Mirror, or any other import/export/reporting software that is attached to the database.

For Met Manager, close the data source connection by selecting "Close connection" from the Setup menu. See the figure below. This then enables (ungrays) the "Pack Database" menu item. *For all other programs that may have a connection to the database, stop and close them to remove their connection to the project database.*

To pack the database and permanently remove any deleted data records, select the "Pack Database" menu item from the Setup menu:



The following dialog is then displayed:



Press "Yes" to begin the pack operation or "No" to not continue.

Note: The pack operation can take awhile, in some cases 20 to 30 minutes (or longer) depending on the number and size of the data tables.

The pack operation can fail for the following reasons:

- There is still an active connection to the project database (i.e., a Met Viewer or Met Mirror may still be running). The database cannot be packed when an active database connection exists.

- A file error occurs. If a file error occurs while attempting to pack the database, the pack operation will fail.

IMPORTANT: To pack a mirrored database, use the Met Database Utility. See Appendix C. Following the pack operation, restart Met Mirror.

5.5 Restructuring the Project Database

The project database must be restructured when changes are made to the database parameters. If the database parameters are changed, for example adding or removing acquired or derived parameters, the database must be modified to reflect the added or removed fields.

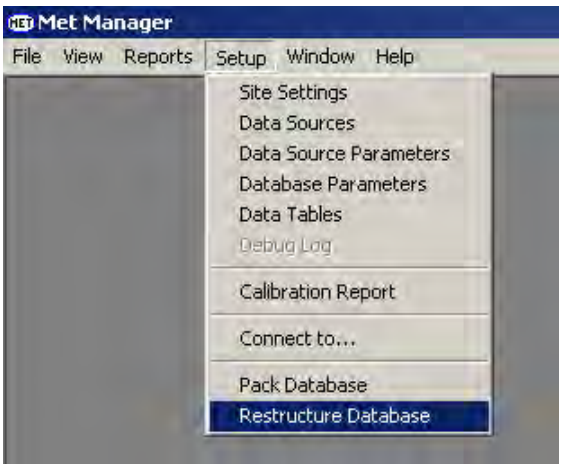
IMPORTANT: Restructuring is normally performed ***automatically*** by Met Manager when the database parameters are changed. Use the Restructure Database menu option ***only*** if the normal restructure operation did not complete for some reason.

IMPORTANT: Before restructuring, insure that there are no active connections (other than Met Manager) to the database. This includes connections by Met Viewer, Met Mirror, or any other import/export/reporting software.

For Met Manager, close the data source connection by selecting "Close connection" from the Setup menu. This then enables (ungrays) the "Restructure Database" menu item. *For all other programs that may have a connection to the database, stop and close them to remove their connection to the project database.*

CAUTION: Before restructuring, be sure that you have a good backup copy of the database.

To restructure the database, select the "Restructure Database" menu item from the Setup menu:



The following dialog is then displayed:

Press "Yes" to begin the restructure operation or "No" to not continue.

Note: The restructure operation can take awhile, in some cases 20 to 30 minutes (or longer) depending on the number and size of the data tables.

The restructure operation can fail for the following reasons:

- There is still an active connection to the project database (i.e., a Met Viewer or Met Mirror may still be running). The database cannot be restructured when an active database connection exists.

- A file error occurs. If a file error occurs while attempting to restructure the database, the restructure will fail. This could cause loss of data. (*That's why its important to backup the project database before adding or removing parameters.*)

IMPORTANT: To restructure a mirrored database, use the Met Database Utility. See Appendix C. Following the restructure operation, restart Met Mirror.

6 TROUBLESHOOTING

6.1 Technical Requirements Related to Microsoft Windows

Met Manager uses the Microsoft Windows registry to retain information about how it was last shut down (last open project, last active data source, and activity status of the data source). Thus, Met Manager must be installed with read/write/create permission to the registry.

Met Manager stores its acquired and derived data in a project database. Thus the Microsoft Windows log-on profile (if any) that executes Met Manager must have read/write/create permission to the project database.

Met Manager must be closed (shut down) when changing to a new user. For proper operation of Met Manager, do not use the fast switching capabilities of the Windows 2000 and XP operating systems.

6.2 Standard Time and Daylight Saving Time

When Met Manager is directly and continuously connected to the data logger, Met Manager acquires the sensory data from the data logger and assigns the Met Manager-hosted computer-based date/time stamp to the data. Met Manager reads Microsoft Windows' settings to determine if daylight saving time is active, and if so, ensures that the time tag is assigned to the database parameters in local "standard" time. Therefore it is important that the date, time, daylight saving time flag, and time zone be properly set and maintained in Windows on the Met Manager-hosted computer. During daylight saving time, the local standard time assigned to the data stream should be exactly one hour before the local daylight saving time reported by Windows. When daylight saving time is not active, then the time assigned to the data stream should be the same time as local time (i.e., local time equals standard time).

When Met Manager captures data from the internal log of the data logger (perhaps by dial or cellular modem), then the data logger assigns its own date and time to the individual records of the data log. Thus, the data logger time must be set to local standard time. During daylight saving time, the data logger time will therefore be exactly one hour before local daylight time. When daylight saving time is not active, then the data logger's standard time should be the same as local time.

Met Manager records each data record within the project database in local standard time. Currently Met Manager also displays and reports all its data in local standard time.

IMPORTANT: Windows handles daylight saving time differently on Windows 95/98/ME computers than on NT/2000/XP computers. On Win NT/2000/XP computers, when daylight saving time *is currently in effect* and the "Adjust for daylight saving time" flag on the clock settings is *manually* disabled (unchecked), then Windows automatically sets your PC clock time back an hour to truly put your computer back in standard time. However, on Win 95/98/ME computers, Windows does not change the clock time. The time has to be manually set back an hour. It is important to know these distinctions in order to ensure that synchronization of a data logger's time to the PC clock time is done in local standard time. Always capture some data from the data logger after its clock time has been changed (or synchronized to the PC clock) to ensure that the data logger's time base is set to local standard time.

In summary, the PC computer's date, time, time zone, and daylight saving time setting must be properly set and maintained in local time. When Met Manager is directly and continuously connected to the data logger, Met Manager uses this information to derive "standard" time to be assigned to the individual records of the database. Met Manager also uses this information for time stamping events within its event logs, and for tagging the date and time of reports.

When the data logger is used to log its data into internal memory for later capture by Met Manager, the data logger's date and time must be properly set and maintained in local "standard" time. Each record of the data log is time stamped in standard time.

Following these rules will ensure a high level of data continuity within Met Manager's database.

6.3 Networking

The project database created and managed by Met Manager (or Met Mirror) allows multiple, simultaneous users. The Paradox database manager tracks the project database users with the use of three Paradox files: PDOXUSRS.NET, PDOXUSERS.LCK, and PARADOX.LCK. If Met Viewer, Met Manager, or Met Mirror loose their connection to the project database because of a power loss or other network glitch, or someone aborts Met Manager or Met Viewer instead of properly shutting them down, then the lock (.LCK) files may not be properly updated. Met Manager or Met Viewer will report a message "Directory is controlled by other .NET file." This can result in the database being perpetually marked for exclusive access to only one program. The solution is to close (shutdown) all active Met Manager, Met Mirror, and Met Viewer programs that have access to the affected project database, and then delete the two ".LCK" files from the project (or mirrored project) database. **CAUTION: It is a recipe for disaster if you delete the lock files while an application is updating the database tables.**

Paradox allows 300 users to be attached to one PDOXUSRS.NET file. The Borland Database Engine (BDE) allows 48 users. However, because of the way that Met Viewer interacts with the database, there is usually only one or two users assigned to a given BDE on a workstation.

6.4 Frequently Asked Questions

6.4.1 Definitions

1. What is a "project"? Met Manager stores its database and related files within a folder on the computer's hard disk or on a network file server. The project is simply the name of the folder. The name is assigned when Met Manager creates a new project (File menu, New Project).

2. What is a "project database"? This is a combination of files that make up the data tables and index files maintained by Met Manager.

3. What is a data table? A data table consists of five files that contain information related to a particular data interval. These files contain the date and time stamp, database parameters, and indexing information associated with that data interval within the overall project database. (A database usually contains several data tables; each related to a different data interval.)

4. Why do you call the data logger a "data source"? Depending on capabilities supported by the vendor of your weather station, Met Manager is capable of acquiring data from more than one source: data logger, data logger file image, and comma-separated variable (CSV) file. That's why the more generic term "data source" is used instead of "data logger".

5. Why do you call a data logger's output channel a "data source parameter"? Perhaps we could have called it a "data logger parameter", but then if the data came from an import file we would have had to call it a "data file parameter". A more generic description is "data source parameter" which describes the source of the data, whether a data logger, data file, or other source.

6. What is the difference between a "data source" parameter and a "database" parameter? A "data source" parameter is one that comes from the source of the data, typically a data logger. A "database" parameter is one that the user wants to be stored within the project database. A database parameter may be an acquired data source parameter or a derived parameter.

6.4.2 Data Logger

7. How do I assign a new sensor to my data logger? Review manuals or other documentation that came with your weather station or data logger to determine how best to connect the new sensor to the data logger and to define the location of the new data associated with that sensor within the output data stream of the data logger.

8. I have been acquiring data from the data logger at a 5-second data rate but want to change it to a 1-second rate. What is required?

    a. Review vendor-supplied documentation or contact your weather station vendor to make sure that your data logger is capable of supporting the higher data

output rate.

b. Verify that your sensors do not limit the output rate to its present 5-second limit. For example, some wind speed sensors provide only one or two pulses per revolution of the cup. To be able to resolve low wind speeds, the data logger must count these pulses over a time period longer than one second.

c. If steps a and b are limiting, then you cannot increase the data rate. If not limiting, then proceed to step d.

d. Program the data logger with a faster output rate. Consult your data logger documentation or contact the vendor of your weather station.

e. Within Met Manager, change the "sample rate" property of the data source to match the data logger output data rate (go to the Setup menu, Data Sources, then select the appropriate data source and press the "Properties" button.) **IMPORTANT**: These rates must match.

6.4.3 Data Source

9. How do I assign my data logger to Met Manager? You must create a "data source" within Met Manager. The data source corresponds to not only your data logger, but how Met Manager will be using your data logger. For example, Met Manager may be directly connected to the data logger and may continuously get data from the data logger. In that case, specify a "Direct Connect" data source. Or Met Manager may be directly-connected but will only periodically capture data from the logger. Specify a "Data Log Capture (COM Port)" data source. Or Met Manager may capture data from the logger by dial-out modem connection. Specify a "Data Log Capture (Modem)" data source. Go to the Setup menu, then Data Sources. If the data source is not already created, then press the New button and select the appropriate data source from the list. Then press the Properties button to review and edit the data source's configuration settings.

10. Why can I have only one data source active in my project even though I have created more than one? The data source parameters define the order and makeup (data types) of the data stream that flows between the data source and Met Manager. Currently Met Manager allows only one unique mapping of the data source parameters to the database parameters; thus only one data source can be active.

11. Why is the data source list blank when I try to connect to the data source from the Setup menu? You have not yet created a "data source". Go to the Setup menu, then Data Sources, and press the New button. Select a data source from the list to create a new one. Then select the icon for that source and press the Properties button to configure its settings.

