



## **Relative Humidity Calibration Kit Instructions**

### **For Calibrating All RH Measuring Kestrel Meters**

**Model Numbers  
3000, 3500, 4000, 4100, 4200**

### **Factory Calibration**

Each Kestrel Pocket Weather Meter is individually calibrated after assembly. In essence, each unit is “taught” what the correct relative humidity (RH) values should be for given signals from the RH sensor.

NK factory calibrates at RH = 32.8% and RH = 75.3%. Calibration is performed in two sealed environmental chambers maintained at 25°C. The humidity is held constant with saturated aqueous salt baths: magnesium chloride for the 32.8% chamber and sodium chloride for the 75.3% chamber. Chamber temperatures are held constant at 25°C ± 0.5°C.

The temperature and RH of each chamber is independently monitored using a precision chilled mirror dew point hygrometer (EdgeTech Model 2002) accurate to ± 0.1°C and NIST (National Institute of Standards and Technology) traceable.

A proprietary auto calibration routine controls the calibration process. After 60 minutes this routine stores a calibration value which forces the Kestrel to be correct at the RH value of the chamber.

The response of the humidity sensor is a highly reproducible, non-linear curve. This non-linear characteristic is stored in the microprocessor used to compute RH, and in this manner we are able to maintain an accuracy of ± 3% of scale over the relative range 5% - 95%.

NK's factory calibration is traceable to the National Institute of Standards and Technology, ensuring the reliability you need. Our primary Calibration Standards are sent for calibration in accordance with N.I.S.T. requirements and based on a regular schedule. Only approved laboratories and N.I.S.T themselves are used for these calibration services. Calibration certificates and stickers may be requested (at an additional charge) when purchasing your Kestrel or returning it for Factory Recalibration (see next section).

### **Factory Recalibration / Certification**

The Kestrel should be recalibrated if the RH sensor has shown drift in its RH measurement. The Kestrel RH sensor is specified to develop less than 2% drift over 24 months. You may return your Kestrel to NK for Factory Recalibration of the relative humidity and related measurements. Recalibration is available with and without certification of NIST traceability and calibration stickers. Note that NK can recalibrate and certify any of the values measured by your Kestrel - wind speed / air flow; temperature; barometric pressure and humidity. Please contact NK for more information about Factory Recalibration and certification.

### **Field Recalibration**

As an alternative to Factory Recalibration, this kit allows you to perform dozens of recalibrations in the field to ensure that your Kestrel is always performing within specifications.

This manual explains in detail all of the steps for recalibrating your Kestrel. This process will take approximately 13 hours, including setup and calibration.

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***While the calibration process is very simple, it is important that you follow the steps carefully! A careless calibration could enter incorrect values into the unit and degrade its performance.***

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### **Contents of the Humidity Calibration Kit**

The RH Calibration Kit includes the following items:

- two clear jars with color-coded salt chamber labels, plastic grids and sealing lids
- one clear jar with no grid (for water)
- one bag with magnesium chloride slurry and color-coded label
- one bag with sodium chloride slurry and color-coded label
- one insulated RH Calibration Kit bag

The insulated RH Calibration Kit bag and jar of water are used to create a stable environment. The jar of water will stabilize the temperature inside the Cal Kit. The saturated salt solutions generate well-defined humidities when they are confined to the contained environment of the two gridded jars inside the insulated, stabilized Cal Kit.

**NOTE! After loading the salt slurries into the salt chambers (see next page), KEEP THE SALT CHAMBER JARS TIGHTLY CLOSED except when opening to perform a calibration. Over time, the magnesium chloride slurry will tend to absorb water from the air and become too wet, and the sodium chloride solution will lose water to the air and become too dry. You may remoisten the sodium chloride solution to its original slurry consistency with distilled water. You may also dry the magnesium chloride slurry in a clean pan in a slow oven. Alternatively, you may simply purchase replacement salt packets from NK and start fresh.**

