

QUESTemp° 32

Thermal Environment Monitor

Operator's Manual

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TABLE OF CONTENTS

| | |
|--|-----------|
| 1. UP AND RUNNING | 4 |
| 2. MEASUREMENTS..... | 5 |
| QUESTEMP ^{°32} | 5 |
| WET BULB GLOBE TEMPERATURE..... | 5 |
| HEAT INDEX / HUMIDEX | 5 |
| 3. KEYPAD OPERATION | 6 |
| I/O ENTER | 6 |
| UP ARROW | 6 |
| DOWN ARROW | 6 |
| SETUP | 6 |
| 4. DISPLAYED ITEMS | 6 |
| 5. SENSORS..... | 7 |
| NATURAL WET BULB THERMOMETER..... | 7 |
| GLOBE THERMOMETER | 7 |
| DRY BULB THERMOMETER..... | 8 |
| RELATIVE HUMIDITY SENSOR | 8 |
| 6. REMOTE, SENSORS 2 AND 3..... | 8 |
| TRI-SENSOR WEIGHTED AVERAGE | 8 |
| 7. OPERATIONAL CHECK | 9 |
| 8. POWER OPTIONS | 9 |
| 9 VOLT ALKALINE BATTERY REPLACEMENT | 10 |
| APPROVED 9 VOLT BATTERIES | 10 |
| NiMH BATTERY PACK..... | 11 |
| 9. USING THE QUESTEMP | 11 |
| 10. SPECIFICATIONS | 12 |
| 11. PRODUCT MARKINGS AND SPECIAL CONDITIONS | 14 |
| 12. APPENDIX A : HEAT EXPOSURE TABLES..... | 15 |
| 13. APPENDIX B : ACCESSORIES..... | 16 |
| 14. QUEST SERVICE AND WARRANTY POLICY | 17 |

1. UP AND RUNNING

1. Make sure the wet bulb's wick is clean. Fill the reservoir with distilled water.
2. Place the QUESTemp in the work area in a safe location approximately 3.5 feet off the ground.
3. Turn the unit ON. If the battery voltage displayed during the power-on sequence is less than or equal to 6.4 volts, replace or recharge the batteries.
4. Use the arrow keys to set the display to the desired items.
5. Allow 10 minutes for the sensors to stabilize to the environment before taking readings.

2. MEASUREMENTS

QUESTemp°32

The QUESTemp°32 portable area heat stress monitor computes the Wet Bulb Globe Temperature (WBGT). The WBGT is an accepted measurement for determining the heat stress level imposed on an individual in a given environment. The QUESTemp°32 measures three parameters: ambient or dry bulb temperature (DB), natural wet bulb temperature (WB), and globe temperature (G).

In addition to the WBGT, the QUESTemp°32 measures relative humidity (RH) and computes the Heat Index (HI) or Humidex. The QUESTemp°32, using inputs on the side of the instrument, has the ability to connect to two additional sensor arrays for monitoring up to three locations simultaneously.

WET BULB GLOBE TEMPERATURE

The WBGT is a weighted average of the three temperature sensors using the following formulas:

$$\text{WBGT (indoor)} = 0.7\text{WB} + 0.3\text{G}$$

$$\text{WBGT (outdoor)} = 0.7\text{WB} + 0.2\text{G} + 0.1\text{DB}$$

The resulting WBGT can then be compared to published charts showing the allowable work-rest regimens (stay-times) for given work loads. Appendix A of this manual shows the table published by the ACGIH.

HEAT INDEX / HUMIDEX

The Heat Index is determined using the dry bulb temperature and relative humidity. Based upon charts available from the U.S. National Weather Service, Heat Index represents how an average person feels relative to climate conditions. For a constant temperature, if the humidity rises, so does the heat index.

The Heat Index is defined over a temperature range of 70°F - 120°F (21°C - 49°C) and a relative humidity range of 30% - 99%. Outside of this range, the instrument will show dashes in the display for the Heat Index.

The Humidex is used primarily in Canada and is very similar to the Heat Index. The values are slightly different. The Humidex is defined over a temperature range of 70°F - 109°F (21°C - 43°C) and a relative humidity range

of 20% - 99%. Outside of this range, the instrument will show dashes in the display for the Humidex.

