Kestrel®

Agriculture Product Line
User Guide
Kestrel 5000AG Livestock Environmental Meter
Kestrel 5400AG Cattle Heat Stress Tracker
Kestrel 5500AG Agricultural Weather Meter

⚠ CAUTION

Your Kestrel Weather/Environmental Meter is designed to provide accurate measurement of current conditions only. Depending on your location and environment, conditions may change rapidly.

Rapid temperature and humidity changes (i.e., moving your meter from indoors to outdoors) may cause inaccurate readings of temperature and humidity as well as all readings that rely on either of these values. Before relying on readings from your Kestrel Meter, be sure to wait until your unit's readings have stabilized, indicating it has equilibrated to its new environment. Forcing air over the sensors by waving or slinging your meter through the air can help speed that process.

To maximize the accuracy and reliability of your readings:
* *Ensure that your Kestrel Meter is in good repair and within factory calibration.*
* *Take readings frequently and carefully according to the guidelines above.*
* *Allow your meter's readings to stabilize after significant changes in temperature or humidity (i.e., changing location from indoors to outdoors).*
* *Allow a margin of safety for changing conditions and reading errors (2-3% of reading is recommended).*

Use care and good judgment when referring to your Kestrel Meter to make any decisions regarding safety, health or property protection.

⚠ WARNING

To reduce the risk of injury or death to persons or animals, read and follow these guidelines!

Your Kestrel Weather/Environmental Meter may provide one or more of these measurements relating to estimation of danger of injury to people or animals from heat or cold: Heat Stress Index, Wind Chill Index, Wet Bulb Globe Temperature ("WBGT"), Temperature-Humidity Index (THI), Heat Load Index (HLI), Accumulated Heat Load Units (AHLU). Note that guidance tables based on these values are based on typical physiological response. Certain individuals/animals may be more susceptible to harm relating to environmental conditions and require additional precautions. For example, high producing dairy cows; heavier finished cattle; and individuals/animals that are very young or elderly, with asthma or respiratory conditions, or who have not become acclimatized to hot conditions are likely to be more prone to heat injury.

* *Biological factors (breed, acclimation, heat sensitivity, diet, health, coat color, etc.) can modify an individual animals response to given environmental conditions with severe and extreme conditions sometimes resulting in death. The use of a Kestrel Meter does not replace the need for animal observation and monitoring.*
* *In the case of human heat illness, remember the rule – "Cool first, transport second." An inexpensive ice bath can mean the difference between life and death.*

Be prepared: know yourself and those you are responsible for, know what to do in the event of a heat or cold injury, and know when to seek guidance of medical professionals.
Your Kestrel Weather/Environmental Meter is not a medical device. It is only one source of information and must be employed with care and good judgment.

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BATTERIES

We recommend that ONLY Lithium AA batteries be used in your Kestrel Weather/Environmental Meter to provide the widest operating temperature range and to avoid damage caused by leaking lead-acid batteries. If you must use conventional AA batteries, please do not store your Kestrel Meter with the batteries in place. Damage caused by battery corrosion is not covered under warranty.

⚠ WARNING: Lithium is a toxic substance and ingestion may cause serious injury or death. Keep lithium batteries out of the reach of children and animals. If swallowed, immediately seek medical help. Have doctor phone 24-hour hotline at (202) 625-3333, call collect if necessary. Dispose of batteries properly and according to local regulations. Do not puncture or burn batteries. If the battery compartment does not close securely, stop using the product and keep it away from children and animals.

⚠ WARNING: Utilizing the alert light and buzzer in your Kestrel Cattle Heat Stress Tracker places a higher demand on the battery. To ensure the alert light and buzzer operate when needed, replace the battery when a third or less of battery life remains, as indicated on start up.

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MEASUREMENTS	Icon	5000 Environmental	5000AG Livestock	5400 HST	5400AG Cattle	5500AG
Wind Direction (Cardinal Points, Degrees)				o	•	•
Wind Speed | Air Speed (mph | fpm | Bft | m/s | km/h | kt)		•	•	•	•	•
Volume Air Flow (cfm, m³/hr, m³/m, m³/s, L/s)			•			•
Crosswind (mph | fpm | Bft | m/s | km/h | kt)				o	•	•
Headwind | Tailwind (mph | fpm | Bft | m/s | km/h | kt)				o	•	•
Temperature (˚F | ˚C)		•	•	•	•	•
Wind Chill (˚F | ˚C)		•	•	•	•	•
Relative Humidity (%)		•	•	•	•	•
Heat Stress Index (˚F | ˚C)		•	•	•	•	•
Temperature-Humidity Index (THI)			•		•	•
Globe Temperature (˚F | ˚C)				•	•	
Naturally Aspirated Wet Bulb Temp (˚F | ˚C)				•	•	
Wet Bulb Globe Temperature (WBGT) (˚F | ˚C)				•	•	
Heat Load Index (HLI)					•	

o *optional*

MEASUREMENTS	Icon	5000 Environmental	5000AG Livestock	5400 HST	5400AG Cattle	5500AG
Accumulated Heat Load Units (AHLU)					•	
Dewpoint Temp (°F | °C)	DP	•	•	•	•	•
Wet Bulb Temp (°F | °C)	WB	•	•	•	•	•
Station Pressure (inHg | hPA | psi | mb)		•	•	•	•	•
Barometric Pressure (inHg | hPA | psi | mb)		•	•	•	•	•
Altitude(m | ft)		•	•	•	•	•
Density Altitude (m | ft)	DA	•	•	•	•	•
Delta T (°F | °C)	DT				•	•

FEATURES		5000 Environmental	5000AG Livestock	5400 HST	5400AG Cattle	5500AG
LiNK Connectivity & Kestrel LiNK Mobile App	N/A	o	o	o	•	o
Backlit Display switchable white or Night-Vision preserving red	N/A	•	•	•	•	•

o *optional*

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GETTING TO KNOW YOUR KESTREL

FRONT

BLACK GLOBE SENSOR*

ZONE ALERT LIGHT*

REPLACEABLE IMPELLER

TEMPERATURE SENSOR

Kestrel

SUNLIGHT READABLE DISPLAY

CAPTURE
BACKLIGHT

OPTIONS/EXIT

SELECT

SCROLL/ADJUST

LiNK

POWER

BACK

IMPELLER COVER

SERIAL NUMBER

HUMIDITY SENSOR

PRESSURE SENSOR

AA BATTERY (1)
(Lithium recommended)