12. I renamed my data source. Why does Met Manager no longer begin logging the data at startup? Apparently you are using command line options (see Appendix D) when

starting up Met Manager to force Met Manager to open a project and activate a data source. If you renamed the data source, then you must use the new name in the command line option; otherwise Met Manager cannot find the new source when starting up.

6.4.4 Project

13. How can other personnel have access to the project database? Met Viewer™ is a software product that is very similar to Met Manager. Met Viewer allows other network users to have access to the project database. In a peer-to-peer or file server network, Met Viewer attaches to the project database maintained by Met Manager, or to a replicated database maintained by Met Mirror. With Met Viewer, you can recall, view, graph, indicate, report, and export the data in a variety of ways, and in the same way as Met Manager. The Met Viewer software product is purchased separately from Met Manager. Met Viewer licenses are available for 1, 5, 10, 20, 50 and unlimited number of users (at one physical site location).

14. Can I create a new project from an existing project? Yes, see Section 3.3. The existing project configuration settings are copied over to the new project but the database is not copied.

15. I want to duplicate the project database. How do I do it? There are at least three ways as explained below, depending on your reason for duplicating the project database; (a) use Met Mirror to create a duplicate copy, (b) create a copy with Windows File Explorer, or (c) use backup software to duplicate the project database.

    a. If you want to create an on-going copy that stays in sync with the master database, then setup and activate Met Mirror. See Appendix B.

    b. If you just want to create a static copy, then first stop Met Manager. Met Manager must be stopped so that new data will not be written to the file while the copy process is occurring. (Otherwise the database index files can get out of synchronization with the rest of the database.) Second, use Windows File Explorer to make a copy of the project folder. Finally, restart Met Manager.

    c. Use backup software to backup the project folder on a regular basis.

6.4.5 Site Settings

16. Met Manager is installed on a Windows NT workstation. Why is the "time zone" list box blank when I click on it? Check with your network administration to ensure that proper user profile permissions have been installed to allow the Met Manager program to access certain Windows information.

6.4.6 Data Tables

17. I have been acquiring 15-minute and hourly data for some time within my project database. Can I add a new 5-minute data table? Yes, go to the Setup menu, then Data Tables. Simply check (enable) the 5-minute data table and specify the wrap

interval. See Section 3.8. Wait a few minutes for Met Manager to create the first 5-minute database record. Then close the Data View and reopen it. You should now see a new "5-minute" tab on the Data View display.

18. I have decided that I no longer need a data table. How do stop adding data to it? Go to the Setup menu, then Data Tables. Uncheck the data table that you no longer want. Met Manager will then stop adding data to that data table.

19. I have decided that I no longer need a data table, and I want to get rid of it entirely. How do I remove it from the project database? First, uncheck (disable) the data table you no longer want from the Data Tables dialog (Setup menu, then Data Tables). Second, stop Met Manager (and Met Mirror if active). Third, make a backup copy of the project folder to protect against accidental file deletions (and in case you later decide you really need the data). Fourth, with Windows File Explorer, locate the "project" folder. Within that folder will be several files with names beginning with DATTBL (or dattbl). Each file name ends with the data table interval and a file extension. For example, a 1-minute data table has the following five files associated with it: dattbl1.db, dattbl1.px, dattbl1.val, dattbl1.xg0, and dattbl1.yg0. Other data tables (intervals) have similar file names. Delete all five files for the particular type of data interval (data table) of interest from the project folder. Finally, restart Met Manager. Review the Data View and verify that the tab is no longer shown for the data table (data interval) you just deleted.

6.4.7 Data Source Parameters and Database Parameters

20. Why should I backup my project folder before adding or deleting data source or database parameters? Adding or deleting data source or database parameters can cause a major reconfiguration of the database and configuration settings files within Met Manager. Deleting a database parameter will remove it from the database. Backing up allows you to restore your data if something goes wrong. That backup will also prove invaluable when you later realize that you need to run a historical report on a parameter that you deleted. Thus it is important to not only periodically backup the database but to backup the entire project folder. (Backing up the project folder also backs up the database.)

21. I have just installed my new weather station. I have created a new project from an existing project using a project template from the installation CD. But I want to remove some of the data source parameters and database parameters and add others. How do I accomplish this? First, make sure that the connection to the active data source is closed (Setup menu, Close connection). Next carefully review the guideline in Section 3.6 for adding or deleting data source and database parameters. Then remove data source and database parameters you no longer want by selecting them one-at-a-time from their respective lists (see Sections 3.6 and 3.7), and pressing the "delete" key. You may also need to rearrange the data source parameters to match their order within the received data stream. Next, add any new data source parameters and finally add any new database parameters. Realize that deleting data

source and database parameters may require reconfiguration of trend charts, the Data View columns, report columns, wind rose, and indicators.

22. I want to add a new data source parameter because I added a new sensor to my data logger. But why is it that when I go to the Setup menu, Data Source Parameters Editor dialog, I don't see any data types? You must close the connection to the data source (Setup menu, Close connection).

23. I have added a new sensor to my data logger. How do I make Met Manager aware of a new sensor? First, close the connection to the active data source (Setup menu, Close connection). Next carefully review the guideline in Section 3.6 for adding or deleting data source and database parameters. Add a new data source parameter (Setup menu, Data Source Parameters) by dragging and dropping a data type corresponding to that sensor to a channel number of the Data Source Parameter List. The channel number identifies the ordering of the data value within the output stream of the data logger (which is also the input stream to Met Manager). Edit the properties of the new data source parameter. Then create a new database parameter by dragging and dropping the newly created parameter from the "Acquired Parameters" tab of the Database Parameters Editor (Setup menu, Database Parameters) to the Database Parameters List (see Section 3.7). Edit the properties of the new database parameter including defining a representative (and unambiguous) column heading name. You may also wish to create additional derived database parameters (e.g., minimums, maximums, etc.) that depend on the new data source parameter.

24. How do I add a new database parameter to Met Manager? We assume that you have not added a new sensor, and thus do not need to add a new data source parameter. (Otherwise see the next question below). You just need to add a new database parameter. First, close the connection to the active data source (Setup menu, Close connection). Next carefully review the guideline in Section 3.6 for adding or deleting data source and database parameters. Then create a new database parameter by dragging and dropping a parameter from one of the tabs of the Database Parameters Editor (Setup menu, Database Parameters) to the Database Parameters List (see Section 3.7). Edit the properties of the new database parameter including defining a representative (and unambiguous) column heading name.

25. How do I remove a sensor from Met Manager? First, make sure that the connection to the active data source is closed (Setup menu, Close connection). Next carefully review the guideline in Section 3.6 for adding or deleting data source and database parameters. Then remove the data source parameter associated with the sensor (see Sections 3.6) by selecting the data source parameter (in the Data Source Parameter List of the Data Source Parameter Editor dialog), and pressing the "delete" key. You may also need to rearrange the data source parameters to match their order within the received data stream. Finally, delete any dependent database parameters (see Section 3.7) associated with the deleted data source parameter and reconfigure or remove trend charts and indicators.

26. How do I remove (delete) a database parameter from the project database? First, make sure that the connection to the active data source is closed (Setup menu, Close connection). Next carefully review the guideline in Section 3.6 for adding or deleting data source and database parameters. Then remove the database parameter (see Sections 3.7) by selecting it from the Database Parameter List of the Database Parameter Editor dialog), and pressing the "delete" key. Finally, delete or reconfigure any dependent database parameters associated with the deleted database parameter and reconfigure or remove trend charts and indicators.

27. Why do I have a red "x" on one of my database parameters in the Database Parameters editor? One or more of the "Parameter Reference" properties of the database parameter is not defined or is improperly assigned. This can happen accidentally (user error) when setting up a new database parameter, or may happen with a data source parameter is removed, and the database parameter depends on that data source parameter.

6.4.8 Data View

28. How do columns of the Data View (also report listings) get named? The column names come from the "Column heading" property of the database parameter. See Section 3.7 for configuring this property.

29. I see a parameter shown as "New Parameter" in the View menu, Options, then Data Columns tab (also Report Columns tab). What is causing this? The "Column heading" name of the database parameter is blank. See Section 3.7 for configuring this property.

30. Why are some of the columns in the Data View missing their names? The "Column heading" names of the affected database parameters have not been defined. See Section 3.7.

31. I occasionally get "p" characters following data columns in the Data View. What is causing this? The "p" denotes that the data is "partially valid". This occurs when at least one, but less than three-fourths of the samples were acquired for a data interval. This may be due to a power outage in which samples were not acquired from the data source, or to a communication problem of some kind. You may wish to go to the View menu, then Event Logs, to review any detected communication faults.

6.4.9 Trend Charts

32. I have a dual-axis trend chart. Why do the grid lines not overlay each other? If you wish to auto-scale the chart, then review the "Use automatic scaling" property of both the left and right axis. Make sure that it's checked (enabled) for both axes. If you wish to use a fixed scale, then make sure that the number of major steps (intervals) is the same for both axes. Also see Section 4.8.

33. Why isn't a trace on my trend chart showing up? Review the "Data Traces" tab of the chart's trend settings. Ensure that the trace's check box is enabled (checked).

34. I have a dual-axis trend chart. Why is the right axis and all of its assigned traces missing? Review the "Axis Settings" tab of the chart's trend settings. Select the "Right y axis" property and make sure that the "Show Y axis" box is checked. This will re-enable that axis and all of its assigned traces.

6.4.10 Indicators

35. Why are indicators reset when I startup Met Manager? Currently Met Manager does not refresh its indicators from the project database at startup. This will be taken care of in a future upgrade.

36. Why are indicators showing red and do not seem to be updating? Met Manager has lost communications with the data source (typically a data logger). Check the physical connection between the data logger and the serial communications port of the computer that is running Met Manager. If necessary, close the connection if it is active (Setup menu, then Close connection). Then run the Windows Hyperterminal program and see if you can reestablish a connection outside of Met Manager. Follow vendor-supplied instructions.

6.4.11 Wind Rose

37. I have a monthly wind rose, but it is shifted off a few days and does not begin at the start of the month. Can I get a monthly wind rose that starts the first hour of the month and ends the last hour of the month? Yes, on the Wind Rose display, press the center "Auto-snap" data navigator button on the tool bar. This will snap the month to its beginning. (This technique also works for daily wind roses).

38. I have three wind direction database parameters; scalar wind direction, resultant vector wind direction, and unit vector wind direction. Which one should I use with my wind rose and wind frequency report? Since the wind rose and wind frequency report are based on the frequency content of the wind speed by the direction from which the wind blows, it is best to use scalar wind speed (normally just called wind speed) and scalar wind direction. Unlike resultant vector wind direction, the scalar wind direction measurement is independent of scalar wind speed.

6.4.12 Reports

39. How do I change the units on the daily rainfall report from inch to millimeter (mm)? Go to the View Menu, then Options. Select the "Report Columns" tab. Then select the rainfall parameter and change its units to "mm".

40. Why are some of the columns in the Daily Summary Report missing their names? The "Column heading" names of the affected database parameters have not been defined. See Section 3.7.

41. Why are negative temperature values not displaying on the Monthly Parameter Report? Each value field of the report can only print a certain number of digits. Go to the View Menu, then Options. Select the "Report Columns" tab. Then decrease the number of digits shown to the right of the decimal place (Display Digits).