3. KEYPAD OPERATION

The unit operates using a membrane keypad with 4 keys. The I/O ENTER key responds when the key is released while all other keys respond when the key is pressed.

I/O ENTER

The unit turns on with a single key press. The unit turns off by holding the key down while a countdown of 3-2-1 occurs in the lower right corner of the display. This key is also used to enter setup changes.

While viewing live readings, pressing and releasing the key will cause the display to view the next available sensor bar (indicated in the upper right corner of the display).

UP ARROW

Changes which items appear in the display. Scrolls up.

DOWN ARROW

Changes which items appear in the display. Scrolls down.

SETUP

Allows changing the setup parameters. Three parameters are available: Celsius or Fahrenheit, the language, and Heat Index or Humidex. Press setup to access the parameters. Use the arrow keys to switch between the two parameters. Use the enter key to change the parameters. Press setup again to exit.

4. DISPLAYED ITEMS

| | | |
|-----|--------|----|
| WET | 80.5°F | <1 |
| DRY | 92.2°F | |

The number in the upper right corner indicates which sensor bar's data is displayed. 1 indicates the sensor bar placed on (or attached to) the top of the instrument. Sensors 2 and 3 are labeled on the side of the unit. W indicates

the weighted average which only appears if a WBGT is displayed and all three sensor bars are attached.

The following measurements can be accessed on the display:

- Screen 1: WET (WET BULB)
 DRY (DRY BULB)
- Screen 2: GLOBE
- Screen 3: WBGTi (WBGT INDOORS)
 WBGT_o (WBGT OUTDOORS)
- Screen 4: RH (Relative Humidity)
 H.I. (Heat Index) or Humidex
- Screen 5: BAT (BATTERY VOLTAGE)

A series of dashes appear in the display if one of the following occur:

- the Heat Index or Humidex is outside of its allowable range
- the temperature is outside of its allowable range
- a temperature sensor has failed

5. SENSORS

NATURAL WET BULB THERMOMETER

The natural wet bulb thermometer gives an indication of the effects of humidity on an individual. Relative humidity and air flow are taken into account by measuring the amount of evaporative cooling taking place at a thermometer covered with a moistened wick. The QUESTemp uses a cotton wick immersed into a reservoir containing distilled water. Ordinary tap water should not be used, as the contaminants that are left behind after evaporation will shorten the life of the wick and cause high readings. If the wick is discolored it should be replaced. To replace the wick, slide the old wick off the top of the sensor. Place a new wick over the sensor, making sure that the bottom of the wick is down in the reservoir.

GLOBE THERMOMETER

The globe thermometer gives an indication of the radiant heat exposure on an individual due to either direct light or hot objects in the environment. This is accomplished by placing a temperature sensor inside a blackened

copper sphere and measuring the temperature rise. The WBGT index is based on the response of a 6 inch diameter globe. The QUESTemp uses a 2 inch diameter globe for a faster response time. The temperature of the 2 inch globe is correlated to match that of a 6 inch globe.

As an option, a sensor array with a 6 inch diameter globe is available.

DRY BULB THERMOMETER

The dry bulb thermometer measures the ambient air temperature. This measurement is used in the outdoor WBGT calculation when a high solar radiant heat load may be present. The series of white plates surrounding the sensor shield it from radiant heat.

RELATIVE HUMIDITY SENSOR

A relative humidity sensor is located in a compartment inside of the sensor bar housing. Slots in the housing allow air to circulate around the sensor.

6. REMOTE, SENSORS 2 AND 3

The top sensor bar (sensor 1) may be removed from the instrument and used through a remote cable. Shelter the instrument and remote the sensor bar if the measured environment is expecting heavy rain or if temperatures are above 60°C.

The sensor 2 and sensor 3 jacks on the side of the instrument allow simultaneous monitoring of up to three sensor arrays using connecting cables.

Cable lengths of up to two hundred feet (61 meters) may be used without a decrease in accuracy provided the environment does not contain strong electromagnetic fields.