BATTERY DOOR

DATA TRANSFER PORT

LANYARD ATTACHMENT

BATTERY DOOR LATCH
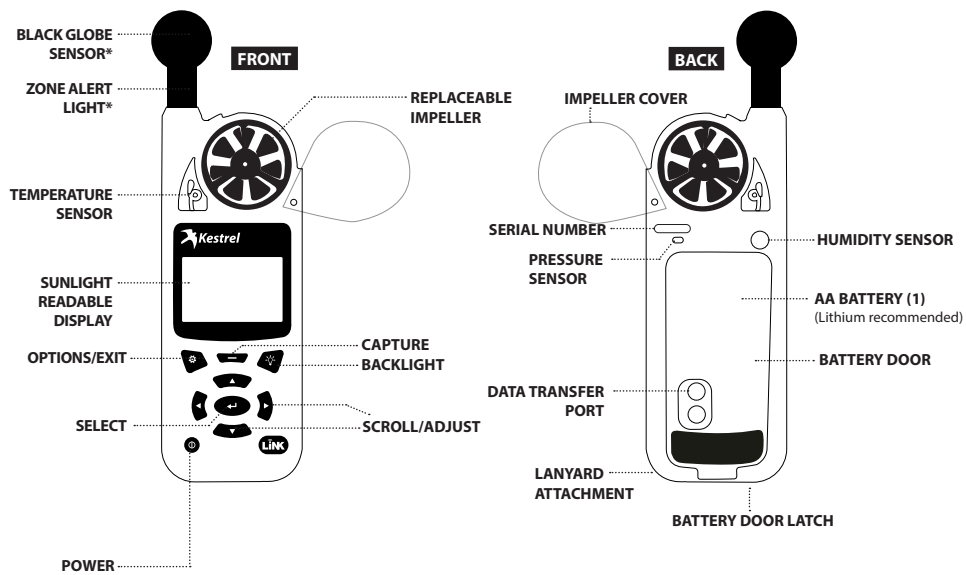
*Only available on 5400 meters

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BUTTONS

Button	Name	Function
⏻	POWER	Turns Kestrel on and off. Press for on, hold for two seconds to turn off.
⚙	OPTIONS/EXIT	Enter the main Options menu or exit a menu.
↵	SELECT	Access Settings on any measurement screen or select a menu option to enter its submenu or confirm a task.
▲▼	UP/DOWN	Scroll up and down through measurement screens or menus. Adjust values when entering text in name menus.
◀▶	LEFT/RIGHT	Scroll options left and right. Adjust values in combo menus and setting submenus.
▬	CAPTURE	In Weather Mode, manually capture all environmental values.
☼	BACK-LIGHT	Turn backlight on or off. (Also turns off automatically after one minute.)

KESTREL OPTIONS MENU

Most system-wide and weather setup options are accessed from the main Options menu by pressing the ⚙ button from any Weather Measurement Screen.

BLUETOOTH
  » Bluetooth On/Off
  » Conct
- **DATA PORT**
- **MEMORY OPTIONS**
  » Mem Used
  » Auto Store
  » Store Rate
  » Overwrite
  » Clear Log
- **GRAPH SCALE**
- **DISPLAY**
  » Auto Shutdown
  » Contrast
  » Backlight
  » Alerts
- **SYSTEM**
  » Time & Date
  » Compass Cal
  » Measurements
  » Units
  » Lang
  » Batt
  » Factory Restore
- **ABOUT**
  » Version
  » Legal

🗌 *Note! Not all features listed available on all units.*

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WEATHER MODE SCREENS

MORE MEASUREMENTS

Measurement & Icon | Units

| 🌡 Temp | °F |

76.5

↵ settings

🌡 Temp	°F
Min	40.8
Avg	67.5
Max	80.3

↵ start

Graph of Stored Data Log

| 🌡 Temp | °F |

↵ data

Data Point Scroll Bar
Data Point Value

| 🌡 | 69.3 |
| °F | |

25 June   4:48:31pm

Data Point Time Stamp
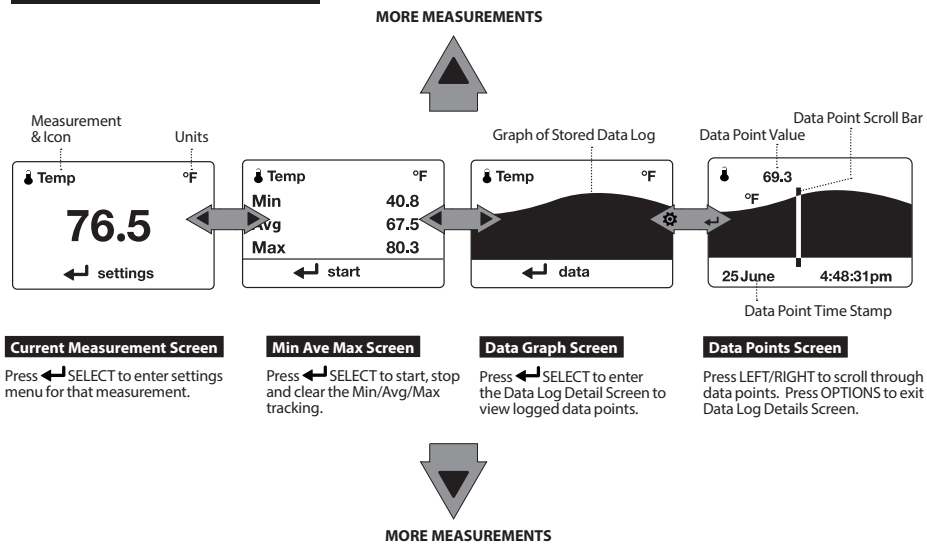
Current Measurement Screen

Press ↵ SELECT to enter settings menu for that measurement.

Min Ave Max Screen

Press ↵ SELECT to start, stop and clear the Min/Avg/Max tracking.

Data Graph Screen

Press ↵ SELECT to enter the Data Log Detail Screen to view logged data points.

Data Points Screen

Press LEFT/RIGHT to scroll through data points. Press OPTIONS to exit Data Log Details Screen.