## Preparing to Calibrate

- 1) **IMPORTANT! Identify your Kestrel model:** The calibration instructions differ depending upon which Kestrel model you have. You must identify your model and follow the correct directions. The three models are:
  - *Two-Button Kestrel 3000:* This model has TWO buttons to control its functions and was manufactured prior to July 2004.
  - *Three-Button Kestrel 3000/3500:* These models have THREE buttons to control their functions and were manufactured after July 2004.
  - *Kestrel 4000/4100/4200:* These models have a center keypad with four directional buttons and a center selection button, as well as a light and an on/off button.
- 2) **Prepare the Humidity Chambers:** Remove the grids from the two salt chambers. Empty the entire contents of the sodium chloride salt slurry bag into sodium chloride salt chamber (note color-coded dots on labels). Simply turning the bags inside out works well. The salt slurry should completely cover the bottom of the jar. Replace the white grid on top of the salt slurry. This grid keeps the Kestrel out of the salt slurry. Repeat with the magnesium chloride salt slurry bag and salt chamber.
- 3) **Prepare the Stabilizing Jar:** Fill the third jar with room temperature tap water. Put both salt chambers and the temperature stabilizing water jar inside the Cal Kit case. Zip the case closed.
- 4) **Choose a Calibration Location:** It is very important that the temperature of the calibration chambers be kept as constant as possible during the calibration process. Ideally, the Cal Kit should be used inside a temperature-controlled structure (house or office) with a temperature variation of  $\pm 2^{\circ}\text{F}$  or less. For even more accurate calibration results, or where a stable environment is not available, the entire Cal Kit may be placed inside a large insulated cooler together with additional containers of water (gallon jugs work fine).
- 5) **Stabilize the Temperature:** Place the Kestrel unit to be calibrated on top of the Cal Kit. Place both in the location where you will perform the calibration and leave them there undisturbed for at least 10 hours. (If using the additional cooler, place inside the cooler with the full jugs of water.) This stabilization period will ensure that the salt chambers, temperature-stabilizing water jar(s) and Kestrel are all at the temperature of the calibration environment.

**Your Cal Kit, stabilizing water chamber and Kestrel are now at the same temperature as their environment and each other. You are ready to proceed to performing the calibration (next page).**

**NOTE: Throughout the calibration process, keep both salt chambers and the jar of water inside the Cal Kit except when turning the unit on, moving the unit between chambers, or starting the calibration cycle.**

## Performing the Calibration

Before recalibrating your Kestrel, the expected humidity calibration chamber values must be programmed into the unit. The salts provided will create chamber humidities of 75.3 (sodium chloride) and 32.8 (magnesium chloride). These are the default calibration values factory programmed into your unit. The following directions cover the steps required to ensure that your Kestrel is programmed for the correct values, set the calibration time period, and run the calibration routine.

**NOTES: Be sure to follow the directions for your model!**

**If the unit is turned off at any time during the above routine, the re-calibration will be aborted and the original calibration values restored.**

**For the Two-Button Kestrel 3000, the 75.3% sodium chloride chamber is used first, and for the Three-Button 3000/3500 and 4000/4100/4200, the 32.8% magnesium chloride chamber is used first.**

### Two-Button Kestrel 3000:

- 1) Turn on the Kestrel 3000. Press the [MODE] button until the unit is in dew point mode (☼).
- 2) Hold the [ON] and [MODE] buttons simultaneously until the display reads "P 1" (approximately 6 seconds).
- 3) Press the ON button to display the first calibration value, which will have the last digit blinking. To keep the displayed value (75.3 for the sodium chloride chamber), simply press the [ON] button twice to skip to step 4. If it is necessary to change the value, press the [MODE] button to change the flashing digit. When the desired number is displayed, press the [ON] button to move to the middle digit. Again, press the [MODE] button to change the flashing digit. When the desired number is displayed, press the ON button to continue to setting the second calibration value.

