

Kestrel® 4100 Pocket Air Flow Tracker

Instruction Manual

NK

Kestrel® 4100 Pocket Air Flow Tracker FRONT

MANUAL MEMORY BUTTON
Press to manually store current conditions to memory.

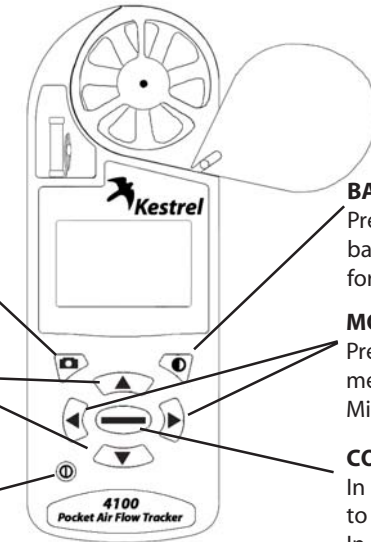
MEASUREMENT BUTTONS
Press to scroll between screens:
Date/Time, Measurements,
User Defined Screens

POWER/SETUP BUTTON
Hold to turn power on or off. Press
to enter and exit Main Setup Menu.

BACKLIGHT BUTTON
Press to activate
backlight
for 1 minute.

MODE BUTTONS
Press to change mode of
measurements: Current,
Min/Max/Avg, Chart.

COMMAND BUTTON
In Chart Screens, press
to view data points.
In Setup Menu, press
to make selection.



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Kestrel® 4100 Pocket Air Flow Tracker BACK

IMPELLER
Sapphire jewel bearings
on a user-replaceable
impeller.

IMPELLER COVER
Swivel cover protects
impeller when not in use.

DATA UPLOAD OPTICAL COUPLER
Software and serial port
interface sold separately.

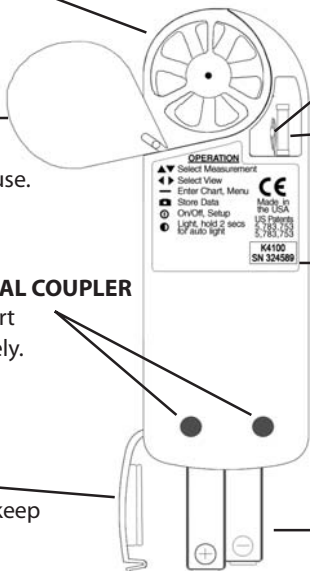
BATTERY DOOR
Sealed with o-ring to keep
product watertight.

TEMPERATURE SENSOR
Hermetically sealed
precision thermistor.

HUMIDITY SENSOR
Capacitive sensor.

SERIAL NUMBER

2 AAA BATTERIES



Congratulations on your purchase of the Kestrel 4100 Pocket Air Flow Tracker! The Kestrel 4100 is the next generation of handheld HVAC instruments. Now, you can instantly measure air velocity, air flow and environmental conditions easily, accurately, and right in the palm of your hand. While the Kestrel 4100 is user-friendly and simple to use (and the Quick Start Card will help get you started), reading the instruction manual is recommended in order to use the Kestrel 4100 to its fullest potential. NK, manufacturer of Kestrel Pocket Weather Meters, is available to answer questions and provide support. Contact NK by phone: 610.447.1555, fax: 610.447.1577, email: info@nkhome.com, or web: www.nkhome.com.

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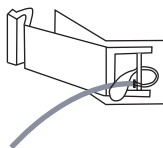
3

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Getting Started

Pouch and Lanyards

Wrist and neck lanyards and a small pouch have been provided. To install the lanyard of your choice, feed the thin end of the lanyard around the metal post on the battery door (as shown in diagram). Feed the thick end of the lanyard through the loop on the thin end. Using tweezers can help.



Battery Installation

Use only AAA batteries. Install batteries as indicated on the battery door. After installing the batteries, the Kestrel 4100 will automatically start in the Date and Time Setting mode. (See Date and Time Setup below.) Custom settings and chart data will be saved during a battery change.

Turning the Kestrel 4100 ON and OFF

ON: Press the **⏻** button.

OFF: Hold the **⏻** button for two seconds. Or, press the **⏻** button, then press the **⏏** button with the word OFF highlighted. (Note: If auto store is enabled, your unit will continue to automatically store data when the power is turned off.)