The data from these arrays may be viewed separately or combined into a weighted average WBGT reading per ISO 7243. Change the displayed sensor bar by pressing and releasing the enter key. The upper right corner of the display shows the current sensor bar. 1 refers to the top sensor bar, 2 and 3 are labeled on the side of the unit, W indicates the weighted average which only appears if a WBGT is displayed and all three of the sensor bars are attached.

TRI-SENSOR WEIGHTED AVERAGE

Per the recommendations outlined in ISO 7243 : 1989, when the temperature in the space surrounding a worker is not uniform, it is necessary to determine

the WBGT index at three heights corresponding to the worker's ankles, abdomen and head and perform a weighted average on those values. It is computed using the formula:

$$WBGT_w = (WBGT_{head} + (2 \times WBGT_{abdomen}) + WBGT_{ankles})/4$$

The QUESTemp always assigns the top sensor bar the double weighting. This calculation is shown if a WBGT display has been selected and if 3 sensor sets are connected.

7. OPERATIONAL CHECK

A verification module, Quest model 054-544, may be used to check the operation of the QUESTemp. Remove the top sensor bar and plug the verification module into the top of the unit. With the QUESTemp set to read in degrees Celsius, verify that the displayed readings match those printed on the module within $\pm 0.5^{\circ}\text{C}$.

If the readings are not within the $\pm 0.5^{\circ}\text{C}$ tolerance, then have the unit serviced and calibrated.

8. POWER OPTIONS

There are 3 options for powering the QUESTemp: a 9 volt alkaline battery, a NiMH (Nickel Metal Hydride) rechargeable 6-cell battery pack, and an AC adapter. A door on the back of the unit allows the user access to the 9 volt battery. The rechargeable battery pack is located inside of the unit. If the rechargeable battery pack ever needs to be replaced, it can be accessed by removing the screws from the bottom panel of the unit.

The 2-position switch located in the battery compartment must be set by the user if the power supply method is changed. The up position is for the 9 volt battery. The down position allows for either the AC adapter or the rechargeable batteries. The AC adapter will trickle charge the rechargeable batteries if they are in place or it will simply allow for line power operation of the unit.



9 VOLT ALKALINE BATTERY REPLACEMENT

WARNING: Replace batteries only in a non-hazardous environment.

The 9 volt battery should be replaced or the NiMH battery pack should be recharged when the voltage drops below 6.4 volts. The battery voltage is displayed when the instrument is turned on. While turned on, the battery voltage can be displayed at any time by pressing the up or down arrow keys to move through the display until the battery voltage screen appears. If, while operating, the battery voltage drops below 6.4 volts, the display will automatically switch to the display showing the battery voltage along with a low battery message. After a low battery occurs, the unit will continue to operate for approximately 8 hours. When the battery voltage falls to 6.2 volts or below, the unit will automatically turn off.

Replace only with an approved 9 volt alkaline battery.

APPROVED 9 VOLT BATTERIES

Eveready: Energizer 522, EN22, 6LR61

Duracell: MN1604

Panasonic: 6LR61, 6AM6X

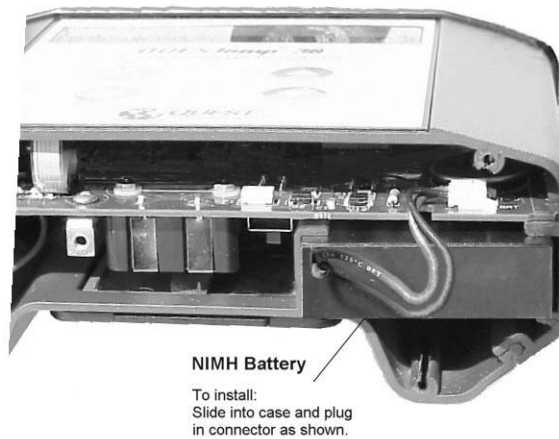
Rayovac: A1604

UltrLife: U9V

NiMH BATTERY PACK

WARNING: *Recharge batteries only in a non-hazardous environment.*

The NiMH rechargeable battery pack is charged in the instrument using Quest's AC adapter #015-910. A discharged battery pack requires an "overnight" charge of 16 hours. Leaving the AC adapter plugged in for extended lengths of time or when operating the instrument will not harm the rechargeable batteries.