MORE MEASUREMENTS

» The ▲▼ UP/DOWN buttons navigate between all weather measurements set to "On" in Options|Measurements.
» The ◀▶ LEFT/RIGHT buttons scroll between the three display screens for the measurement.

» The ⚙ OPTIONS button exits the **settings** submenu and Data Log Detail Screen.

KESTREL MENU NAVIGATION

TYPES OF MENU ITEMS

Task   **Go**
Submenu...
Setting   **On**
Combo Field...   **Yes▼**
⚙ **exit**   ◄►   **adjust**

Locked Value
Locked Value...
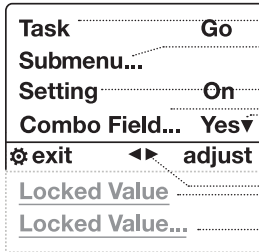
» Tasks are executed by highlighting the field and pressing Select.
» The presence of a submenu is indicated by a "…" following a field.
» Highlight the field and press Select to enter a submenu.
» Adjust a setting by pressing left or right.
» An arrow indicates there are additional fields off screen.
» Adjust the value of a Combo Field by pressing left or right.
» Enter the Combo Field sub menu by pressing select.
» Navigation buttons indicate available actions on the current screen.
» Locked values are either driven by another value or cannot be edited on the current screen.
» Locked values may have submenus which are entered by pressing select.

HLI MEASUREMENT SCREEN

🐂 **HLI**

79.2

MLA:Orange
↵ **settings**
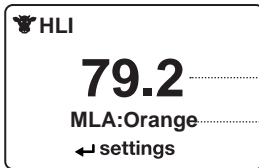
» HLI Measurement

» Selected Guideline: Current Zone

▢ *Note! While HLI and THI are measured in Fahrenheit and Celisius, the scale of both values is not comparable to standard temperature readings.*

AHLU MEASUREMENT SCREEN

🐄 **AHLU-86**

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MLA: Orange
↵ **settings**
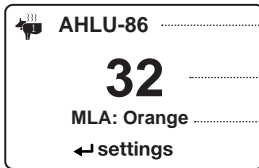
» HLI Upper Limit Threshold

» AHLU Measurement

» Selected Guideline: Current Zone

1. **INSTALL BATTERY.** Slide the battery door latch and open door. Insert the provided AA lithium battery as indicated by the label. Replace the battery door, ensuring it "clicks" fully into place.
2. **POWER ON KESTREL.** Press ⏻ to power on Kestrel.
3. **ENTER OPTIONS MENU.** Press ⚙ to enter the Options Menu.
4. **SET AUTO STORE RATE.** Scroll to and select **Memory Options**. Scroll to **Auto Store** and ensure it is set to **ON**. Scroll to **Store Rate** and adjust to desired frequency of automatic weather data logging.
5. **SET OVERWRITE.** Scroll to and select **Memory Options**. Scroll to **Overwrite** and set to **On** to allow the data log to wrap once full and to **OFF** to stop logging when full.
6. **SET GRAPH SCALE.** Scroll to and select **Graph Scale**. Scroll to and select the desired measurement type. Adjust the **Set High** and **Set Low** values to bound the desired display values.
7. **SET AUTO SHUTDOWN.** Scroll to and select **Display**. Scroll to **Auto Shtdwn** and choose a time window after which the Kestrel will shut down without any button presses.
8. **SET BACKLIGHT COLOR.** Scroll to and select **Display**. Scroll to **Backlight** and set to either **White** or **Red**. White is very bright and ideal for any dim light use. Red is reduced brightness and a wavelength selected to preserve adapted night vision for true dark operations.
9. **SET DATE AND TIME.** Scroll to and select **System**. Scroll to and select **Time & Date**. Adjust the time and date.
10. **CALIBRATE THE COMPASS.**
    Kestrel 5400AG and 5500AG Cattle Heat Stress Tracker Only

Scroll to and select **System**. Scroll to and select **Compass Cal**. Follow the on-screen instructions:
» Place the base of the Kestrel on a flat surface at least 3 feet from any large metal objects.
» Start the calibration routine. Rotate the Kestrel around its vertical axis 3 times,
keeping the unit as vertical as possible and taking approximately 10 seconds per full rotation. You may need to restart the routine a few times until you get the timing correct.
Note: When taking compass readings, keep the Kestrel as vertical as possible for maximum accuracy.

11. **TURN MEASUREMENT SCREENS ON/OFF.** Scroll to and select **System**. Scroll to and select **Measurements**. Set measurement screens to either **On** or **Off** as desired.
12. **SET UNITS.** Scroll to and select **System**. Scroll to and select **Units**. To change all units select **Global**, then set **Global to Imperial** or **Metric,** and then scroll to **Apply** and select **Go.** To set units individually, scroll to each measurement type in the **Units** submenu and set to the desired units. Units can also be set in the **Settings** menu for each measurement.
13. **SET LANGUAGE.** Scroll to and select **Lang.** Adjust to desired language: **English, Deutsche, Francais, Espanol.**

MEASURING AIR FLOW

Kestrel 5000AG and 5500AG Meters Only
Kestrel Meters can calculate air flow through a duct by combining user input information about the size and shape of the duct with the measured air velocity. In addition to reading the instantaneous Air Flow off the main measurement screen, a more accurate result may be obtained by capturing an average air flow on the Min/Ave/Max screen while traversing the duct. Capturing an average can be particularly helpful when measuring ducts with registers or dimensionally uneven air flow.