6.4.13 Wind Speed and Wind Direction Parameters

42. Why is the wind direction trace going to 0 degrees? Met Manager has detected that the wind is calm based on measurement of wind speed below the calm threshold. This property is defined in the wind speed data source parameter's properties. When calm wind is detected, Met Manager sets the wind direction to 0 degrees.

43. Isn't 0 degrees the same thing as 360 degrees as far as wind direction is concerned? In some systems there may be no distinction; however, Met Manager uses 0 degrees to denote a calm wind direction (i.e., there is no wind direction) and 360 degrees to denote that the wind is from the "north".

44. The wind speed sensor has failed and is reading below the calm threshold setting. This is also causing wind direction to read calm. How can I disable the wind speed sensor until I get it repaired, and in the meantime retain the wind direction reading? Set the status of the wind speed sensor to "invalid". Go to the View menu, Instantaneous Data, and press the Maintenance button. Then select the wind speed data source channel from the left column followed by pressing the Invalid button. Met Manager will now ignore the wind speed reading. No calm winds will be detected until the wind speed sensor is repaired and return to normal "valid" mode.

45. Wind direction goes to 0 degrees when the wind speed is calm. This may be fine for some applications but I want to retain the wind direction reading all the time, even during calm winds. Can I do this? Go to the Setup menu, Data Source parameters. Set the "calm threshold" property of the wind speed data source parameter to zero (0.0). Since the wind speed can never be less than the threshold of 0.0, a calm will never be detected. (But a calm is indicated in the data for each wind speed of 0.0.) This decouples the wind direction data source parameter (and dependent database parameters) from the wind speed data source parameter.

46. There are multiple types of wind speed and wind direction parameters within the Database Parameter Editor's "Wind" tab. Which ones should I use? Horizontal wind speed database parameters include scalar wind speed and resultant wind speed. Horizontal wind direction database parameters include scalar wind direction, resultant vector wind direction, and unit vector wind direction. Additional related parameters include the standard deviation of wind speed and Sigma-Theta which is the standard deviation of wind direction. USEPA or other state or local governmental requirements may require specific parameters depending on your application. For atmospheric modeling and industrial uses, it is recommended that you log all the horizontal wind parameters to the database. That way, the data will be available should it be needed later. For general agriculture purposes, it is recommended that

you retain scalar wind speed, standard deviation of wind speed, scalar wind direction, and Sigma-Theta.

47. I can't find "peak wind speed" in the "Wind" tab of the Database Parameter Editor. How do I set it up? Peak wind speed is actually "maximum" wind speed. Drag and drop a "Maximum" database parameter type (go to Setup menu, then Database Parameters; select the "Other" tab of the Database Parameters Editor) to the Database Parameter List. Then edit the properties of this new "Maximum" database parameter. Rename it to "Peak Wind Speed". Assign it a "Column heading" name of "Peak WS" (or some other unambiguous descriptor). Set its units and display decimal digits to your preference. Assign to its "Parameter References" property the corresponding channel-based "wind speed" database parameter.

6.4.14 Communications

48. How can I tell if I have intermittent communication problems with my continuously-connected data logger? You will receive "p" (partially valid) or "m" (missing) codes following the data columns in the Data View. Also go to the View menu, then Event Logs to review any detected communication faults.

6.4.15 Miscellaneous

49. How are "base units" different from other engineering units? Base units are just an initial set of engineering units. When the data source parameter arrives in the data stream already in engineering units, then the base unit is usually set to be the same as the implied engineering unit of the arriving data channel by setting the conversion slope and offset properties to 1 and 0 respectively. However, when the data source parameter arrives as a digital voltage or count value, then the conversion slope and offset values are used to convert the digital voltage or count into an initial engineering unit; that unit being called the "base unit".

50. I see an "x" following one or more columns of data on the Data View. It appears that Met Manager is somehow invalidating my data. What is happening?

    a. On each new input of sensor data into Met Manager (via a data source parameter obtained from the data stream), Met Manager compares the data (in base units) to an acceptance range. If within the range, the data is valid. If outside the range, Met Manager invalidates the data and any database parameters derived from that data. Either the sensor has malfunctioned, the range is too narrow or incorrect, or there is some other cause. You may wish to review the data source parameter's properties (Setup Menu, Data Source Parameters).

    b. Go to the Instantaneous View (View menu, Instantaneous data) and press the Maintenance button. Then select the channel and verify that the channel has not been placed into an "invalid" state. If so, then take it out of the "invalid" state (see Section 5.1). If it continues to show as invalid then the received data source value (in base units) is not within the acceptance range defined for the data source parameter (see Section 3.6).

51. Met Manager has a direct and continuous connection to the weather station. However, Met Manager seems to start slower and won't generate one of my data tables. What's wrong? It is very likely that a power outage occurred or that someone shut off the computer without properly shutting down Met Manager. If Met Manager happened to be writing data to its database when this occurred, then one or more of the data tables of the database likely got corrupted. You will have to restore the files of the affected data table from a mirrored or backup copy (if you are lucky enough to have set one up), or delete them if you have no mirrored copy or backup:

    a. Run Met Manager. Go to the Instantaneous View and ensure that you are properly acquiring data from the data logger. If not, then correct the communication problem before you continue.

    b. With good communications established with the data logger, go to the Data View. Determine which data table is not updating. This will be the corrupted one. (There may be more than one; if so, this procedure applies to each).

    c. STOP MET MANAGER AND ALL APPLICATIONS THAT MAY BE ACCESSING THE PROJECT DATABASE. This includes Met Mirror and any Met Viewer users.

    d. With Windows File Explorer, make a backup copy of the entire project folder. This step protects against deletions that you could accidentally make in the steps below.

    e. If you have a mirrored or backup copy of the database, then with Windows File Explorer, go to the mirrored (or backed-up) project folder. Within that folder will be several files with names beginning with DATTBL (or dattbl). Each file name ends with the data table interval and a file extension. For example, a 1-minute data table has the following five files associated with it: dattbl1.db, dattbl1.px, dattbl1.val, dattbl1.xg0, and dattbl1.yg0. Other data intervals have similar file names. Copy all five files for the particular type of data interval (data table) of interest from the mirrored project folder to the project folder that is maintained by Met Manager. Go to step g (skip step f).

    f. If you do not have a mirrored or backup copy of the database, then you have to delete the files associated with the corrupted data table. With Windows File Explorer, go to the project folder. Within that folder will be several files with names beginning with DATTBL (or dattbl). Each file name ends with the data table interval and a file extension. For example, a 1-minute data table has the following five files associated with it: dattbl1.db, dattbl1.px, dattbl1.val, dattbl1.xg0, and dattbl1.yg0. Other data intervals have similar file names. Delete all five files for the particular type of data interval (data table) of interest from the project folder.

g. Restart Met Manager and verify that new data can now be added to the data table. Then if applicable, restart Met Mirror and Met Viewer.

52. From the above question, I had to delete a data table from the project folder to correct a corrupted database. What can I do to minimize this type of problem from occurring again? First, install an uninterruptible backup power supply on your computer. This protects your computer against short power outages. Second, make a daily backup of your project database. That way you can at least restore most of your data. You can also use Met Mirror to make a mirrored copy of the project database. If properly installed, the mirrored copy will be more up-to-date than a daily backup.

53. I just packed the database with Met Manager. Why didn't the size of one of the data tables change? Packing has no effect on data tables that are not wrapped. These data tables have their "Keep data indefinitely" property enabled. Also, the pack will not work if some other software such as Met Mirror or Met Viewer is attached to the project database. Met Manager cannot pack the database if other applications are using it. Be sure to shut them down first.

APPENDIX A
DATA SOURCE AND DATABASE PARAMETERS

I. List of Data Source and Derived Database Parameters

Data source parameters represent data values that come from the data stream between the data logger (or other source of data such as a file) and Met Manager, and that have been converted to base units.

Data source parameters are based on *data types*. Data types are meant to be general; for example, a "temperature" data type might be ambient temperature, soil temperature, indoor temperature or some other type of temperature. The data type becomes an "acquired" data source parameter when the user defines the properties of that data type, such as giving the data type a specific name (e.g., ambient temperature).

Table 1
Data Source Parameters

Data Source Parameters	***Units***
Evaporation or ET	in, mm
Humidity (relative)	%
Leaf Wetness	0-100 (unitless)
Moisture (soil, etc.)	%
Precipitation (rain, snow, etc.)	in, mm
Pressure (barometric, etc.)	inHg, mmHg, hPa, kPa, atm, mb, bar, cbar
Solar Energy	J/m^2, KJ/m^2, MJ/m^2, $W\text{-}hr/m^2$, Langley
Solar Radiation (global, net, or direct)	W/m^2
Temperature (all types)	°C, °F
User-defined Average	user-supplied unit
Voltage	volt, mV
Wind Direction (horizontal and vertical)	deg, sector (horizontal winds only)
Wind Speed (horizontal and vertical)	mph, knots, m/s

Database parameters are those acquired and derived parameters that the user has assigned to be stored within Met Manager's database.

Table 2
Database Parameters

Derived - Standard Parameters	***Units***
Dewpoint	°C, °F
Heat Index	°C, °F
Relative Humidity	%
Solar Energy	J/m^2, KJ/m^2, MJ/m^2, $W\text{-}hr/m^2$, Langley
Wet Bulb Temperature	°C, °F
Wind Chill Temperature (After Nov 1, 2001)	°C, °F
Wind Chill Temperature (Traditional)	°C, °F
Wind Derived Parameters	
Resultant Vector Wind Direction (horizontal)	deg, sector
Resultant Wind Speed (horizontal)	mph, knots, m/s
Scalar Vertical Wind Direction	deg
Scalar Vertical Wind Speed	mph, knots, m/s
Scalar Wind Direction (horizontal)	deg, sector
Scalar Wind Speed (horizontal)	mph, knots, m/s
Sigma-Phi (std dev of Vertical Wind Direction)	deg
Sigma-Theta (std dev of horizontal Wind Dir.)	deg
Standard deviation of Vertical Wind Speed	mph, knots, m/s
Standard Deviation of Wind Speed (horizontal)	mph, knots, m/s
Unit Vector Wind Direction (horizontal)	deg, sector
Agriculture Derived Parameters	***Units***
Chill Hour (Standard Base Method)	CH (number of chill hours)
Chill Hour (Base with Lower Cutoff)	CH (number of chill hours)
Chill Hour (Base with Lower Cutoff and Ceiling Negation)	CH (number of chill hours)
Chill Unit (32°F to 45°F)	CU (number of chill units)
Chill Unit (45°F and Under)	CU (number of chill units)
Chill Unit (Utah Model)	CU (number of chill units)
Chill Unit (Utah-Pomology Model)	CU (number of chill units)
Growing Degree Day (Integration)	DD°C, DD°F (degree days in °C or °F)
Growing Degree Hour (Integration)	DH°C, DH°F (degree hours in °C or °F)
Crop ET (Integration)	in, mm (implied in or mm per time period)
Ref. ET_{os}, Short, Standardized ASCE Penman-Monteith (Integration)	in, mm (implied in or mm per time period)
Ref. ET_{rs}, Tall, Standardized ASCE Penman-Monteith (Integration)	in, mm (implied in or mm per time period)
Energy Derived Parameters	
Cooling Degree Days (Integration)	DD°C, DD°F (degree days in °C or °F)
Heating Degree Days (Integration)	DD°C, DD°F (degree days in °C or °F)

Other Derived Parameters	
Change (from successive time intervals)	Unit is same as primary parameter
Difference (over same time interval)	Unit is same as primary parameters
Maximum	Unit is same as primary parameter
Minimum	Unit is same as primary parameter
Rate	User-supplied unit
Standard Deviation	Unit is same as primary parameter

II. Explanation of Data Source and Derived Database Parameters

A. Data Source Parameters

Data source parameters include:

1. Evaporation or ET - Evaporation or evapotranspiration (ET) data type
2. Humidity - Humidity data type; usually relative humidity
3. Leaf Wetness - Leaf wetness data type typically scaled from 0 to 100.
4. Moisture - Moisture data type; for example soil moisture.
5. Precipitation - The generic type includes rain, snow, ice, etc., but usually expressed as "rain" or "rainfall."
6. Pressure - Pressure data type; for example barometric pressure.
7. Solar Energy - Solar energy data type expressed in units of J/m^2, KJ/m^2, MJ/m^2, $W\text{-}hr/m^2$, or Langley. A unit of MJ/m^2 is commonly used.
8. Solar Radiation - Solar radiation data type expressed in radiation flux units of W/m^2.
9. Temperature - Temperature data type; for example, ambient temperature, indoor temperature, soil temperature, and so forth.
10. User-defined Average - A data type that represents an average value and in which the name and units are assigned by the user.
11. Voltage - A voltage data type; for example, data logger battery voltage.
12. Wind Direction - A wind direction data type.
13. Wind Speed - A wind speed data type.