9. USING THE QUESTEMP

The QUESTemp should be placed at a height of 3.5 feet (1.1m) for standing individuals or 2 feet (.6m) for seated individuals. Tripod mounting is recommended to get the unit away from anything that might block radiant heat or airflow. A 1/4"x20 threaded bushing on the bottom of the instrument allows mounting to a standard photographic tripod. Do not stand close to the unit during sampling.

Make sure that the wet bulb reservoir is filled with distilled water and that the cotton wick is clean and fully wetted. After adding water or placing the unit in a new environment, allow ten minutes for the globe and wet bulb readings to stabilize.

10. SPECIFICATIONS

Measurements:

Globe, dry bulb, wet bulb, WBGT_{in}, WBGT_{out}, WBGT weighted average (if 3 sensor sets), relative humidity, Heat Index, Humidex.

Temperatures given in Celsius or Fahrenheit.

Languages:

English, French, Spanish, Italian, German

Housing:

Designed water resistant to a light rain or mist. If rain is frequent, best practice would be to remote the sensor bar and keep the instrument sheltered.

Size:

Height 9.2in (23.5cm); Width 7.2in (18.3mm); Depth 3.0in (7.5mm)
Dimensions include mounted sensor assembly

Weight:

2.6 lbs. (1.2 kg) with mounted sensor assembly

Sensor Types:

Temperature: 1000 ohm platinum RTD

Humidity: Integrated circuit with capacitive polymer sensor

Accuracy:

Temperature: +/-0.5°C between 0°C and 100°C

Relative Humidity: +/-5%

Operating Temperature Range:

Sensor Assembly: -5°C to +100°C

Electronics: -5°C to 60°C

Operating Relative Humidity Range:

0 to 100% (extended exposure to humidity > 90% can cause a reversible shift of 3%)

Remote Sensor Bars:

2 x 15pin D-sub jacks are located on the side of the unit for plugging in 1 or 2 additional sensor bars by using remote cables up to 200 feet (61m). The top sensor bar can also be remote with a cable.

Power Options:

9V alkaline, 7.2V NiMH rechargeable pack (charged in the unit), or AC adapter wall power cube (AC adaptor will operate the unit or recharge the NiMH battery pack)

Battery Life:

9V alkaline: 140 hours

Rechargeable Nickel Metal Hydride: 300 hours

(Adding additional sensor bars reduces battery life.)

Charge Time (NiMH Battery Pack):

16 hours (charge in the unit)

Safety Approvals:

ETL, cETL: Class I,II,III Groups A,B,C,D,E,F,G, Temperature code T3

KEMA 04ATEX1072 X <Ex> II 2 G EEx ia IIC T3

CE mark

11. PRODUCT MARKINGS AND SPECIAL CONDITIONS

KEMA 04ATEX1072 X
<Ex> II 2 G EEx ia IIC T3

Compliance with Essential Health and Safety Requirements has been assured by compliance with: EN 50014 : 1997 and EN 50020 : 2002

The year of manufacture is determined by the third character in the instrument's serial number. "A" was manufactured in 2001, "B" in 2002, "C" in 2003, "D" in 2004 and so forth.

Special conditions for safe use:

1. Only the following battery types may be used:

Non-rechargeable battery:

| <u>Type</u> | <u>Manufacturer</u> |
|----------------------|---------------------|
| U9V | Ultralife |
| MN1604 | Duracell |
| 522 or EN22 or 6LR61 | Energizer |
| A1604 or BR232 | Rayovac |
| 6LR61 or 6AM6 | Panasonic |

Rechargeable battery:

Integral NiMH battery pack type DC2121.

2. The batteries may not be replaced or charged within the hazardous area.
3. The rechargeable battery may only be recharged with class 2 charger, rated 9Vdc, 1 A max.
4. The plugs or sockets marked "SENSOR 2" and "SENSOR 3" may not be used within the hazardous area.

12. APPENDIX A : HEAT EXPOSURE TABLES

ACGIH

Screening Criteria for Heat Stress Exposure. WBGT values in °C (°F).