Date and Time Setup

The first time that you turn on your Kestrel 4100, as well as after a battery change, you will need to set the date and time. The Introduction Screen will appear for 3 seconds, followed by the Date/Time Setup Screen. Press the **▲** and **▼** buttons to scroll through the settings. Press the **◀** and **▶** buttons to scroll through the setting options. After entering the date and time, press the **⏻** button to exit the Date/Time Setup. Then press the **⏻** button again to exit the Main Setup Menu.



Measurement Navigation

Starting on the Date & Time Screen...



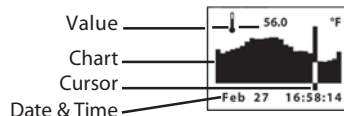
...Press the **▼** button to scroll to the Current Wind Velocity Screen.

Press the **▼** button again to scroll to the Current Air Flow Screen.

Continue pressing the **▼** button to scroll through the Current Measurement Screens, listed on the previous page, followed by the 3 User Screens. Press the **▲** button to scroll through these screens in reverse order.

Navigation of Charts

The Kestrel 4000 is capable of storing up to 480 data points. To review the data, press the **⏏** button while viewing a chart. A cursor will appear on the most recent data point. Press the **◀** button to scroll through older data points and the **▶** button to scroll through more recent data points. The date and time at which the data was stored will be displayed at the bottom of the screen. The data value will be displayed at the top of the screen. Hold down the **◀** or **▶** button to scroll quickly through the data points.



Press the **▲** or **▼** button to review the data for the other measurements. Please note that the cursor will remain at the same date and time. If new data is stored while viewing chart data, the entire chart will shift left with the new data point charted on the right. The cursor will not shift with the chart.

Press the **⏏** button to return to the Chart Mode.

Navigation

The Kestrel 4100 is set up to display 6 Measurements (some are actually calculations) in 3 Modes.

The Measurements are listed to the right with their corresponding screen icon. Use the **▲** and **▼** buttons to scroll through the various Measurements.

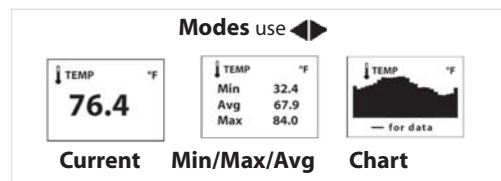
The Modes are:

Current - displays the instantaneous reading

Min/Max/Avg - displays the Minimum/Maximum/Average readings from stored data

Chart - displays a graphical representation of up to 480 stored data points

Examples of each of these screens are shown below. Use the **◀** and **▶** buttons to scroll through the various Modes.



In addition to these Measurements and Modes, there are also 3 User Screens, which simultaneously show 3 current measurements (see pages 8 and 11 for more information); and the Date & Time Screen, which gives the current date and time.

Measurements

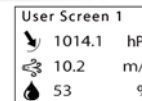
use **▲▼**

- Air Velocity
- Air Flow
- Temperature
- Wind Chill
- Humidity
- Heat Index
- Dew Point

Special Functions

User Screens

The Kestrel 4100 has three User Screens which can be customized to display three current measurements simultaneously. (See page 11 for setup instructions.)



Min/Max/Avg for Velocity, Air Flow and Wind Chill

The Min/Max/Avg values for Wind Velocity, Air Flow and Wind Chill are measured independently from the stored and charted data. While viewing the Min/Max/Avg screen for either Wind Velocity, Air Flow or Wind Chill, press the **⏏** button when the screen displays "--average" to begin collecting data for both measurements. Press the **⏏** button when the screen displays "--stop" to stop collecting data and hold the values on the display. Press the **⏏** button when the screen displays "--clear" to clear the data. This routine will work simultaneously for all measurements, regardless of which one is displayed while the routine is run. The Min/Max/Avg for Wind Velocity, Air Flow and Wind Chill will not affect any other Min/Max/Avg or stored data.

Relative Humidity

The Kestrel 4000 is capable of measuring RH very accurately (+/- 3% RH). However, there are a number of circumstances that can reduce the Kestrel 4000's ability to perform within these specifications:

- Direct sun will heat the air inside the humidity sensor enclosure and cause inaccurate readings. Keep the Kestrel 4000 in the shade when taking RH measurements.
- Rapid large temperature changes, such as when taking a Kestrel stored inside at 70°F outside to a temperature of 40°F, can require as long as 30 minutes to for the temperature inside the RH enclosure to match the temperature outside, permitting the unit to provide accurate RH readings. Any air flow over the RH sensor enclosure, even as low as 2 mph, significantly speeds up the response time.