B. "Derived - Standard" Database Parameters

"Standard" derived database parameters include:

1. Dewpoint - The calculation of this parameter requires ambient temperature (same as dry bulb temperature) and relative humidity.

2. Heat index - The calculation of this parameter requires ambient temperature and relative humidity. The heat index equals ambient temperature when the ambient temperature is below 70 °F.

3. Relative humidity - Normally this parameter is measured directly. However, it can be calculated from ambient temperature and dew point (when dew point is measured). Units are in percent (%).

4. Solar energy - The calculation of this parameter requires solar radiation. Units include J/m^2, kJ/m^2, MJ/m^2, Watt-hr/m^2 and Langley. "MJ/m^2" is a common selection.

5. Wet bulb temperature - The calculation of this parameter requires ambient temperature, dew point and barometric pressure.

6. Wind chill (Nov 1, 2001) - This wind chill temperature is based on the joint United States and Canadian wind-chill index effective November 2001. The calculation requires ambient temperature and wind speed. This newer wind chill temperature equals ambient temperature when the wind speed is less than 3 mph.

7. Wind chill (Traditional) - This wind chill temperature precedes the newest update of November 2001. Its calculation requires ambient temperature and wind speed. This older wind chill temperature equals ambient temperature when the wind speed is less than 4 mph.

C. "Wind" Derived Database Parameters

"Wind" derived database parameters are discussed in the U.S. Environmental Protection Agency (EPA) document titled "Meteorological Monitoring Guidance for Regulatory Modeling Applications," EPA-454/R-99-005, February 2000. These parameters include:

1. Resultant vector wind direction (for horizontal wind)
2. Resultant wind speed (for horizontal wind)
3. Scalar vertical wind direction
4. Scalar vertical wind speed
5. Scalar wind direction (for horizontal wind)
6. Scalar wind speed (for horizontal wind)
7. Sigma-Phi, standard deviation of vertical wind direction
8. Sigma-Theta, standard deviation of wind direction (for horizontal wind)
9. Standard deviation of vertical wind speed
10. Standard deviation of wind speed (for horizontal wind)
11. Unit vector wind direction (for horizontal wind)

D. "Agriculture" Derived Database Parameters

"Agriculture" derived database parameters include:

1. Chill Hour (Base with Lower Cutoff and Ceiling Negation) - One chill hour accumulates for each hour that the hourly average ambient temperature is

between the base temperature and the lower cutoff temperature. One hour is negated for each hour that the ambient temperature is above the ceiling temperature.

Hourly Average Temperature	Chill Hour
$TE_{avg} \leq$ Lower Cutoff	0.0
Lower Cutoff $< TE_{avg} \leq$ Base	1.0
Base $< TE_{avg} \leq$ Ceiling	0.0
$TE_{avg} >$ Ceiling	-1.0

The lower cutoff, base, and ceiling temperature values are set by the user when the database parameter is first created. Default settings are: lower cutoff temperature (32°F), base temperature (45°F), ceiling temperature (65°F).

2. Chill Hour (Base with Lower Cutoff) - This accumulation of chill hours is the same as item 1 above, except there is no negation above a ceiling temperature.

Hourly Average Temperature	Chill Hour
$TE_{avg} \leq$ Lower Cutoff	0.0
Lower Cutoff $< TE_{avg} \leq$ Base	1.0
$TE_{avg} >$ Base	0.0

Default settings are: lower cutoff temperature (32°F), base temperature (45°F).

3. Chill Hour (Standard Base Method) - One chill hour is accumulated for each hour that the hourly average ambient temperature is below a user-defined base temperature. There is no lower cutoff temperature with this method.

Hourly Average Temperature	Chill Hour
$TE_{avg} \leq$ Base	1.0
$TE_{avg} >$ Base	0.0

The default base temperature is 45°F.

4. Chill Unit (32°F to 45°F) - One chill unit is accumulated for each hour that the hourly average ambient temperature is between 32 to 45°F.

Hourly Average Temperature	Chill Unit
$TE_{avg} \leq 32$ °F	0.0
32°F $< TE_{avg} \leq 45$ °F	1.0
$TE_{avg} > 45$ °F	0.0

5. Chill Unit (45°F and Under) - One chill unit is accumulated for each hour that the hourly average ambient temperature is 45°F or less.

Hourly Average Temperature	Chill Unit
$TE_{avg} \leq 45$ °F	1.0
$TE_{avg} > 45$ °F	0.0

6. Chill Unit (Utah Model) - One chill unit, or a fraction of a chill unit, is accumulated for each hour that the hourly average ambient temperature is within the range stated in the table below:

Hourly Avg Temperature	Chill Unit
$TE_{avg} < 35$ °F	0.0
$35 \leq TE_{avg} \leq 36$ °F	0.5
$37 \leq TE_{avg} \leq 48$ °F	1.0
$49 \leq TE_{avg} \leq 54$ °F	0.5
$55 \leq TE_{avg} \leq 60$ °F	0.0
$61 \leq TE_{avg} \leq 65$ °F	-0.5
$TE_{avg} > 65$ °F	-1.0

7. Chill Unit (Utah-Pomology Model) - One chill unit, or a fraction of a chill unit, is accumulated (or negated) for each hour that the hourly average ambient temperature is within the range stated in the table below:

Hourly Avg Temperature	Chill Unit
$TE_{avg} < 34.01$ °F	0.0
$34.01 \leq TE_{avg} < 36.01$ °F	0.5
$36.01 \leq TE_{avg} < 48.01$ °F	1.0
$48.01 \leq TE_{avg} < 54.01$ °F	0.5
$54.01 \leq TE_{avg} < 60.01$ °F	0.0
$60.01 \leq TE_{avg} < 65.01$ °F	-0.5
$TE_{avg} > 65.01$ °F	-1.0

8. Growing Degree Day (Integration) - Daily growing degrees are calculated by totaling (integrating) the Growing Degree Day values reported for each hour of the day.

Hourly Average Temperature	Growing Degree Days (for the hour)
$TE_{avg} \leq$ Base	0.0
Base $< TE_{avg} \leq$ Ceiling	$(TE_{avg}$ - Base)/24
$TE_{avg} >$ Ceiling	(Ceiling - Base)/24

The base and ceiling temperature settings are supplied by the user when

creating the Growing Degree Day database parameter. The default ceiling and base temperatures are 86°F and 50°F, respectively.

9. Growing Degree Hour (Integration) - Hourly growing degrees are accumulated for each hour that the hourly average ambient temperature is within the range stated in the table below:

Hourly Average Temperature	Growing Degree Hours
$TE_{avg} \leq$ Base	0.0
Base $< TE_{avg} \leq$ Ceiling	(TE_{avg} - Base)
$TE_{avg} >$ Ceiling	(Ceiling - Base)

The base and ceiling temperature settings are supplied by the user when creating the Growing Degree Hour database parameter. The default ceiling and base temperatures are 86°F and 50°F, respectively.

10. Crop ET (Integration) - Daily Crop Evapotranspiration (ET_C) is calculated by totaling (integrating) the Crop ET values reported for each hour of the day.

For a crop ET based on a reference to short grass (similar to clipped grass):

$$ET_C = ET_{os} \times K_C \times K_{STRESS}$$

For a crop ET based on a reference to tall grass (similar to alfalfa):

$$ET_C = ET_{rs} \times K_C \times K_{STRESS}$$

where:

ET_C = Crop Evapotranspiration (mm or inch per period)

ET_{os} = Reference Evapotranspiration calculated from the standardized short-grass ASCE Penman-Monteith equation (mm or inch per period); see items11 and 12 below.

ET_{rs} = Reference Evapotranspiration calculated from the standardized tall-grass ASCE Penman-Monteith equation (mm or inch per period); see items11 and 12 below.

K_C = Crop coefficient (dimensionless)
K_{STRESS} = Stress factor (dimensionless); 0 to 1.0 (1.0 if no stress)

The default K_C and K_{STRESS} coefficients have values of 1.0.

11. Ref. ET_{os}, Short, Standardized ASCE Penman-Monteith: Daily Reference ET (ET_{os}) as referenced to a short grass of 0.12 m height (similar to clipped grass)

and calculated by totaling (integrating) the Reference ET_{os} values reported for each hour of the day. For further information, refer to the report on The ASCE Standardized Reference Evapotranspiration Equation, Environmental and Water Resources Institute of the American Society of Civil Engineers, Standardization of Reference Evapotranspiration Task Committee, December 21, 2001.

12. Ref. ET_{rs}, Tall, Standardized ASCE Penman-Monteith: Daily Reference ET (ET_{rs}) as referenced to a tall grass of 0.50 m height (similar to full-cover alfalfa) and calculated by totaling (integrating) the Reference ET_{rs} values reported for each hour of the day. For further information, refer to the report on The ASCE Standardized Reference Evapotranspiration Equation, Environmental and Water Resources Institute of the American Society of Civil Engineers, Standardization of Reference Evapotranspiration Task Committee, December 21, 2001.

E. "Energy" Derived Database Parameters

"Energy" derived database parameters include:

1. Cooling Degree Day (Integration) - Daily cooling degrees are calculated by totaling (integrating) the Cooling Degree Day values reported for each hour of the day based on the range in the following table:

Hourly Average Temperature	Cooling Degree Days (for the hour)
$TE_{avg} \leq$ Base	0.0
$TE_{avg} >$ Base	$(TE_{avg}$ - Base)/24

The default base temperature is 65°F.

2. Heating Degree Day (Integration) - Daily heating degrees are calculated by totaling (integrating) the Heating Degree Day values reported for each hour of the day based on the range in the following table:

Hourly Average Temperature	Heating Degree Days (for the hour)
$TE_{avg} <$ Base	(Base - TE_{avg})/24
$TE_{avg} \geq$ Base	0.0

The default Base temperature is 65°F.