» From any current measurement screen, scroll to **AIR FLOW** and select **Settings.**
» Set Shape to match the shape of the duct, either **Rect** (rectangle) or **Circle**.
» Input the dimensions of the duct by setting **Length** and **Width** for a **Rectangle** or **Diameter** for a **Circle** duct and press **exit.**

MEASURING THI, HLI, AHLU, AND WBGT

1. **SELECTING THI AND HLI EQUATIONS.**
    1. Scroll to the THI Current Measurement Screen and press select.
    2. Set THI Model to either **NRC** or **YOUSEF** (see Glossary/THI Menu for definitions).
    3. Your Kestrel Cattle Heat Stress Tracker offers the blended HLI equation (see Glossary/HLI Menu for definitions).
2. **CONFIGURE HLI AND THI SETTINGS**
HLI Available in Kestrel 5400AG Cattle Heat Stress Tracker Only
    1. Scroll to HLI (or THI) Current Measurement Screen and press select.
    2. To use the colored HLI/THI zones or categories, scroll to **Zones** and set to **On**. The zones increase from White to Black in order of severity of risk of heat injury.
    3. To access a pre-saved HLI/THI guideline, scroll to **Zones**. . . and press select, then scroll to **Guide**. . . and press select. Follow the menu options to find your organizations suggested threshold guidelines for each zone. More detailed information on zones can be found in the Glossary/THI MENU and HLI MENU.
    4. For information on setting custom zone settings see page 16.
    5. **Light or buzzer alerts are available in the Kestrel 5400AG Cattle Heat Stress Tracker only.** To receive light or buzzer alerts when HLI or THI is above a zone threshold, scroll to and select **Alerts**. . . in the HLI/THI Settings menu. You may set **Light** and **Buzzer** individually. Selecting a zone for **Light** or **Buzzer**

will cause that alert to activate when conditions reach the threshold for the selected zone.

Warning: In addition to monitoring AHLU/HLI/THI values, please observe cattle for additional signs and symptoms of heat stress. Additional factors such as age, coat length, coat color, acclimation, health, and nutritional status interact with environmental factors and contribute to severity of heat stress on individual animals.

3. CONFIGURE AHLU SETTINGS
Kestrel 5400AG Cattle Heat Stress Tracker Only
Your Kestrel Cattle Heat Stress Tracker offers 3 AHLU screens. Each AHLU screen can be configured for different pen and cattle conditions.

1. Scroll to AHLU (1,2 or 3) Current Measurement Screen and press select.
2. Scroll to **Pen Management**. . . and press select. Default settings are set to "reference animal" as defined in the Glossary/AHLU Menu/Table 1. The reference animal has an HLI upper limit of 86. Set parameters for your pen conditions if they vary from reference animal. Set **Manure Class** based on your site's manure management practices (Glossary/AHLU Menu/ Table 2 and 3). Set **Shade** based on the amount of shade available calculated at midday per Standard Cattle Unit (Glossary/AHLU Menu/Table 4). Set **H2O Temp** based on the temperature of the water in the troughs (Glossary/AHLU Menu/Table

5). Set **Extra H2O** to **Yes** if extra water troughs are installed during heat events (Glossary/AHLU Menu/Table 6). Set **Heat Rations** to **Yes** if your site implements a feeding strategy for heat stress management (Glossary/AHLU Menu/Table 6). Set **Manure Clear** to **Yes** if your site implements strategic manure clearing of wet deposition areas during heat events (Glossary/AHLU Menu/Table 6).

3. Scroll to **Cattle Profile**. . . and press select. Default settings are set to "reference animal" as defined in the Glossary/AHLU Menu/Table 1. The reference animal has an HLI upper limit of 86. Set parameters for your herd conditions if they vary from reference animal. Set **Type** based on cattle breed (Glossary/AHLU Menu/ Table 7). Set **Coat** based on coat color (Glossary/AHLU Menu/Table 8). Set **Days** based on the number of days on feed for cattle (Glossary/AHLU Menu/Table 9). Set **Health** based on if cattle are healthy or sick/recovering/unacclimatised (Glossary/AHLU Menu/Table 10).

4. To use the colored AHLU zones or categories, scroll to **Zones** and set to **On**. The zones increase from White to Black in order of severity of risk.

5. To access a pre-saved guideline, scroll to **Zones**. . . and press select, then scroll to **Guide**. . . and press select. Follow the menu options to find your organizations suggested threshold guidelines for each zone. More detailed information on zones can be found in the Glossary/AHLU MENU.

6. For information on setting custom zone settings see **page 16**.

7. To receive light or buzzer alerts when AHLU is above a zone threshold, scroll to and select **Alerts**. . . in the AHLU Settings menu. You may set **Light** and **Buzzer** individually. Selecting a zone for **Light** or **Buzzer** will cause that alert to activate when conditions reach the threshold for the selected zone.

8. Repeat steps 1 and 7 for all AHLU screens.

❑ *Note: The AHLU Current Measurement Screen will display the HLI Upper Limit threshold based on the selected pen and cattle conditions as part of the icon. If varying pen and cattle conditions were selected, each AHLU Current Measurement Screen will display a different AHLU icon value.*

4. CONFIGURE WBGT SETTINGS.

Kestrel 5400AG Cattle Heat Stress Tracker Only

1. Scroll to the WBGT Current Measurement Screen and press select.

2. Set **Type** to either **Indoor** or **Outdoor**, depending on your environment.

3. To use the colored WBGT zones (also known as Flag Settings), scroll to **Zones**… and set to **On**. The zones increase from White to Black in order of severity of risk of heat injury.

4. To access one of the pre-saved WBGT guidelines, scroll to **Zones**… and press select, then scroll to Guide… and press select. Follow the menu options to find your organization's WBGT guidelines. If additional workload or clothing inputs are required, set **Workload** and **Clothing** to appropriate values for your situation.

5. For information on setting custom threshold flag settings see **page16**.

6. To receive light or buzzer alerts when WBGT is above a zone threshold, scroll to and select **Alerts**… in the WBGT Settings menu. You may set **Light** and **Buzzer** individually. Selecting a zone for **Light** or **Buzzer** will cause that alert to activate when conditions reach the threshold for the selected zone.

Warning: In addition to monitoring WBGT values, please refer to your state or organization's requirements for measuring WBGT, heat acclimatization guidelines, work/rest ratios and water consumption.

HOW TO MEASURE WBGT, AHLU, HLI and THI ACCURATELY:

» Differences in the reflectivity of ground surfaces such as grass or asphalt will impact measurements. Be sure to take measurements in the same solar/radiant heat environment as the people and animals you are monitoring.

» When changing environments (moving from an air conditioned room to outdoors or removing the unit from your pocket) the unit requires between 8-15 minutes to equilibrate to its surroundings before taking readings.

» Take measurements at least 3 feet off the ground and in the same wind or air flow conditions as the people or animals you are monitoring. Ensure the Kestrel is oriented into the wind and able to measure the full wind value. A tripod or pole mount and the Kestrel Rotating Vane Mount are ideal for ensuring accurate measurements.