When taking measurements under conditions where there is a significant change in temperature (more than 2C or 4F) be sure to allow enough time for the RH value to stabilize. The greater the temperature change, the greater the time. You can use the logging capability of the K4000 to confirm that the unit has stabilized to a correct reading: Set the memory options to a relatively short logging interval (20 seconds works well, see page 10 for instructions), select the graphical display of RH, and you can see when the value is no longer changing significantly. At that point, the RH value is stable and can be relied upon to be within the accuracy specifications.

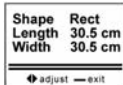
Backlight

Press the **⏻** button to activate the backlight. The light will remain activated for one minute. Press the **⏻** button within one minute to deactivate the light manually.

Air Flow

The Kestrel 4100 will display the volume air flow, based on the instantaneous air velocity and cross-sectional area of the opening through which the air is passing. If your particular industry uses a standard of practice for air flow measurements, be sure to adhere to those standards when using this product.

To set the dimensions of the duct or opening, press the **⏻** button while viewing the AIR FLOW screen. The DIMENSIONAL SETTING screen will appear with the word SHAPE highlighted.



The shape of the opening can be selected by pressing the **◀** or **▶** button. The options are round or rectangular openings. Press the **v** button to highlight the dimensional settings. For round openings, simply set the correct diameter of the opening. Use the **◀** and **▶** buttons to increase and decrease the value. Holding these buttons will increase and decrease the value quickly. For rectangular openings, set both the length and the width of the opening.

When the dimensional settings are correct, press the **⏻** button to exit the DIMENSIONAL SETTING screen and return to AIR FLOW screen. The displayed air flow value will be the result of multiplying the instantaneous air velocity by the area of the programmed opening.

Note that you may change the units for setting duct dimensions under the Main Setup Menu (see page 11 for instructions). Choices are inches, feet, centimeters and meters.

Manual Data Storage

In addition to automatic readings, the Kestrel 4100 can also take readings manually. Simply press the **⏻** button to store all the presently measured values in memory with date and time. Readings taken manually will appear chronologically within the automatically store data in the chart. Manual Data Storage may be disabled - see page 10 for Manual Data Storage settings.

Measurements - Measurement screens can be hidden from the normal measurement navigation. For example, if wind chill is not of interest, it can be hidden. Press the **▲** or **▼** button to highlight the desired measurement. Press the **◀** or **▶** button to toggle between ON and OFF for each individual measurement. Press the **⏻** button to return to the Main Setup Menu.

Graph Scale - These settings control the chart limits of your meter. Depending on the conditions, the lower and upper limits of the chart scale may need to be adjusted in order to get the best view of the data. Highlight the desired measurement by pressing the **▲** or **▼** button. Select the highlighted measurement by pressing the **⏻** button. Press the **◀** or **▶** button to increase or decrease the value of the limits. Press the **▲** or **▼** button to change between the upper and lower limits. Press the **⏻** button to exit and return to the measurement selection screen. Press the **⏻** button to return to the Main Setup Menu.

Units - The units of measure can be adjusted to best suit the application. The following units are available:

Air Velocity	Air Flow	Temperature, Dewpoint, Wind Chill, Heat Index	Dimensions
m/s meters per second	cfm	°F Fahrenheit	ft
km/h kilometers per hour	m ³ /h	°C Celsius	cm
kt knots	m ³ /m		m
mph miles per hour	m ³ /s		in
fpm feet per minute	L/s		
Bft Beaufort			

Highlight the desired measurement by pressing the **▲** or **▼** button. Press the **◀** or **▶** button to scroll through the available units. Press the **⏻** button to return to the Main Setup Menu.

User Screens - The three User Screens can be reconfigured to display the most appropriate information for the application. Only current measurements can be selected for the User Screens - Min/Max/Avg and Charts are not available.

Highlight the desired User Screen by pressing the **▲** or **▼** button. Press the **⏻** button to select the highlighted User Screen. Press the **▲** and **▼** buttons to change lines, and the **◀** or **▶** button to scroll through the available measurements for each highlighted line. Press the **⏻** button to return to the User Screen Setup Menu. Repeat above process for the other User Screens or press the **⏻** button to return to the Main Setup Menu.