F. "Other" Derived Database Parameters

"Other" derived database parameters include:

1. Change - This parameter calculates the change of a parameter between two successive measurement intervals (for example, change of barometric pressure).

2. Difference - This parameter calculates the difference between two parameters of the same type over the same time interval (for example, temperature difference as the difference between the measurements from two matched temperature probes located at different heights on a meteorological tower.

   Difference = Parameter 1 - Parameter 2

3. Maximum - This parameter calculates the maximum (or high) of a parameter over a measurement interval (for example, maximum or peak wind speed).

4. Minimum - This parameter calculates the minimum (or low) of a parameter over a measurement interval (for example, minimum or low ambient temperature).

5. Rate of a Totalized Value - This parameter calculates the rate of a totalized value over a measurement interval (for example, rate of rainfall).

6. Rate of an Averaged Value - This parameter calculates the rate of an averaged value over a measurement interval (for example, rate of ambient temperature).

7. Standard Deviation - This parameter calculates the standard deviation of a parameter over a measurement interval. *Note that wind speed and wind direction parameters require special processing, so their standard deviation should be calculated by selecting an appropriate derived parameter from the "Wind" tab*.

APPENDIX B
MET MIRROR UTILITY

I. Overview

Met Mirror™ is used to create and update a copy of the Met Manager database. This is referred to as *mirroring*. The Met Mirror software is used only in a networked environment and its use is optional.

II. Installing Met Mirror

The Met Mirror software is automatically installed on a Windows-based workstation during installation of the Met Manager software.

IMPORTANT: Met Mirror uses the Windows registry to retain information about its definition files. This information is then read from the registry on startup of Met Mirror. Therefore, Met Mirror must be installed in a way that it can have create/read/write access to the Windows registry. Before installing Met Mirror, check with your network or system administrator to ensure that your log-on profile is configured to allow Met Mirror to have create/read/write access to the Windows registry.

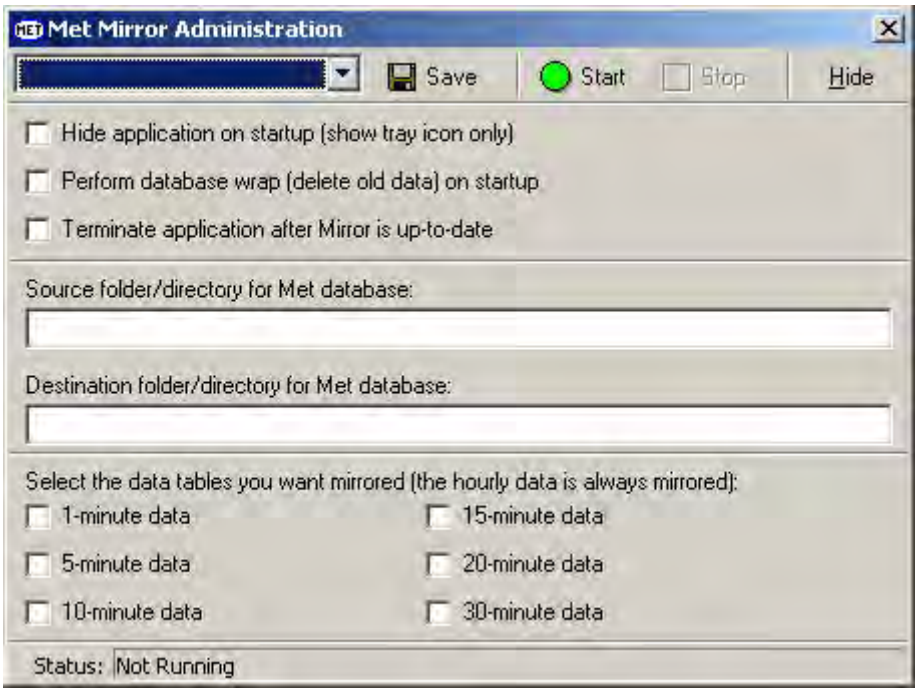
Refer to Section 2.3 for scenarios for using Met Manager, Met Viewer, and Met Mirror. Included are requirements for project folder read/write/create access permission depending on your application requirements.

IMPORTANT: Configure Met Mirror to automatically startup when Windows starts up. Place a shortcut of the Met Mirror executable program (metmrr.exe) in the Windows "Startup" folder. This folder may be located under "Administrators", "All Users", "Default Users", or may be applicable only to your particular log-on profile depending on your version of Microsoft Windows. Check with your network or system administrator for the proper startup folder to contain the Met Mirror shortcut.

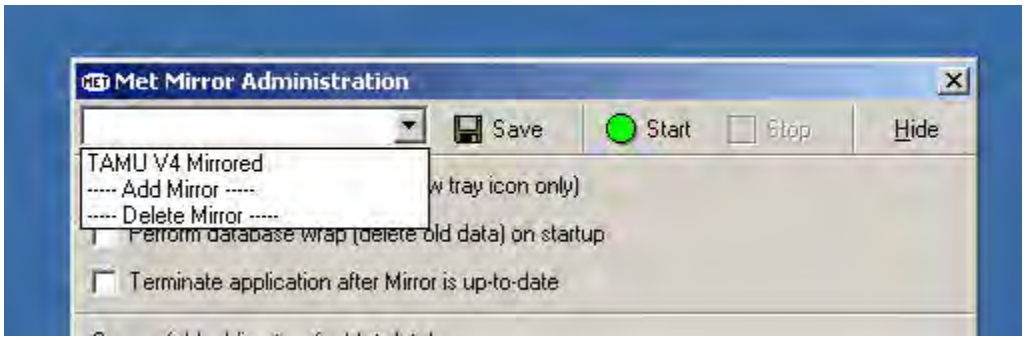
Command line options are not required but are useful for forcing Met Mirror to open a particular definition file when starting up in Windows. If you use a command line option, you will want to assign it to the Met Mirror shortcut in the Windows "Startup" folder. See Appendix D.

III. Using the Software

When Met Mirror is run, the following dialog is displayed:



Select the drop down box in the upper left corner to add a new mirror definition name to hold the Met Mirror settings, or to select an existing mirror definition name. As an example, the following figure shows that a mirror definition named "TAMU V4 Mirrored" already exists:



(The above figure is an example only; your configuration may be different.)

Check the "Hide application on startup" option to hide Met Mirror from the desktop when it is run. Met Mirror appears as an icon in the "tray" region of the Windows task bar.

Check the "Perform database wrap" option to wrap the mirrored database on startup of Met Mirror with the same wrap options as performed by Met Manager. This is useful if

you periodically, but not continuously, run Met Mirror. In any event, Met Mirror performs this wrap function at midnight. *Thus if Met Mirror is run continuously, it's best to leave this box unchecked.*

Check the "Terminate application after Mirror is up-to-date" to stop Met Mirror as soon as it has updated the mirrored database to match the original database managed by Met Manager. *For continuous mirroring, leave this box unchecked*.

In the "Source folder/directory for Met database", enter the path and folder name to Met Manager's project.

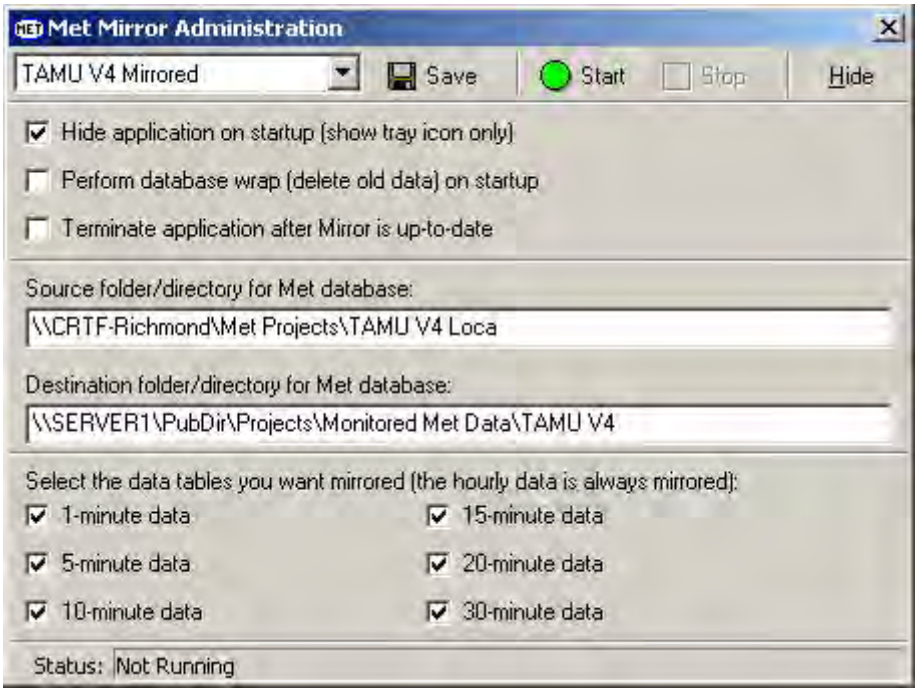
In the "Destination folder/directory for Met database", enter the path and folder name to Met Mirror's project. This is the path and folder name for the destination location of the mirrored database. The path/folder must be created outside of Met Mirror; for example, with Microsoft Windows File Explorer software.

Select (check) each of the data tables that you want mirrored. Note that the hourly data table is always mirrored; thus you cannot select it. It is alright to select a Met Manager data table that does not exist as the setting will be ignored. That way, should a new data table later be added to Met Manager, the new table will then be automatically mirrored by Met Mirror.

IMPORTANT: Press the "Save" button to save the settings. The settings will be saved in the Windows registry under the definition name given to the mirror.

To start the mirror activity, press the "Start" button. To hide the mirror from the desktop, but still keep its "Met" icon in the tray region of the Windows desktop, press the "Hide" button.

Below is an example of settings for a continuously-connected mirror definition named "TAMU V4 Mirrored":



(The above figure is an example only; your configuration may be different.)

IV. Auto-starting Met Mirror

For normal usage in which Met Mirror continuously maintains a mirrored copy whenever Met Manager is running, follow these steps:

1. Run Met Mirror and add a new mirror name, or select an existing name (from the drop down box). Then configure the settings and press the "Save" button.

2. Setup Met Mirror to run in the Windows "Startup" folder as discussed in Section II above.

IMPORTANT: If you use a command line option when starting Met Mirror, be sure to set the "-o" (oh; not zero) command line option with the *identical* name of the mirror definition. If the name includes spaces, then you must include the entire -o and name within quotation marks (e.g., "-oMirror Name"). In the above example (Section III), the command line option is "-oTAMU V4 Mirrored" to automatically activate a definition named "TAMU V4 Mirrored" on startup of Met Mirror.

APPENDIX C
MET DATABASE UTILITY

I. Overview

The Met Database Utility (sometimes referred to as "MetDBU") is used to perform periodic maintenance on a mirrored database. With this utility, you can restructure the database, and can pack it. Restructuring is useful only to fix a structure problem with the mirrored database, should it ever occur. Packing permanently removes all deleted records from the database, and should be performed periodically on data tables that are wrapped.

Note: The restructure and pack capabilities are also included in the Setup menu of Met Manager for maintenance of the database managed by Met Manager. The advantage of having a separate utility program is that this program can be run on mirrored copies of the database, and independently of Met Manager.