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CUSTOM ZONE AND FLAG SETTINGS

If you do not wish to follow one of the WBGT, AHLU, HLI or THI guidelines pre-loaded into your Kestrel meter, you may set custom zones and zone thresholds. Your Kestrel allows you to activate and set up to six customized heat stress warning zones identified by color names on screen.

SETTING CUSTOM HEAT STRESS ZONES:
1. In the Settings Menu of the WBGT, AHLU, HLI or THI Current Measurement Screen, scroll to and select **Zones.**
2. Scroll to the colored zones you wish to edit and press select. Editing any value from a preset guideline in the Zone Settings Menu will automatically change the name of the guideline to **Custom.**
3. In the Zone submenu you can turn zones on or off by setting **Status** to **ON** or **OFF** as well as change the lower temperature bound of the zone by adjusting the **Threshold** value.
4. The threshold for a zone cannot be greater than the zone above or less than the zone below it.
5. Zone thresholds cannot be adjusted if the **Status** is set to **Off**.
6. If the **Status** of a zone is set to **OFF** and the thresholds of the zones above and below are set one tenth of a degree apart (the minimum resolution available) the **Status** of the intermediary zone cannot be set to **On**.

Warning: While the Kestrel LiNK app for mobile devices does have a threshold alerts feature, it does not currently synch with the zone thresholds set in the Kestrel 5400 which must be set separately.

MEASURING DIRECTION

Kestrel 5400AG and 5500AG Meters Only
» The Kestrel's compass is intended for measuring wind direction. The Kestrel must be held vertically with the back of the unit pointed towards the direction to be determined.
» Using the included Kestrel Vane Mount adjusted to level will provide the most accurate wind and direction measurements.

ALTIMETER AND BAROMETER

The Kestrel employs a stable, accurate pressure sensor to measure station pressure, the unadjusted air pressure in your location.

» To use your Kestrel to measure barometric pressure (station pressure adjusted for local elevation), you must enter a correct reference value for your altitude. Accurate barometric readings require that no elevation changes be made while taking measurements.

» To use your Kestrel to measure altitude changes (changes in station pressure associated with changes in elevation), you must enter a correct reference value for your starting barometric pressure. Accurate altitude readings depend on stable, weather related barometric air pressure while measurements are taken.

» Synched values between the Altitude and Barometer measurement screens allow reference value updates on either screen to automatically update reference values on the other.

❑ *Note! You cannot use your Kestrel as a barometer and altimeter simultaneously.*

SETTING REFERENCE VALUES ON BARO MEASUREMENT SCREEN:

» Scroll to the **Baro** measurement screen and select **Settings.**

» Adjust either the Altitude or the Barometric Pressure value to a local, known value obtained from a mapping reference, GPS, or accurate weather station in the same location.

SETTING REFERENCE VALUES ON ALTITUDE MEASUREMENT SCREEN:

» Scroll to the **ALTITUDE** measurement screen and select **Settings**.

» Adjust either the Altitude or the Barometric Pressure value to a local, known value obtained from a mapping reference, GPS, or accurate weather station in the same location.

❑ *Note! You should enter new reference values whenever you are using the Altimeter or Barometer functions and your reference value is no longer accurate (Ref Baro for Alt, Ref Alt for Baro) due to a change in weather or location.*

USING MIN/ AVG/ MAX

Pressing the right scroll button from any Current Measurement Screen will open the Min/Avg/Max Screen. The capture process is linked for all measurement screens, capturing Min/Avg/Max values on one measurement screen will capture Min/Avg/Max values over the same time period for all measurements. Each new Min/Avg/Max capture overwrites the previously captured value from all measurements.

CAPTURING MIN/AVG/MAX VALUES:

» Scroll to the Min/Avg/Max Screen of the desired measurement. This can be done by scrolling right from the desired Current Measurement Screen or scrolling vertically from another measurement's Min/Avg/Max Screen.
» Press Select to **Start** a new Min/Avg/Max capture.
» Press Select to **Stop** the capture period and view Min, Avg, and Max values.
» Press Select to **Clear** the Min/Avg/Max values.

CONNECTING TO DEVICES USING LINK

Your Kestrel can be connected wirelessly to other LiNK-compatible devices. LiNK is powered by *Bluetooth* Smart®, also known as *Bluetooth*® LE, which is available in most iOS devices released after 2014 and Android devices released after 2015, as well as in a USB Dongle available from Kestrel that supports connectivity to Windows and Mac OS devices. LiNK-enabled Kestrel units can connect to mobile devices running Kestrel LiNK to install firmware updates. LiNK-enabled units can be run wirelessly to computers using the Kestrel Dongle.

CONNECTING TO A COMPUTER, MOBILE PHONE OR TABLET:

» On your phone or tablet, follow the links at **www.kestrelinstruments.com** to locate Kestrel LiNK for iOS or Android in the App or Play store and install on your mobile device.

OR

» On your computer, follow the links and install on your computer. Insert your Kestrel USB Dongle (available separately) into an open USB port.
» On the Kestrel, open the Options Menu and select **Bluetooth**. Set **Bluetooth** to **On**.
» On your Kestrel select **Conct** from the Bluetooth Options menu and set to **PC/Mobile**. In **PC/Mobile mode,** the Kestrel's Status will change to **Available**, indicating that it is available for pairing with a computer or mobile device.

» Ensure the computer or mobile device is searching and in range. When **Status** changes from **Available** to **Connected**, the pairing is active and your Kestrel is ready to communicate.

CONNECTING TO A NEW LINK-COMPATIBLE DEVICE:

» Follow directions for your LiNK-compatible Device to power it on and put it in pairing mode.
» On the Kestrel, open the Options Menu and select **Bluetooth**. Set **Bluetooth** to **On**.
» Set **Conct** to **Device.**
» Scroll to **Name** and select **New**, then wait for the list of available devices in range to populate.
» Select a device from the available list. Once connected, the settings menu for that device will open, allowing you to manage the device's settings.
» Exit to the Bluetooth menu**. Status** should indicate **Connected**, meaning the pairing is active and your Kestrel is ready to communicate.