Main Setup Menu

You can customize your Kestrel 4100 in multiple ways. Press the **⏻** button to access the Main Setup Menu. Press the **⏻** button to select the highlighted setting.

Off - Press the **⏻** or the **⏻** button to turn the display off. Even when the Kestrel's display is turned off, the unit will continue to automatically store data if Auto Store is enabled. Wind speed will NOT be stored when the unit is off. To continuously measure wind speed, turn the auto shutdown off (pg. 12). The battery life will be decreased if data is stored frequently. The only way to completely shut off the unit is to remove the batteries. Custom settings and data will be stored when the batteries are removed.

Memory Options - These settings control the data storage properties. Press the **⏻** button to return to the Main Setup Menu.

Setting	Description	Operation
Clear Log (Go/Done)	All stored data is cleared. This will also clear Min/Max/Avg data.	Press ◀ or ▶ to clear the log.
Reset MMA (Go/Done)	All Min/Max/Avg data is cleared. Chart data will remain intact.	Press ◀ or ▶ to clear the MMA.
Auto Store (On/Off)	When On, data is automatically stored at preset Store Rate. When Off, data is only stored when manually captured with the ⏻ button.	Press ◀ or ▶ to toggle between On and Off.
Store Rate* (2 sec - 12 hr)	The frequency at which data sets are automatically stored. (Battery life may be shortened if data is stored frequently.)	Press ◀ or ▶ to increase or decrease Store Rate frequency.
Overwrite (On/Off)	This setting only applies when the data log is full. When On, oldest data point is discarded to allow memory for the new data point. When Off, new data points are not saved.	Press ◀ or ▶ to toggle between On and Off.
Man Store (On/Off)	When On, data is stored when the ⏻ button is pressed. When off, the ⏻ button is disabled.	Press ◀ or ▶ to toggle between On and Off.

* When unit is off, data is NOT stored for 2 sec and 5 sec Store Rates.

System - The display Contrast and Auto Shutdown can be reconfigured as desired. The relative humidity and pressure sensors can also be recalibrated. Press the **▲** and **▼** buttons to highlight the appropriate selection, and the **◀** or **▶** button to adjust or select.

The Contrast can be adjusted for better visibility depending on the ambient lighting conditions. Press the **◀** or **▶** button to increase or decrease the contrast from 0 to 20 (0 is lightest, 20 is darkest).

The display can be set to automatically turn off in order to conserve the battery life. Auto Shutdown will only occur after the preset time has elapsed without any button presses. Press the **◀** or **▶** button to scroll through the Auto Shutdown options (15 minutes, 60 minutes, Off).

Humidity Cal - The humidity sensor can be calibrated by "teaching" it the correct humidity. Some special equipment is required for this calibration, including two hermetically sealed containers and saturated salt solutions. NK offers a calibration kit, and instructions are available on www.nkhome.com. Recalibration of this sensor is typically not required, and it is not recommended that you recalibrate without speaking to an NK technician.

Press the **⏻** button to return to the Main Setup Menu.

Date & Time - The date and time, as well as date and time formats, can be adjusted. The Time Formats available are: 12 hour and 24 hour. The Date formats available are day/month/year and month/day/year. (See page 5 for instructions on how to set the date and time.) Press the **⏻** button to return to the Main Setup Menu.

Language - Displayed text can be set in one of five languages: English, French, German, Italian or Spanish. To choose a language, use the **▲** and **▼** buttons to highlight the desired language. Press the **⏻** button to select the language and return to the Main Setup Menu. Otherwise, press the **⏻** button to return to the Main Setup Menu without changing languages.

Restore - Default settings for units of measure, date and time formats, and system settings can be restored. (See page 17 for a list of the default settings.) Press the **▲** or **▼** button to highlight the desired default setting: Metric, Imperial or Defaults. Press the **◀** or **▶** button to reset the factory setting. Press the **⏻** to return to the Main Setup Menu.

Application Examples

This section provides examples of applications where a Kestrel 4100 might be used, and the appropriate memory settings.