II. Installing the Met Database Utility

The MetDBU utility software is automatically installed on a Windows-based workstation during installation of the Met Manager software. Once installed, select and run the Met Database Utility program from the Start | Program menu of the Windows desktop. You can also setup a shortcut icon on the desktop.

Note: Command line options are normally not required for MetDBU but are useful for forcing MetDBU to start in a particular way. See Appendix D.

III. Restructuring the Project Database

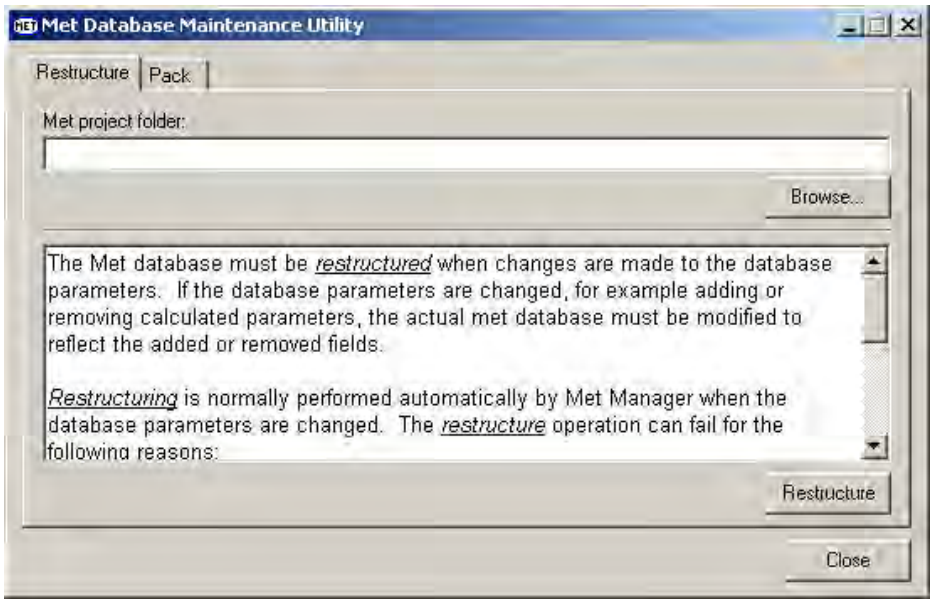
The project database managed by Met Manager or Met Mirror must be restructured when changes are made to the database parameters. For example, when adding or removing acquired or derived parameters, the database must be modified to reflect the added or removed fields.

IMPORTANT: Met Manager automatically restructures its project database when new parameters are added or deleted. ***Therefore you will not normally perform a restructure with MetDBU.*** The only time you will use MetDBU to perform a restructure is when something happens to the structure of a mirrored database, and you need to repair it.

IMPORTANT: Before restructuring, insure that there are no active connections to the database. This includes connections by Met Manager, Met Viewer, Met Mirror, or any other import/export/reporting software. Stop and close all programs that may have connections to the database.

CAUTION: Be sure that you have a good backup of the project database before restructuring it.

The following dialog is displayed when the Met Database Utility software is run:



To restructure a database, locate the project folder with the "Browse" button and press the "Restructure" button.

Note: The restructure operation can take awhile, in some cases 20 to 30 minutes (or longer) depending on the number and size of the data tables, and speed of your network.

The restructure operation can fail for the following reasons:

- There is still an active connection to the database (i.e. Met Manager, Met Viewer, or Met Mirror may still be running). The database cannot be restructured when an active database connection exists.

- A file error occurs. If a file error occurs while attempting to restructure the database, the restructure will fail.

IMPORTANT: Following the restructure operation, restart Met Mirror and any other programs that need access to the mirrored project database.

IV. Packing the Project Database

The project database managed by Met Mirror must be periodically packed so that deleted records are permanently removed from the database. For instance, if data for a 1-minute table is "wrapped" at seven (7) days, the records deleted from the table by the wrap

function still remain in the database even though they are not visible to the application. Even when a wrap is used, the wrap function does not reduce the actual size of the file. *To reduce the file size and permanently remove the deleted records, the database must be periodically packed.*

IMPORTANT: To pack Met Manager's project database, use the "Pack" operation located in Met Manager's Setup menu. *Only use the MetDBU utility to pack a mirrored project database.*

Below is a recommended pack schedule; use the *minimum* pack schedule (i.e., maximum frequency) that applies to your table configuration.

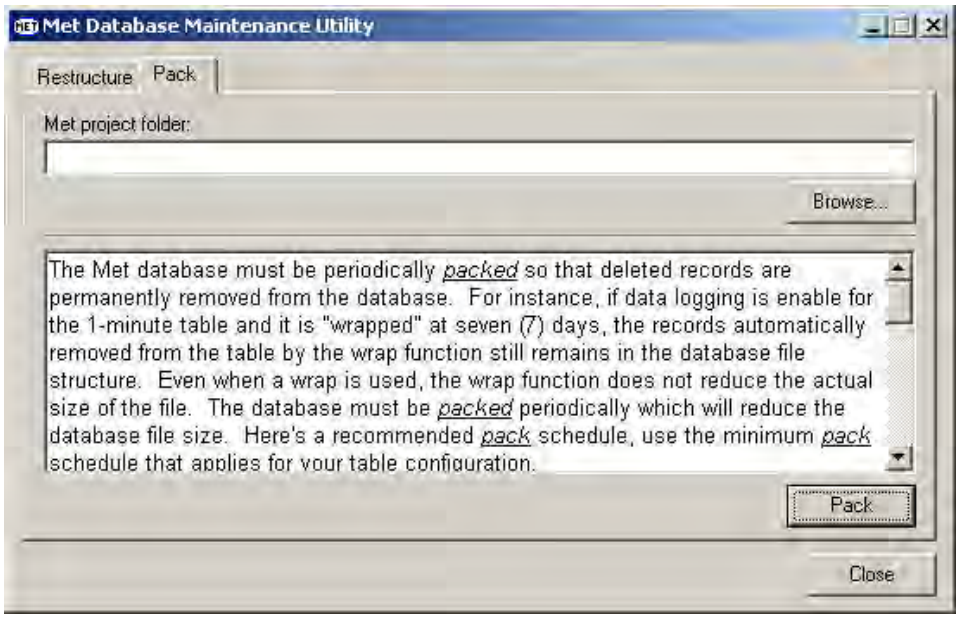
Data Table Interval (with "Delete data older than" option set)	**Pack Schedule**
1 Minute Data Table	Every 1 month
5 Minute Data Table	Every 3 months
10 Minute Data Table	Every 6 months
15 Minute Data Table	Every 6 months
20 Minute Data Table	Every 6 months
30 Minute Data Table	Every 6 months
Hourly Data Table	Once a year

Note: You do not have to pack data tables that are setup with the "Keep data indefinitely" option, since these data tables are not wrapped.

Note: When a pack is performed, *all* the data tables within the project database are packed. That's why the pack schedule should be based on the *minimum* period (maximum frequency) of the data tables assigned to the project.

IMPORTANT: Before packing, insure that there are no active connections to the database. This includes connections by Met Manager, Met Viewer, Met Mirror, or any other import/export/reporting software that is attached to the database. *For all programs that may have a connection to the database, stop and close them to remove their connections.*

To pack the database and permanently remove any deleted data records, select the "Pack" tab. The following dialog is then displayed:



Locate the project folder with the "Browse" button and press the "Pack" button.

Note: The pack operation can take awhile, in some cases 20 to 30 minutes (or longer) depending on the number and size of the data tables, and speed of your network.

The pack operation can fail for the following reasons:

- There is still an active connection to the project database (i.e., Met Manager, Met Viewer, or Met Mirror may still be running). The database cannot be packed when an active database connection exists.

- A file error occurs. If a file error occurs while attempting to pack the database, the pack operation will fail.

IMPORTANT: Following the pack operation, restart Met Mirror and any other programs that need access to the mirrored database.

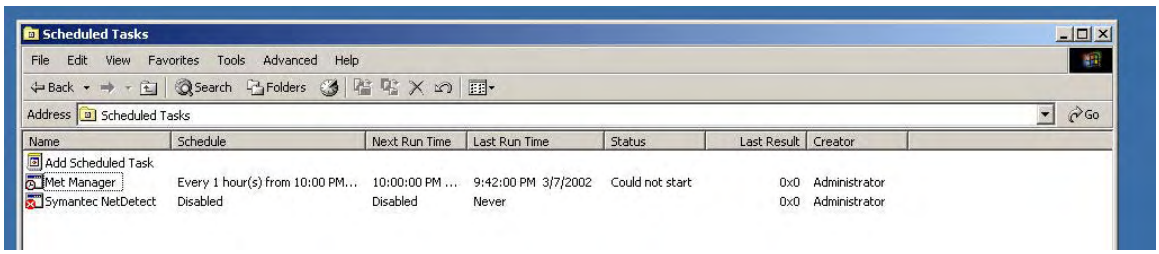
V. Met Database Utility Command Line Options

You can also start the Met Database Utility software with a command line option. Edit the utility's properties to include a command line startup option. For further instructions, see Appendix D - Command Line Options.

APPENDIX D
COMMAND LINE OPTIONS

I. Overview

Why would someone want to use a command line option? Command line options provide flexibility in the startup and subsequent use of Met Manager, Met Viewer, Met Mirror, and Met Database Utility software. For example, in conjunction with a task scheduler (such as provided with Windows 98 and beyond), Met Manager can be configured to startup and acquire data from a particular data source, for example a "Data Log Capture (Modem)" data source, and store the acquired and derived data parameters into a particular project folder:



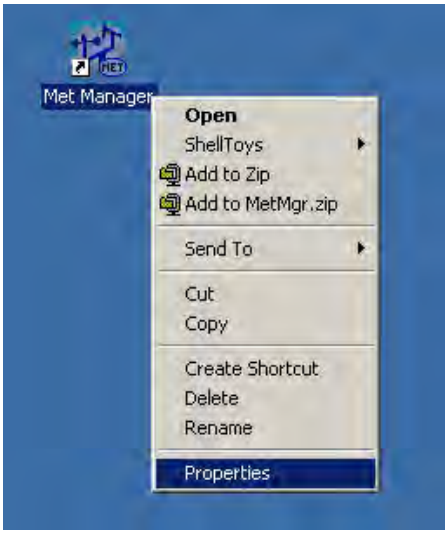
(Example from "Scheduled Tasks" of the Control Panel of Windows 2000 Workstation)

In this way, Met Manager can retrieve data from multiple remote weather stations and can store the data into separate projects. Or, you may wish to force the software to startup and open a particular project and use a particular data source to override any user configuration settings.