CONNECTING TO/ADJUSTING A PREVIOUSLY PAIRED LINK-COMPATIBLE DEVICE:

» Follow the directions for connecting to a new device except instead of selecting **New** in the **Name** field, scroll left or right to find the desired device.
» **Status** will change to **Searching**. If the device is in range and in active pairing mode, a connection will be made and **Searching** will change to **Connected,** indicating that the pairing is active and your Kestrel is ready to communicate.

Note! LiNK range is typically 100 ft/30M line of sight. Shorter distances should be expected if there are obstacles such as walls or metal enclosures. Range is also impacted by the signal strength of the other device.

CONNECTING TO COMPUTERS USING USB CABLE:
All Kestrel 5 Series units can connect to a computer via the Data Transfer Port using the USB Data Transfer Cable available separately. Kestrel LiNK software is available for Windows and Mac for downloading logged weather. data and installing firmware updates.

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CREATING, VIEWING, & EXPORTING DATA LOGS

In addition to taking live measurements, your Kestrel 5 Series weather meter is a powerful data logger. The Kestrel will automatically create a time stamped data log of all measurements at the logging interval you set. Additional log points can also be captured manually. Logged data can be accessed four ways:

» Viewed on the Kestrel Meter on the Data Graph Screen and Data Log Detail Screens.
» Exported to an iOS or Android mobile device using the Kestrel LiNK mobile apps available in the App Store and Google Play Store. Requires a Kestrel LiNK-enabled meter and a compatible Bluetooth® Smart/LE devices.
» Exported to a PC or Mac using Kestrel LiNK software and a Kestrel USB Dongle (available separately). Requires a Kestrel LiNK-enabled meter
» Exported to your Windows or Mac computer using Kestrel LiNK software and a Kestrel USB Data Transfer Cable (available separately). All 5 Series Kestrel meters can connect to Kestrel LiNK using a Kestrel USB Data Transfer Cable.

TURNING ON AND ADJUSTING AUTOMATIC DATA LOGGING:

» In the main Options menu, scroll to and select **Memory Options**. Scroll to and select **Auto Store** and set to **ON**. Scroll to **Store Rate** and adjust to desired frequency of automatic weather data logging.
» In the Memory Options sub menu scroll to **Overwrite** and set to **On** to allow the data log to wrap once full and **Off** to stop logging when full.
» When **Auto Store** is set to **On**, the Kestrel unit will automatically begin logging at the rate set in **Store Rate**.

MANUAL DATA LOGGING:

» Individual data points can be added to the log at any time by pressing the Capture button.
» Manual capture simply adds every measurement to the data log at the capture time/date.

VIEWING LOGGED DATA ON THE KESTREL METER:

» Scroll to the Graph Data Screen of the desired measurement. This can be done by scrolling right from the desired Current Measurement Screen or scrolling vertically from another measurement's Graph Data Screen.
» A graph of the most recently logged data points will be displayed and continue to grow at the selected store rate.
» To view individual data log points, or to view graph data older than what is shown in the Graph Data Screen, press Select to open the Data Log Detail Screen. Scrolling left or right will move the bar highlighting individual data points. Log values are shown in the upper left and the time stamp is shown along the bottom. Press Exit to return to the Graph Data Screen.
» To change the resolution of the graph, scroll to and select **Graph Scale** in the Options menu. Scroll to and select the desired measurement type. Adjust the **Set High** and **Set Low** values to bound the desired display values.

EXPORTING DATA LOGS TO A MOBILE DEVICE:

» Follow the links to locate Kestrel LiNK in the App or Play store and install on your mobile device.

» Follow the directions in the Kestrel LiNK app and in the section of this manual titled Pairing with a Computer, Mobile Phone or Tablet: to connect the mobile device to the Kestrel.

» The Kestrel's new logged data will automatically be added to the app's log whenever the devices are connected.

» To export logged data to a .csv file for further analysis, go to the **Stats** page of the app or the **Manage Data Logs** screen on the **Manage** page.

» Hit the **Export Data** button. Choose a method for exporting the data and follow the in-app prompts to send.

EXPORTING DATA LOGS TO A COMPUTER:

» Follow the links at **www.kestrelinstruments.com** to download Kestrel LiNK to a PC or Mac computer. Install.

Use one of the following two methods to connect your Kestrel to your computer.

1. **Connect your LiNK-enabled Kestrel Meter to your computer wirelessly:**
   » Purchase a Kestrel LiNK Dongle and install in your computer's USB port.
   » Follow the instructions in the "Pairing with a Computer, Mobile Phone or Tablet" section of

this manual along with the Kestrel LiNK program to pair the Kestrel and your computer.

2. **Connect your Kestrel 5 Series Meter to your computer using a Kestrel USB Data Transfer Cable:**

» Purchase a Kestrel USB Data Transfer Cable.

» In the main Options menu, scroll to and select **Data Port** and set to **On**.

» Insert the USB Data Transfer Cable into an open USB port and the Data Transfer Port on the back of the Kestrel unit.

Once connected

» Follow the directions in the Kestrel LiNK program to confirm the connection.

» In the Kestrel LiNK software, choose a data log from the Logs window and click on the Export to File button.

» Choose a file export directory on your computer and click on the Ok button.

WEATHER GLOSSARY

DIRECTION – Compass heading in true or magnetic

WIND SPD – Wind Speed is the measurement of the wind passing through the impeller. For greatest accuracy, point the back of the Kestrel directly into the wind.

CROSWND – Crosswind uses the internal compass and a user selected heading to calculate the crosswind component of the full wind.

HEADWND – Headwind uses the internal compass and a user selected heading or target direction to calculate the headwind component of the full wind.

TEMP – Ambient Temperature is the temperature measured at the thermistor. For best results, ensure the thermistor is not exposed to direct sunlight and is exposed to good airflow.

CHILL – Wind Chill is a calculated value of the perceived temperature based on temperature and wind speed.

HUMIDITY – Relative Humidity is the amount of moisture currently held by the air as a percentage of the total possible moisture that the air could hold.

HEAT INDEX – Heat Index is a calculated value of the perceived temperature based on temperature and relative humidity.

THI - The Temperature-Humidity Index (THI) is an index combining the effects of temperature and relative humidity to assess environmental heat stress on cattle and other livestock. It has been used for over 4 decades to manage heat stress in both dairy and beef cattle.