HVAC - Environmental Monitoring

Auto Store On Store Rate 5min
 Overwrite On Man Store Off

These settings will record conditions every five minutes, for a total storage of almost 21 hours. You can monitor the conditions in a laboratory or manufacturing plant, both day and night, to determine if the climate control is working properly. Or you can examine the effect on the environment when employees enter and exit the building.

HVAC/R - System Function Verification

Auto Store Off Store Rate —
 Overwrite Off Man Store On

These settings will require you to press the Manual Store Button in order to store any data at a duct, hood, vent, or other system location. The meter will not store any data automatically. Be sure to record the location and date/time of storage for reference when reviewing the data. After storing the conditions at each location, simply review the data and balance the system.

Air Duct Measurements

There are two useful techniques for measuring air flow in a duct or at the face of a duct opening. First, the unit can be used in the Max/Avg Mode (see page 8). Hold the unit in one corner or side of the duct. Press the **■** button to begin the averaging interval. Slowly traverse the duct. Press the **■** button at the end of the traverse of the duct. The maximum and average air flow measurements will be displayed.

Second, the unit can be used to store the air flow at multiple points in a duct. Hold the unit in one position in or on the duct. Press the **■** button to manually store the measurements (see page 9). Repeat this process in multiple positions in or on the duct. When complete, review the stored measurements in the chart data (see page 7), and average them if desired.

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Glossary

The below definitions have been simplified in order to keep this section brief. We strongly recommend that anyone who wishes to make use of these measurements refer to one of the many excellent weather references available for a more in-depth definition. On the internet, visit www.usatoday.com or www.noaa.gov. Or, locate the USA Today publication, *The Weather Book*. Please note that any words in a definition printed in *italics* are themselves defined in this glossary.

Air Flow: The volume of air passing through an area for a given period of time. This is commonly calculated by multiplying the air velocity by the cross sectional area through which the air is passing.

Dewpoint: The *temperature* to which air must be cooled in order for condensation to occur. The difference between *dewpoint* and *temperature* is referred to as the “temperature/dew point spread”. A small dewpoint spread indicates high *relative humidity*, while a high dewpoint spread indicates dry conditions.

Heat Index: A practical measure of how hot the current combination of *relative humidity* and *temperature* feels to a human body. Higher *relative humidity* makes it seem hotter because our ability to cool ourselves by evaporating perspiration is reduced.

Relative Humidity: The amount of water vapor actually in the air divided by the maximum amount of water vapor the air could hold at that *temperature*, expressed as a percentage.

Temperature: The ambient air temperature.

Wind Chill: The cooling effect of combined wind and temperature. The wind chill gives a more accurate reading of how cold it really feels to the human body. The Kestrel 4100's wind chill is based on the National Weather Service standards as of November 1, 2001.

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Memory Capabilities

Store Rate	Total Memory	Store Rate	Total Memory
2 sec	8 min, 20 sec	10 min	1 day, 17 hr, 40 min
5 sec	20 min, 50 sec	20 min	3 days, 11 hr, 20 min
10 sec	41 min, 40 sec	30 min	5 days, 5 hr
20 sec	1 hr, 13 min, 20 sec	1 hr	1 wk, 3 days, 10 hr
30 sec	2 hr, 5 min	2 hr	2 wk, 1 day, 20 hr
1 min	4 hr, 10 min	5 hr	7 wk, 3 days, 2 hr
2 min	8 hr, 20 min	12 hr	17 wk, 6 days
5 min	20 hr, 50 min		

PC Upload

Stored data may be uploaded to a PC with the optional Kestrel PC Interface, NK part number 0830.

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Default Settings

UNIT	METRIC	IMPERIAL
Velocity	m/s	fpm
Air Flow	m ³ /s	fpm
Temperature Functions	°C	°F
Dimensions	cm	in
Time Format	24 hour	12 hour
Date Format	day/month/year	month/day/year

SETTING	FACTORY DEFAULT
Automatic Data Store	On
Data Store Rate	1 hour
Data Overwrite	On
Manual Data Store	On
User Screen 1	velocity, air flow, temperature
User Screen 2	temperature, humidity, dewpoint
User Screen 3	air flow, temperature, humidity
Display Contrast	10
Automatic Shutdown	15 minutes
Language	English