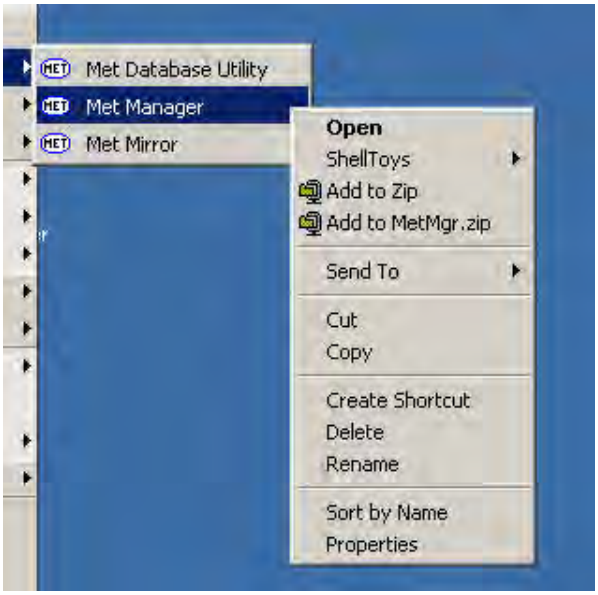
The command line option is defined in Windows by accessing and selecting a shortcut to the program executable, right-clicking on the shortcut with the mouse, and then setting the "properties". The program executable names are:

Met Manager = metmgr.exe
Met Viewer = metvwr.exe
Met Mirror = metmrr.exe
Met Database Utility = metdbu.exe

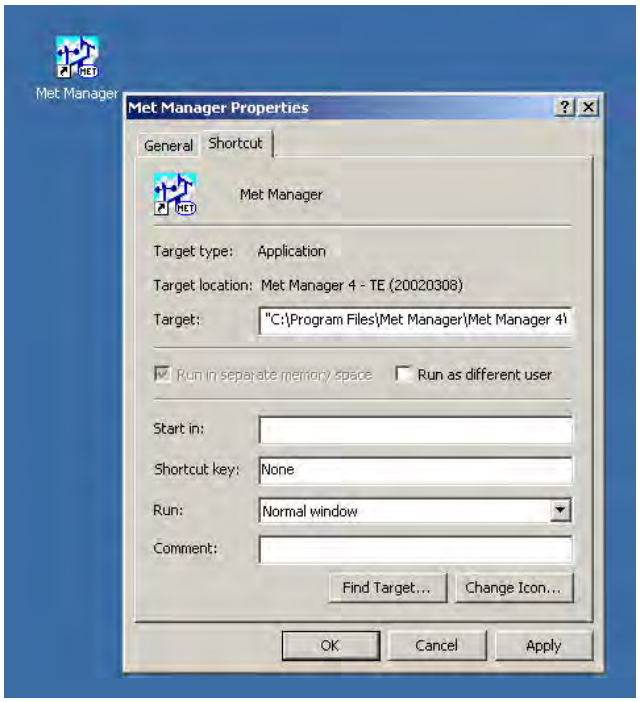
For example, to setup the Met Manager command line, right-click on a shortcut created from the Met Manager program executable; then select the "Properties" item:



or right-click on Met Manager from the Windows desktop "Start Programs" menu:



Then select "Properties" and configure the "Target" property with the desired command line option:



(The above figure is an example only; your configuration may be different. Also, the setup requirements may be different for different version of Microsoft Windows. The above example is for a Windows 2000 workstation.)

An example "Target" command line for Met Manager is:

```
"C:\Program Files\Met Manager\Met Manager 4\metmgr.exe" "-pC:\my
projects\weather" "-oDirect Connect"
```

See below for a description of the above command line option.

IMPORTANT: Met Manager, Met Viewer, and Met Mirror use the Windows registry to retain information about how they were last shut down. This information is then read from the registry on startup. Therefore, these programs must be installed in a way that they can have create/read/write access to the Windows registry. Before installing these programs, check with your network or system administrator to ensure that your log-on profile is configured to allow these programs to have create/read/write access to the Windows registry.

IMPORTANT: Also refer to Section 2.3 for scenarios for using Met Manager, Met Viewer, and Met Mirror. Included are requirements for project folder read/write/create access permission depending on your application requirements.

IMPORTANT: Configure Met Manager and Met Mirror to automatically startup when Windows starts up. Place a shortcut of the Met Manager and Met Mirror executable programs (metmgr.exe and metmrr.exe) in the Windows "Startup" folder. This folder may be located under "Administrators", "All Users", "Default Users", or may be applicable only to your particular log-on profile depending on your version of Microsoft Windows. Check with your network or system administrator for the proper startup folder to contain the shortcuts. (You may also want Met Viewer to automatically startup when Windows starts up. If so, the same requirements apply to Met Viewer.)

II. Met Manager

The command line format is:

```
..\path\metmgr.exe [-p][-][project path] [-o][data source name]
```

where:

"..\path\" is the path to the Met Manager executable program; in the example of Section I as "C:\Program Files\Met Manager\Met Manager 4\". Replace "..\path\" with your actual path name to the Met Manager executable program on your computer.

"MetMgr.exe" is the name of the Met Manager executable program

-p is the command line option for specifying a project to open on startup or selecting no project to be opened.

For example, to open a project in the folder <C:\My Projects\Weather>, the command line is:

```
"..\path\metmgr.exe" "-pC:\my projects\weather"
```

To insure that Met Manager does not open a project when it starts up, then the command line is:

```
"..\path\metmgr.exe" -p-
```

If no -p option is specified, then the *default* action is to open the project that was active when Met Manager was last shut down. The project pathname is read from the Windows registry.

-o is the command line option for automatically opening a named data source when the project, specified by the -p option, is opened. This action is valid as long as you did not rename the data source within Met Manager.

> **IMPORTANT**: The data source name within Met Manager must exactly match the name given in the -o option.

If no -o option is specified, the default action is to open the named data source that was active when Met Manager was last shut down. If Met Manager was logging data from the data source when Met Manager was shut down, then Met Manager will begin logging data from the named data source when started back up. However, this default action is not implemented if a project is not opened.

For example, to open a project in the folder <C:\My Projects\Weather> and automatically begin data collection using a pre-defined data source name of "Direct Connect" then the command line would be:

```
"..\path\metmgr.exe" "-pC:\my projects\weather" "-oDirect Connect"
```

IMPORTANT: If a command line option has embedded blank spaces in it, then the entire command line option must be enclosed in double quotation marks.

III. Met Viewer

The command line format is:

```
..\path\metvwr.exe [-p][-][project path] [-u][user name]
```

where:

"..\path\" is the path to the Met Viewer executable program. Replace "..\path\" with your actual path name to the Met Viewer executable program on your computer.

"Metvwr.exe" is the name of the Met Viewer executable program

-p is the command line option for specifying a project to open on startup or selecting no project to be opened.

For example, to open a project in the folder <C:\My Projects\Weather>, the command line is:

```
"..\path\metvwr.exe" "-pC:\my projects\weather"
```

To insure that Met Viewer does not open a project when it starts up, then the command line is:

```
"..\path\metvwr.exe" -p-
```

If no -p option is specified, then the *default* action is to open the project that was active when Met Viewer was last shut down. The project pathname is read from the Windows registry.

-u is the command line option that specifies the user view settings to apply in Met Viewer.

For example, to open a project in the folder <C:\My Projects\Weather> and apply the user setup view settings for Met Viewer user <RJones>, then the command line would be:

```
"..\path\metvwr.exe" "-pC:\my projects\weather" "-uRJones"
```

Note: At startup, the *default* action if no -p command line option is specified, is to open the project that was opened prior to shutting down Met Viewer. Similarly, the *default* action if no -u command line option is specified and the same project is opened, is to use the view settings of the last user setup that viewed the project.

IMPORTANT: If a command line option has embedded blank spaces in it, then the entire command line option must be enclosed in double quotation marks.

IV. Met Mirror

The command line format is:

```
..\path\metmrr.exe [-o][definition name]
```

where:

"..\path\" is the path to the Met Mirror executable program. Replace "..\path\" with your actual path name to the Met Mirror executable program on your computer.

"metmrr.exe" is the name of the Met Mirror executable program

-o is the command line option for specifying a mirror definition to activate on startup. This definition is retained in the Windows registry.

For example, to run met mirror and activate the definition named <Test Mirror>, then the command line would be:

```
..\path\metmrr.exe "-oTest Mirror"
```

Note: A command argument with [/O] instead of [-o] is accepted in order to be backward compatible with previous versions of Met Mirror. Always use "-o" (oh; not zero) instead of "/O" to be compatible with current and future versions of Met Mirror.

Note: At startup, the *default* action if no -o command line option is specified, is to not open any mirror definition.

IMPORTANT: If a command line option has embedded blank spaces in it, then each entire command line option must be enclosed in double quotation marks.

V. Met Database Utility

The command line format is:

```
..\path\metdbu.exe [-p][project path] [-u+] [-a][{Pack}{Restructure}]
```

where:

"..\path\" is the path to the Met Database Utility executable program. Replace "..\path\" with your actual path name to the utility program on your computer.

"metdbu.exe" is the name of the Met Database Utility executable program

-p is the command line option for specifying a project to open. For example, to open a project in the folder <C:\My Projects\Weather>, the command line is:

```
"..\path\metdbu.exe" "-pC:\my projects\weather"
```

To insure that MetDBU does not open a project when it starts up, then the command line is:

```
"..\path\metdbu.exe" -p-
```

If no -p option is specified, then the *default* action is to open the project that was active when MetDBU was last shut down. The project pathname is read from the Windows registry.

-u is the command line option specifying user interaction. The default is -u- for no user interaction. For user interaction, use -u+.

-a is the command line option for specifying the action for the database utility to automatically perform. The action must be one of the following: "Pack" or "Restructure"; for example:

```
..\path\metdbu.exe "-pC:\my projects\weather" -u+ -aPack
```

APPENDIX E
Calibration Overview

I. Data Path and Adjustments

The path from a physical weather variable to the data displayed in a table or a graph is not trivial. The figure below illustrates a typical path beginning at the input to the MET Instrument, proceeding to the Data Logger, and on to the Met Manager™ software for storage and presentation.

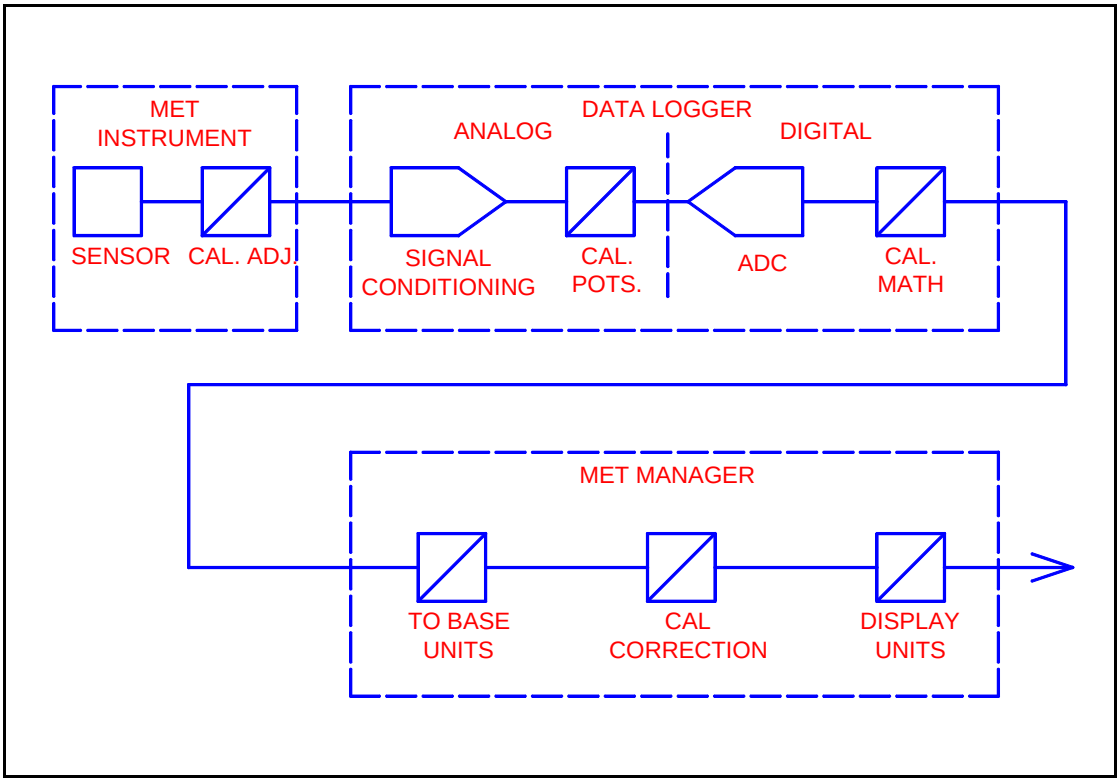


FIGURE 1

While on its path to the user, the measured weather variable may be altered in up to three different ways:

1. The variable may be physically altered by mechanical adjustments in the MET Instrument.

2. The variable may be electronically altered in the MET Instrument, the Data Logger, or both. This usually involves amplifiers and potentiometers that alter the analog gain and offset.