- 4) The display will now read "P 2". Press the [ON] button to display the second calibration value, which will have the last digit blinking. To keep the displayed value (32.8 for the magnesium chloride chamber), simply press the [ON] button twice to exit setting. If it is necessary to change the value, press the [MODE] button to change the flashing digit. When the desired number is displayed, press the [ON] button to move to the middle digit. Again, press the [MODE] button to change the flashing digit. When the desired number is displayed, press the [ON] button to exit setting the second calibration value.
- 5) The display will return to the normal dew point mode. (Note that the RH measurement will NOT be any different than before setting the calibration values.) The unit is now ready for calibration.
- 6) Press the [MODE] button until the unit is in relative humidity mode (RH%).
- 7) Hold the [ON] and [MODE] buttons simultaneously until the display reads "C 1" (approximately 6 seconds).
- 8) Press the [MODE] button. The display will alternate between "C 1" and the programmed first chamber value. This will continue for 60 minutes to indicate that the first calibration point is being taken.
- 9) Place the unit into the sodium chloride chamber, close the jar tightly, place it inside the Cal Kit, and zip the bag closed. If you are using a secondary chamber, place it inside the second chamber. Leave the Cal Kit undisturbed for 60 minutes. After that time, remove the Kestrel from the first chamber. The display should read "C2", indicating that the first calibration point is finished and the unit is ready for the second point.
- 10) Thoroughly wipe off any sodium chloride clinging to the Kestrel or lanyard. Press the MODE button to begin the calibration count-down for the second point. The display will toggle between "C2" and the programmed second chamber value. This will continue for 60 minutes.
- 11) Place the unit into the magnesium chloride chamber, close the jar tightly, place it inside the Cal Kit, and zip the bag closed. If you are using a secondary chamber, place it inside the second chamber. Leave the Cal Kit undisturbed for 60 minutes. After that time, remove the Kestrel from the second chamber. The display should read "End", indicating that the second calibration point is finished.
- 12) Press the MODE button to return to the normal mode of operation. Wipe or rinse the unit clean. Your Kestrel is now recalibrated and ready to take accurate measurements.

### **Three-Button Kestrel 3000/3500:**

- 1) Begin with the Kestrel 3000/3500 turned off. Hold the left button while pressing the center button. The display will read "P1".
- 2) Press the center button to display the first calibration value. To keep the displayed value (75.3 for the sodium chloride chamber), simply press the center button to skip to step 3. If it is necessary to change the value, use the left arrow button to adjust the value down, and the right arrow button to adjust it up. When the desired number is displayed, press the center button to continue to setting the second calibration value. The display will read "P2".
- 3) Press the center button to display the second calibration value. To keep the displayed value (32.8 for the magnesium chloride chamber), simply press the center button to exit value setting. If it is necessary to change the value, use the left arrow button to adjust the value down, and the right arrow button to adjust it up. When the desired number is displayed, press the center button to exit value setting. The display will read "C1".
- 4) Press the center button to begin the calibration count-down. The display will toggle between "C1" and the number of minutes remaining in the calibration.
- 5) Place the unit into the magnesium chloride chamber, close the jar tightly, place it inside the Cal Kit, and zip the bag closed. If you are using a secondary chamber, place it inside the second chamber. Leave the Cal Kit undisturbed for 60 minutes. After that time, remove the Kestrel from the first chamber. The display should read "C2", indicating that the first calibration point is finished and the unit is ready for the second point.
- 6) Thoroughly wipe off any magnesium chloride clinging to the Kestrel or lanyard. Press the center button to begin the calibration count-down for the second point. The display will toggle between "C2" and the number of minutes remaining in the calibration.
- 7) Place the unit into the sodium chloride chamber, close the jar tightly, place it inside the Cal Kit, and zip the bag closed. If you are using a secondary chamber, place it inside the second chamber. Leave the Cal Kit undisturbed for 60 minutes. After that time, remove the Kestrel from the second chamber. The display should read "End", indicating that the second calibration point is finished.
- 8) Press the center button to return to the normal mode of operation. Wipe or rinse the unit clean. Your Kestrel is now recalibrated and ready to take accurate measurements.

### **Kestrel 4000/4100/4200:**

- 1) Turn on the Kestrel 4000/4100/4200. Press the **⓪** button to enter the main setup menu. Press the **▼** button to highlight the "Humidity Cal" option which will be found either on the main menu or under the "System" sub-menu, depending on your software version. Press the **◀** or **▶** button to enter the humidity cal setup screen.
- 2) Press the **▼** button to highlight "Period". Use the **◀** and **▶** arrow buttons to adjust the setting for the length of time that the Kestrel will remain in each humidity chamber. The default and recommended setting is 60 minutes.
- 3) Press the **▼** button to highlight "RH Point 1". Use the **◀** and **▶** buttons to adjust and set the humidity value for the first calibration chamber (32.8 for the magnesium chloride chamber).
- 4) Press the **▼** button to highlight "RH Point 2". Use the **◀** and **▶** arrow buttons to adjust and set the humidity value for the second calibration chamber (75.3 for the sodium chloride chamber).
- 5) Press the **▼** button to highlight "Start 1". Press the **◀** or **▶** button to begin the first calibration period. A timer will appear next to "Start 1" and will immediately begin counting down the calibration period in seconds (i.e. beginning with 3600 for 60 minutes).
- 6) Place the unit into the magnesium chloride chamber, close the jar tightly, place it inside the Cal Kit, and zip the bag closed. If you are using a secondary chamber, place it inside the second chamber. Leave the Cal Kit undisturbed for 60 minutes (or other time period selected in step 2). After that time, remove the Kestrel from the first chamber. The display should be on "Start 1" with the counter no longer visible, indicating that the timer has counted down to "0" and the first calibration point is finished. The unit is now ready for the second point.
- 7) Thoroughly wipe off any magnesium chloride clinging to the Kestrel or lanyard. Use the down arrow key to highlight "Start 2". Press the **◀** or **▶** button to begin the second calibration period. A timer will appear next to "Start 2" and will begin counting down the second period in seconds.
- 8) Place the unit into the sodium chloride chamber, close the jar tightly, place it inside the Cal Kit, and zip the bag closed. If you are using a secondary chamber, place it inside the second chamber. Leave the Cal Kit undisturbed for 60 minutes. After that time, remove the Kestrel from the second chamber. The display should again show "Start 2" highlighted with the timer no longer visible, indicating that the second calibration point is finished.
- 9) Press the **⓪** button twice to exit the calibration and main menus and return to the normal mode of operation. Your Kestrel is now recalibrated and ready to take accurate measurements.