Acclimatized

| <u>Work Demands</u> | <u>Light</u> | <u>Moderate</u> | <u>Heavy</u> | <u>Very Heavy</u> |
|-----------------------|----------------|-----------------|----------------|-------------------|
| 100% Work | 29.5 (85.1) | 27.5 (81.5) | 26.0 (78.8) | |
| 75% Work; 25% Rest | 30.5 (86.9) | 28.5 (83.3) | 27.5 (81.5) | |
| 50% Work; 50% Rest | 31.5 (88.7) | 29.5 (85.1) | 28.5 (83.3) | 27.5 (81.5) |
| 25% Work; 75% Rest | 32.5 (90.5) | 31.0 (87.8) | 30.0 (86.0) | 29.5 (85.1) |

Unacclimatized

| <u>Work Demands</u> | <u>Light</u> | <u>Moderate</u> | <u>Heavy</u> | <u>Very Heavy</u> |
|-----------------------|----------------|-----------------|----------------|-------------------|
| 100% Work | 27.5 (81.5) | 25.0 (77.0) | 22.5 (72.5) | |
| 75% Work; 25% Rest | 29.0 (84.2) | 26.5 (79.7) | 24.5 (76.1) | |
| 50% Work; 50% Rest | 30.0 (86.0) | 28.0 (82.4) | 26.5 (79.7) | 25.0 (77.0) |
| 25% Work; 75% Rest | 31.0 (87.8) | 29.0 (84.2) | 28.0 (82.4) | 26.5 (79.7) |

from "American Conference of Governmental Industrial Hygienists - Threshold Limit Values and Biological Exposure Indices for 2001"
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13. APPENDIX B : ACCESSORIES

| | |
|---------------------------------------|--------|
| Sensor array with 2 inch globe | 56-795 |
| Sensor array with 6 inch globe | 56-780 |
| 6 Foot shielded remote sensor cable | 53-924 |
| 25 Foot shielded remote sensor cable | 53-925 |
| 100 Foot shielded remote sensor cable | 53-926 |
| 200 Foot shielded remote sensor cable | 53-927 |
| 120VAC to 9VDC adapter | 15-910 |
| 220VAC to 9VDC adapter | 15-680 |
| Verification module | 53-923 |
| Tripod | 59-045 |
| Replacement wicks | 56-679 |
| Water bottle 2 oz. | 56-068 |
| User's manual | 56-661 |

14. QUEST SERVICE AND WARRANTY POLICY

Service Information

Congratulations! You have purchased one of the finest instruments available, manufactured by one of the most respected names in safety & industrial hygiene instrumentation. Your instrument is backed by a limited warranty that seeks complete customer satisfaction. Should your instrument require service for any reason, you can expect prompt and courteous attention.

You must obtain a return authorization prior to shipment. We reserve the right to refuse any shipments forwarded without prior authorization. **The following information will expedite the service process and is required when obtaining return authorization:**

1. Model and serial number of each instrument.
2. Description of work required and symptoms of any failures for each instrument.
3. VISA, MasterCard or American Express credit card -- or -- company purchase order number (non-warranty service only).
4. Billing and/or return shipping addresses.

Use one of the methods below to obtain return authorization, service pricing and shipping instructions.

Warranty Policy

Quest Technologies warrants our instruments to be free from defects in materials and workmanship for one year under normal conditions of use and service. For U.S.A. customers, we will replace or repair (our option) defective instruments at no charge, excluding batteries, abuse, misuse, alterations, physical damage, or instruments previously repaired by other than Quest Technologies. Microphones, sensors, printers, and chart recorders may have shorter warranty periods. This warranty states our total obligation in place of any other warranties expressed or implied. Our warranty does not include any liability or obligation directly resulting from any defective instrument or product or any associated damages, injuries, or property loss, including loss of use or measurement data.

For warranty outside the U.S.A., a minimum of one year warranty applies subject to the same limitation and exceptions as above with service provided or arranged through the authorized Quest sales agent or our Quest European Service Laboratory. Foreign purchasers should contact the local Quest authorized sales agent for details.