3. The variable may be altered by computer calculations (including digital slope and offset adjustments) in the Data Logger, Met Manager, or both.

There are four reasons a weather variable may be altered:

1. The variable is converted from its physical form to an electronic signal (voltage, current, resistance, counts, pulses, etc.) with appropriate range and resolution.

2. The variable is converted into a digital number that can be stored, displayed, and analyzed with the aid of a data logger or computer.

3. The variable is converted into engineering units appropriate for the physical weather variable being measured.

4. The variable should be adjusted to agree with accepted calibration standards thereby assuring the accuracy of the measurement is suitable for its intended use.

Each of these reasons can be accomplished in one or more of the major system components. Usually, physical conversion and initial electronic signal scaling are done in the Met Instrument. Signal scaling, conversion to digital form, and initial engineering units conversions are often done in the Data Logger. Base unit and other engineering unit conversions are usually done in Met Manager.

Calibration adjustments can be made in any of the three major system components. It is very important that calibration adjustments be made with care to assure corrections are not erroneously applied in multiple places. Multiple calibration corrections could result in incorrect values being stored and presented in various tables, reports, and graphs.

II. Calibration Methods

There are pros and cons to consider when deciding where and how to adjust the measurement to agree with calibration standards. There is usually a tradeoff between convenience, component interchangeability, and accuracy. Component interchangeability is enhanced if the Met Instrument and Data Logger are individually and independently calibrated. In doing so, the Met Instrument is connected to an appropriate calibration standard and its output is adjusted physically and/or electronically to its specified nominal values corresponding to the values of the standard connected to its input. This requires an additional instrument to measure the output of the Met Instrument. Similarly, the corresponding Data Logger channel is calibrated by connecting its input to a calibration standard that provides a signal of the same physical type (e.g. if the MET Instrument is a temperature to voltage device, then a volt meter and source are required) as the output of the Met Sensor and adjusting the Data Logger's output until it agrees with the standard. Note that this requires two standards and the ability to accurately measure the output of the Met Instrument. It makes the accuracy and traceability of the output of the weather instrument an additional calibration and accuracy burden. The benefit is that either the Met Instrument or the Data Logger can be replaced and the measurement accuracy will remain with the limits established by the entire ensemble of instrumentation. The calibration ensemble that affects the overall accuracy includes:

- The Met Instrument (precision, drift, and stability)
- The Data Logger (precision, drift, and stability)
- **AND** the weather variable calibration standard (accuracy)
- **AND** the instrument used to measure the output of the Met Instrument (accuracy)
- **AND** the standard used to calibrate the Data Logger (accuracy)

CAUTION: In the above context, it is very important that adjustments made in the Met Instrument pertain only to the Met Instrument's accuracy and that adjustments made to the Data Logger pertain only to the Data Logger's accuracy.

Note: Additionally, steps should be taken during the calibration process to demonstrate the overall integrity of the data. If the data is stored and processed by a computer that is located downstream of the Data Logger, it is a good practice to provide calibration data that demonstrates that the data stored and presented are in good agreement with the weather variable calibration standard. This requires observations and recording of data stored and displayed on the computer located downstream of the Data Logger.

Accuracy and convenience are enhanced with an "endpoint-to-endpoint" calibration. With this type of calibration, a calibration standard for the weather variable is connected to the input of the Met Instrument. Then the output of the Data Logger, or the output of a downstream computer, is observed. The values of intermediate signals are not relevant. While the Met Instrument and the Data Logger are not interchangeable without calibration, the total error is reduced because the calibration ensemble (i.e. the number of devices contributing error) has been reduced to only:

- The Met Instrument (precision, drift, and stability)
- The Data Logger (precision, drift, and stability)
- **AND** the weather variable calibration standard (accuracy)

Reducing the total error is great, but a critical question remains. If the observed output does not agree with the standard, where should you make the required adjustments? Should you adjust the Met Instrument or the Data Logger? In most cases, the computer downstream of the Data Logger does not provide calibration support. This is not the case with Met Manager. Met Manager facilitates "endpoint-to-endpoint" calibrations by providing calculations to correct for linear errors. Met Manager also simplifies the calibration process.

III. Met Manager Calibration

Met Manager provides three levels of basic signal adjustments:

- Conversion from the Data Logger's output format to base units.
- Correction for calibration slope and offset (optional).
- Conversion to a broad set of additional engineering units for display and analysis.

Each of the signal adjustments is a linear transformation as described below:

$$y = m \bullet x + b$$

where : x is the value prior to adjustment

y is the value after adjustment

m is the slope

and b is the offset

Each level of adjustment made by Met Manager is distinct and separate, having its own slope and offset.

Met Manager's initial calibration slope and offset adjustments are assigned default values of one and zero, respectively. If these values are not changed (via Met Manager's calibration capability), then it is expected that any necessary calibration adjustments have been made in the Met Instrument and/or the Data Logger. This is usually appropriate for standalone applications where the Data Logger is located remotely from Met Manager, or in which the data from the Data Logger is made available to more than one external application. For cases in which Met Manager is directly connected to a local Data Logger, and is the only direct consumer of the data from the Data Logger, then it is appropriate to perform an endpoint-to-endpoint calibration from the Met Instrument to Met Manager using Met Manager's internal calibration capability.

IMPORTANT: If calibration adjustments are made at the Met Instrument or the Data Logger, then ensure that Met Manager's calibration slope and offset are set to one and zero respectively so that Met Manager will not apply additional calibration corrections to the weather variable.

IV. Additional Considerations

If an "endpoint-to-endpoint" calibration with Met Manager is more accurate and more convenient and component interchangeability does not drive the decision, then why would you ever use another method? When the system operates in a stand-alone batch mode, there may be other computers, in addition to the one running Met Manager, that connect to the Data Logger to extract and use the data (See Figure 2 below). If Met Manager were used to adjust for calibration errors, then only Met Manager would have the correct calibrated values. For the other computers to have corrected data values, it is important that the data be properly calibrated at the point of distribution. Therefore, in this case, any necessary calibration adjustments should be performed in the MET Instrument, the Data Logger, or both. (An "end-point to end-point" calibration is still possible if one considers the output of the Data Logger as the "end-point" of the system for calibration purposes.)

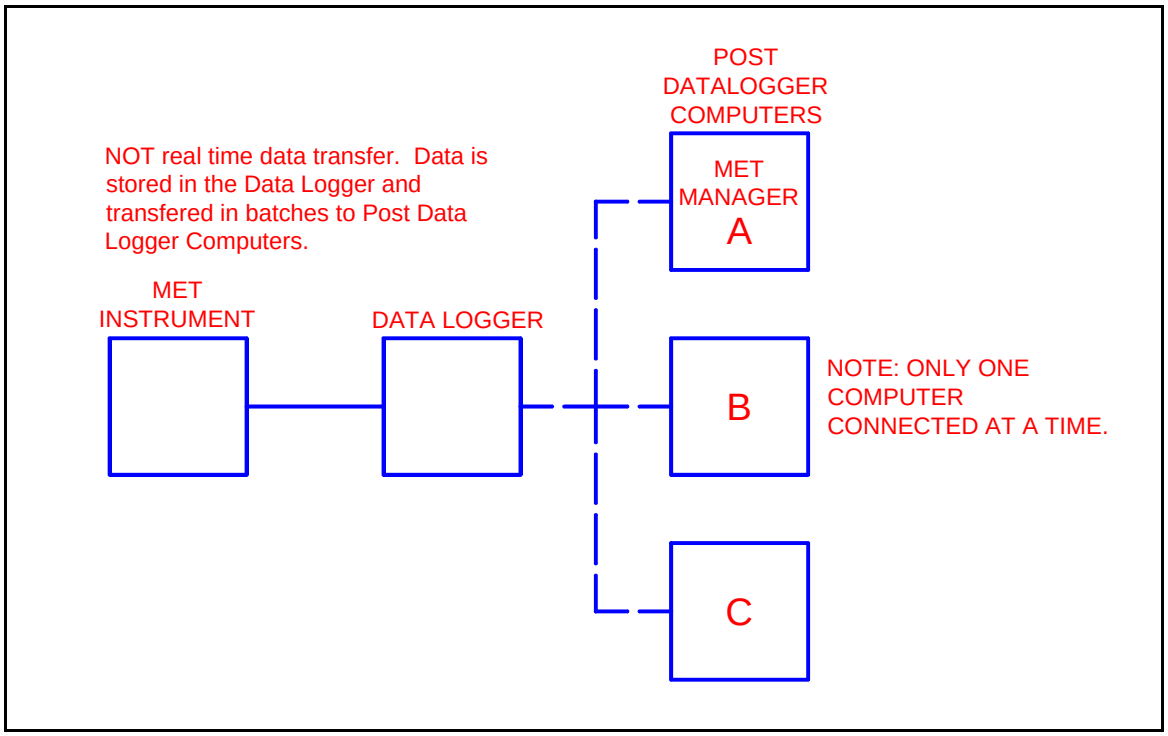


FIGURE 2

What do you do if you have decided that the calibration adjustments should be made in the MET Instrument and Data Logger but the Data Logger is only storing relatively long-term aggregate values such as one hour averages? This can significantly complicate the calibration process because it may be difficult to get the calibration standard to create a constant value for the entire averaging period. While it is desirable to calibrate a weather station as it operates in its normal configuration, some temporary configuration changes may be required in order to get a more timely output response from the Data Logger. Consult the weather station or Data Logger user manual for ways to increase the frequency of the Data Logger's output (for calibration purposes) while maintaining the integrity of post-calibration long-term aggregate values.

Note: If the Data Logger's operating configuration is changed to facilitate calibration adjustments, it is recommended that some data be captured, following calibration adjustments, with the calibration standard connected and the Data Logger reset back to its normal configuration. This data should be transferred to, and processed by, the post Data Logger computer. Verify that the outputs agree with the calibration standard. Otherwise, find and fix the cause of the error.