## **Using the Calibration Kit to Check Your Unit's Calibration Accuracy**

**Kestrel 4000/4100/4200:** Press the **⓪** button to enter the main setup menu. Press the down arrow button to highlight the "Auto Off" option. Use the left/right arrow buttons to disable the auto-off feature. Press the **⓪** button to exit the main setup menu. Place the unit in the desired salt chamber and leave it undisturbed in the chamber inside the Cal Kit for one to two hours. Remove the chamber from the Cal Kit and view the %RH through the jar. The reading should be within 3 percentage points of the expected value for that chamber's salt solution. For further confirmation of the calibration accuracy, you may set the unit to log the humidity data at 2-5 min intervals. Review the graph to be certain that the %RH had stabilized and that the temperature was not changing at the point where you took the confirming reading.

**Kestrel 3000 (Two-Button and Three-Button) and 3500:** It is not possible to disable the auto-off feature on these models. With the unit OFF, place it in the desired salt chamber inside the RH Cal Kit for an hour or more to allow the temperature and humidity to stabilize. After the stabilization period, open the jar quickly and turn on your unit. Using the [MODE] or **◀** / **▶** buttons (depending on model), select the relative humidity mode. Return the unit to the jar and leave it undisturbed in the jar inside the RH Cal Kit for 20 minutes. Remove the jar from the Cal Kit and view the %RH through the jar. The reading should be within 3 percentage points of the expected value for that chamber's salt solution. Be sure to take your confirmation reading within 30 minutes before auto shut-off.

The Kestrel RH Calibration Kit can be used to calibrate and check calibration of other hygrometers that will fit inside the provided salt chambers. Follow your product's instructions regarding the calibration routine and auto-off settings.

## Verification of Other RH Values

It is possible to test the Kestrel at humidity values other than 32.8% and 75.3%. To set up a test at another RH value, simply use a different saturated salt solution in the humidity chamber. Refer to the table below for various salts and their corresponding RH values.

- 1) Set up a large clear sealed container with a saturated salt solution using any one of the salts from the table below and distilled water to make a slurry similar to the slurry provided with the Cal Kit.
- 2) Follow the value checking instructions above for your unit. The Kestrel should display an RH value within  $\pm 3$  percentage points of the chart listing for the salt solution chosen.

**NOTE: Please observe all Material Safety precautions applicable to the salt you have chosen to use.**

### SALT BATH

### PUBLISHED RH AT 25 °C

LITHIUM BROMIDE	6.37%
LITHIUM CHLORIDE	11.30%
POTASSIUM ACETATE	22.51%
MAGNESIUM CHLORIDE	32.80%
POTASSIUM CARBONATE	43.16%
MAGNESIUM NITRATE	52.89%
SODIUM BROMIDE	57.57%
POTASSIUM IODIDE	68.86%
SODIUM CHLORIDE	75.30%
POTASSIUM CHLORIDE	84.34%
POTASSIUM SULFATE	97.30%

*\*Based on: Humidity Fixed Points of Binary Saturated Aqueous Solutions, Greenspan, Lewis; Journal of Research of the National Bureau of Standards-A. Physics and Chemistry, Vol. 81A, No. 1, p. 89 January-February 1977*



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