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Specifications

Measurement	Units	Operational Range	Resolution	Accuracy (+/-)	Specification Range
<i>Response Time</i>					
Air Velocity <i>1 second</i>	MPH	0.8 to 135.0	0.1	3% of reading	0.8 to 89.0 MPH
	fpm	59 to 11,948	1		59 to 7877
	Knots	0.6 to 118.3	0.1		0.6 to 78
	Beaufort	0 to 12	1		0 to 12
	m/s	0.4 to 60.0	0.1		0.4 to 40.0 m/s
	KPH	1.0	0.1		1.0 to 144
Air Flow <i>1 second</i>	cfm	0 to 99,999	1	3% of reading	0 to 99,999
	m³/h	0 to 99,999	1		0 to 99,999
	m³/m	0 to 99,999	1		0 to 99,999
	m³/s	0 to 99,999	0.1		0 to 99,999
	L/s	0 to 99,999	1		0 to 99,999

1 inch diameter impeller with precision axle and sapphire bearings, individually tested in NIST-traceable wind tunnel. Calibration drift < 1% after 100 hours use at 16 MPH / 7 m/s. Sustained operation above 60 MPH / 27 m/s will wear impeller rapidly and may cause destruction of impeller. Replacement impeller, PN-0801, may be field-installed without tools (US Patent 5,783,753).

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Data Display and Storage	Minimum, maximum, average and logged history stored and displayed for every measured value. 480-point data logger with graphical display. Auto data storage; interval settable from 2 seconds to 12 hours. Manual data capture.
Display Digits	Multifunction, multi-digit programmable dot-matrix display.
Display Update	1 second
Display Languages	English, French, German, Italian, Spanish
Display Backlight	Aviation green electroluminescent backlight. Automatic or manual operation.
Operational Temperature Range	The operational temperature range of the liquid crystal display and batteries is 0° F to 131° F / -18 °C to 55 °C. Beyond the limits of this range, the unit must be maintained within range and exposed for minimum time necessary to take reading.
Storage Temperature	-22 °F to 140 °F / -30 °C to 60 °C
Auto Shutdown	User-selectable: 15 minutes, 60 minutes or disabled
Batteries	AAA Alkaline, two, included. Average life, 400 hours of use, +/- depending on backlight use.
Sealing	Waterproof (IP69 standard)
Dimensions	5.0 x 1.8 x 1.1 in / 12.7 x 4.5 x 2.8 cm
Weight	3.6 oz / 102 gm
Color	Safety orange.

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Measurement	Units	Operational Range	Resolution	Accuracy (+/-)	Specification Range
Temperature <i>1 minute</i>	°F	-50.0 to 260.0	0.1	1.8	-20 to 158
	°C	-45.0 to 125.0	0.1	1	-2 to 70 °C
Thermally isolated, hermetically sealed, precision thermistor mounted externally (US Patent 5,939,645). Calibration drift negligible.					
Relative Humidity <i>1 minute</i>	%RH	0.0 to 100.0	0.1	3.0 %RH	5 to 95 % non condensing
Polymer capacitive humidity sensor mounted in thin-walled chamber external to case for rapid, accurate response (US Patent 6,257,074). Response specification is time to achieve 95% or better of stated accuracy. Calibration drift +/- 2% over 24 months. Relative humidity may be recalibrated at factory or in field using Kestrel Humidity Calibration Kit, PN-0824.					
Wind Chill <i>1 second</i>	°F	0.7 to 135.0 MPH, -50.0 to 260.0 °F	0.1	1.8	1.8 to 89 MPH, -20 to 158 °F
	°C	0.4 to 60.0 m/s, -45.0 to 125.0 °C	0.1	1	0.4 to 40 m/s, -29 to 70 °C
Dewpoint <i>1 minute</i>	°F	0.0 to 100.0 %RH, -50.0 to 260.0 °F	0.1	3.6	-20 to 158 °F, 20 to 95% RH
	°C	0.0 to 100.0 %RH, -45.0 to 125.0 °C	0.1	2	-29 to 70 °C, 20 to 95 %RH
Heat Index <i>1 minute</i>	°F	0.0 to 100.0 %RH, -50.0 to 260.0 °F	0.1	3.6	-20 to 158 °F, 20 to 95% RH
	°C	0.0 to 100.0 %RH, -45.0 to 125.0 °C	0.1	2	-29 to 70 °C, 20 to 95 %RH

The above values are calculated from the primary measurements of wind speed, temperature and relative humidity.

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