GLOBE TEMP – Globe Temperature is defined as the temperature measured inside a 6-inch copper globe painted black. On the Kestrel HST, the temperature inside the 1-inch|25 mm globe is converted to the equivalent temperature for a standard globe. The closest equivalence will be obtained with airflow greater than 2.2 mph|1 m/s.

NWB TEMP – Natural Wet Bulb Temperature is a measure of evaporative cooling in an environment with unforced, naturally occurring air flow.

WBGT – Wet Bulb Globe Temperature is a measure of human heat stress resulting from the combination of effects due to temperature, humidity, wind speed (wind chill), and visible and radiant heat. Outdoor WBGT is calculated from a weighted sum of Natural Wet Bulb Temperature, Globe Temperature and dry bulb Temperature.

HLI - Heat Load Index (HLI) is a measure incorporating black globe temperature (solar radiation), relative humidity, and wind speed. It was developed as an indicator of the environmental heat load on cattle.

AHLU - Accumulated Heat Load Units (AHLU) is a measure of accumulated heat by an animal above its HLI UPPER LIMIT threshold.

DEW POINT – Dew Point is the temperature at which water vapor will begin to condense out of the air.

WET BULB – Wet Bulb is the lowest temperature that can be reached in the existing environment by cooling through evaporation. Wet Bulb is always equal to or lower than ambient temperature.

STATION – Station Pressure (Absolute Pressure) is the pressure exerted by the earth's atmosphere at any given point.

BARO – Barometric Pressure is the local station (or absolute) pressure with the pressure differential associated with the locations altitude above sea level subtracted. An accurate reading depends on an accurate initial altitude input and unchanging altitude while measuring.

ALTITUDE – Altitude is the change in vertical distance associated with a change in atmospheric pressure. An accurate reading depends on an accurate initial barometric pressure input and stable barometric pressure while measuring.

DENS ALT – Density Altitude is the altitude at which the density of the theoretical standard atmospheric conditions (ISA) would match the actual local air density.

DELTA T – Delta T is the spread between the wet bulb temperature and the dry bulb temperature and is used to assess spraying conditions.

THI MENU

Your Kestrel Meter offers 2 accepted THI calculations. The NRC THI equation is defined as:

$THI = (1.8 \times Tdb +32) - [(.55 - .0055 \times RH) \times (1.8 \times Tdb-26)]$ (National Research Council, 1971) where Tdb is dry bulb temperature in °C and RH is relative humidity expressed as a %. This is the equation referenced by Ontario Ministry of Agriculture, Food, and Rural Affairs; Journal of Dairy Science; and the University of Arizona.

The YOUSEF THI equation is defined as:

$THI = Tdb + (0.36 \times Tdp) + 41.2$ (Yousef, 1985) where Tdb is dry bulb temperature in °C and Tdp is dew point temperature in °C. This is the equation referenced by Dairy Australia, University of Missouri, and USDA,

Zones - Preprogrammed zones available are:

LWSI (Livestock Weather Safety Index) zone thresholds:

Information provided from https://www.ars.usda.gov/ARSUserFiles/54380560/ Publications/Evora2004.pdf (verified Oct 2016)

Green THI ≤ 74	Red THI 79 - 83
Yellow THI 75 - 78	Black THI ≥ 84

Dairy (Revised Temperature-Humidity Index for Lactating Dairy Cows) zone thresholds**:**

Information provided from http://dairy.ifas.ufl.edu/rns/2012/6CollierRNS2012a. pdf (verified Oct 2016)

Green THI < 68	Red THI 80 - 89
Yellow THI 68 - 71	Black THI ≥ 90
Orange THI 72 - 79	

DairyAU (Dairy Australia) zone thresholds:
Information provided from http://www.coolcows.com.au/go-on-alert/thi.htm (verified Oct 2016)

Green THI < 72	Red THI 78 - 81
Yellow THI 72 - 74	Black THI ≥ 82
Orange THI 75 - 77	

Additional features found in Kestrel 5400AG Cattle Heat Stress Tracker Only

Alerts - Light and/or Buzzer alerts can be set to **ON** by selecting appropriate zone.

Your Cattle Heat Stress Tracker offers the blended HLI equation which is defined as:HLI = S(BGT) * HLIHI + (1 – S(BGT)) * HLILO.
BGT is defined as Black Globe Temp in °C (measured as Globe Temperature in your Kestrel). RH is defined as relative humidity expressed as %. WS is defined as Wind Speed in m/s. The blending function is defined as:
S(BGT) = 1 / (1 + exp(-(BGT – 25) / 2.25))
HLIHI and HLILO are defined as:
if (BGT is below 25) then
HLILO = 1.3 x BGT + 0.28 x RH – WS + 10.66
else
HLIHI= 1.55 x BGT + 0.38 x RH – 0.5 x WS + exp (2.4 – WS) + 8.62

Where * exp is the exponentiation function and the HLI value was taken as either HLIHI or HLILO depending on the BGT value.

Zones - Preprogrammed zones available are:

MLA (Meat & Livestock Australia Ltd) zone thresholds:
Information provided from B.FLT.0344 Meat & Livestock Australia Ltd., published December 2008 (verified Oct 2016)

Green HLI ≤ 70	Red HLI 86.1 - 95
Yellow HLI 70.1 - 77	Black HLI > 95
Orange HLI 77.1 - 86	

Alerts - Light and/or Buzzer alerts can be set to ON by selecting appropriate zone.

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AHLU MENU

The default AHLU setting uses an HLI Upper Limit Threshold of 86 based on a reference animal defined as:

Table 1: Reference Animal

Parameter	Value
Cattle type	Bos taurus
Coat Color	Black
Health status	Healthy
Days on feed	80-130
Shade provision	No shade
Trough water temperature	20-30°C
Manure management class	Class 1
Extra water troughs installed	No
Heat load ration	No
Wet manure removal	No

86 is the HLI Upper Limit Threshold and the point when cattle with the above characteristics may start to accumulate heat. Users can modify pen and cattle characteristics by varying parameters within the 3 AHLU screens.

Information provided from: http://chlt.katestone.com.au/help/risk-analysis-program-rap/

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Pen Management - the following pen management parameters can be adjusted based on site conditions and will result in the noted HLI Upper Limit Threshold adjustment.

Table 2: Manure Class

Criteria - Feedlots were previously subject to a 4-tiered classification scheme (classes 1-4) in Australia. In the future, all new or expanding feedlots are expected to operate at the equivalent of a Class 1.	Class 1 (Best Mgt Practices)			Class 2			Class 3 & 4		
Pen Foundation Preparation	Compacted base with uniform slope built in			Compacted base with uniform slope built in			Strip topsoil and grade to a durable uniform surface		
Pen Slope	2.5 - 4% away from feeding area			2.5 - 4% away from feeding area			2 - 6% away from feeding area		
Stocking Density (a measure of stocking intensity expressed in terms of m2/SCU)	10	15	20	10	15	20	10	15	20
Maximum Manure Removal Interval (weeks)	7	10	14	14	20	26	26		
Maximum Manure Pack Depth (mm)	50			100			200		
Under Fence Cleaning	monthly			quarterly			at each pen cleaning		
Eliminate Wet Patches	weekly			monthly			at each pen cleaning		
Repair Potholes	weekly			monthly			6 months		

Information provided from: http://chlt.katestone.com.au/help/risk-analysis-program-rap/

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Table 3: Manure Class HLI Adjustments

Manure Management	HLI Adjustment
Class 1	0
Class 2	-4
Class 3 & 4	-8

Table 4: Shade

Shade Provision	HLI Adjustment
No Shade	0
Shade (1.5m2/SCU – 2m2/SCU) or (16 ft2/SCU - 21 ft2/SCU)	+3
Shade (2m2/SCU – 3m 2/SCU) or (21ft2/SCU - 32 ft2/SCU)	+5
Shade (3m2/SCU – 5m2/SCU) or (32 ft2/SCU - 54 ft2/SCU)	+7

SCU = A Standard Cattle Unit (SCU) is equivalent to an animal with a liveweight of 600 kg (1,323 lbs).

Table 5: H2O Temp

Trough Water Temperature	HLI Adjustment
Temperature of water in troughs = 15 – 20°C (59-68°F)	+1
Temperature of water in troughs = 20 – 30°C (68 - 86°F	0
Temperature of water in troughs = 30 – 35°C (86 - 95°F)	-1
Temperature of water in troughs > 35°C (>95°F)	-2

Table 6: Extra H2O, Heat Rations, and Manure Clear as mitigation measures for heat load events

Mitigation Measure	HLI Adjustment
Install Extra Water Troughs	+1
Implement Heat Load Feeding Strategy	+2
Strategic Clearing of High Manure Deposition Areas	+2

❑ *Installing extra water troughs HLI adjustment only takes effect on upper limit threshold if no shade is provided when determining the HLI Upper Limit Threshold*

Cattle Profile - the following cattle profile parameters can be adjusted based on herd characteristics and will result in the noted HLI Upper Limit Threshold adjustment.

Table 7: Type

Genotype	HLI Adjustment
Bos Taurus Genotypes	0
Bos Indicus Cross (25%)	+4
Bos Indicus Cross (50%)	+7
Bos Indicus Cross (75%)	+8
Bos Indicus Genotypes	+10
Wagyu	+4
European Genotypes	+3

Table 8: Coat

Coat Color	HLI Adjustment
Black Coat Color	0
Red Coat Color	+1
White Coat Color	+3

Table 9: Days

Days on Feed	HLI Adjustment
Days on Feed (0-80)	+2
Days on Feed (80-130)	0
Days on Feed (130+)	-3

Table 10: Health

Health Status	HLI Adjustment
Healthy	0
Sick/Recovering/Unacclimatised	-5

Manual Offset - The Manual Offset function allows users to adjust their AHLU value in increments of 10. User must select Apply for AHLU to include the Manual Offset value.

Zones - Preprogrammed zones available are:

MLA Meat & Livestock Australia Ltd) zone thresholds:
Information provided from B.FLT.0344 Meat & Livestock Australia Ltd., published December 2008 (verified Oct 2016)

White AHLU = 0	Red AHLU 50.1 - 100
Green AHLU .1 - 10	Black AHLU > 100
Yellow AHLU 10.1 - 25	
Orange AHLU 25.1 - 50	

Alerts - Light and/or Buzzer alerts can be set to ON by selecting appropriate zone.

IMPELLER REPLACEMENT

❏ *Press only the sides of the impeller when removing and inserting to avoid damaging the precision hub bearing. [Figure 1] .*

» Press FIRMLY on the impeller module to remove it.

» Insert the new impeller so the side that has the small triangle (close to the perimeter) faces the front of the Kestrel when installed.

Figure 1

» Orient one "arm" of the module straight up .
[Figure 2]. The impeller can be pushed in from either side.

Figure 2

WARRANTY CERTIFICATE

Your Kestrel Weather/Environmental Meter is warrantied to be free of defects in materials and workmanship for a period of FIVE YEARS from the date of its first consumer purchase. NK will repair or replace any defective meter or part when notified within the warranty period, and will return the meter via domestic ground shipping or NK's choice of method of international shipping at no charge. The following are excluded from warranty coverage: damage due to improper use or neglect (including corrosion); damage caused by severe or excessive impact, damage caused by failed or leaking batteries, crushing or mechanical harm; modifications or attempted repairs by someone other than an authorized NK repair agent; impeller failure not caused by a manufacturing defect; normal usage wear and failed batteries. Measurement accuracy is warranted to be within the specifications on the supplied Certificate of Conformity including specified drift since date of manufacture. If no warranty registration or proof of purchase is provided, the warranty period will be measured from the meter's date of manufacture.

Except for the warranties set forth herein, NK disclaims all other warranties, expressed, implied or statutory, including, but not limited to, the implied warranties of merchantability or fitness for a particular purpose. Any implied warranties that may be imposed by applicable law are limited to the term of this warranty. In no event shall NK be liable for any incidental, special or consequential damages, including, but not limited to, loss of business, loss of profits, loss of data or use, whether in an action in contract or tort or based on a warranty, arising out of or in connection with the use or recalibration, performance of an NK product, even if NK has been advised of the possibility of such damages. You agree that repair, and (upon availability) replacement, as applicable, is your sole and exclusive remedy with respect to any breach of the NK Limited Warranty set forth herein.

All product liability and warranty options are governed exclusively by the laws of the Commonwealth of Pennsylvania.

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