

hs-32

Area Heat Stress Monitor

Operator's Manual

Thank you for choosing Metrosonics to meet your heat stress measuring needs. The Metrosonics hs-32 area heat stress monitor is a lightweight easy-to-use instrument. It is our goal to make your decision to purchase a Metrosonics brand product the right one, and to provide support for any questions or concerns that might arise.

The purpose of this manual is to provide the user with all the necessary information to operate the hs-32 area heat stress monitor. The entire manual should be read to fully understand the many features this instrument offers.

This manual is not all-inclusive and cannot cover all unique situations. In addition no warranties are contained in this manual except as described under the warranty policy section.

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Revision C
P/N 053-192*



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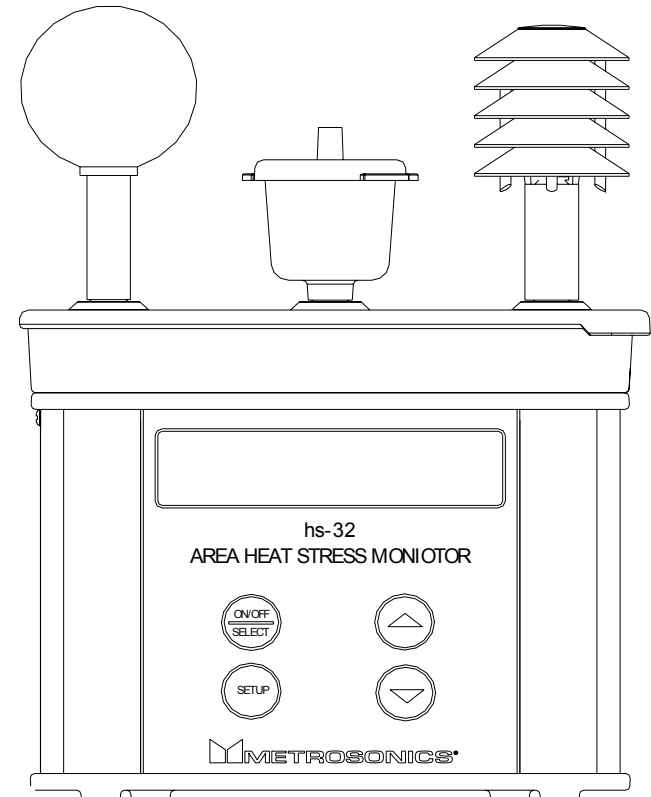
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1 Up and Running

- 1) Make Sure the bulb's wick is clean. Fill the reservoir with distilled water.
- 2) Place the hs-32 in the work area to be monitored 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 ten minutes for the sensors to stabilize to the environment before taking readings.



2 Measurements

The hs-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 hs-32 measures ambient or dry bulb temperature (DB), natural wet bulb temperature (WB) and globe temperature (G).

In addition to the WBGT, the hs-32 also measures relative humidity (RH) and computes the Heat Index (HI) or Humidex. The hs-32, using inputs on the side of the instrument, has the ability to accept 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 ACGIH.

Heat Index / Humidex

The Heat Index is determined using the dry bulb temperature and relative humidity. It is based upon charts available from the U.S. National Weather Service. The Heat Index represents how an average person feels relative to climate conditions. For a given temperature, the higher the humidity, the higher 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 display will show dashes in the display for 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 On/Off Select key responds when the key is released while all other keys respond when the key is pressed.

On/Off Select

The unit turns on with a single key press. The unit is turned off by pressing and holding the On/Off Select key. After a few seconds a 3-2-1 countdown to "Off" will occur in the lower right corner of the display. This key is also used to select parameters from the setup manual.

When multiple sensors are connected, pressing On/Off Select will update the display to view the next available sensor bar's values. The sensor bar currently selected is displayed 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 the changing of setup parameters. Two parameters are available: Celsius or Fahrenheit, the language, and Heat Index or Humidex. Press Setup to access the parameters. Use the arrow key to select the parameter desired. Use the On/Off Select key to alter the parameters. Press the Setup key again to exit.

4 Displayed Items

The number in the upper right corner indicates which sensor bar's data is displayed. A "1" indicates the default sensor bar (the one connected to the port located on the top of the unit). Sensor ports 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 is a list of available display screens:

- Screen 1: WET (Wet Bulb)
DRY (Dry Bulb)

- Screen 2: GLOBE (Globe Thermometer)
- Screen 3: WBGTi (WBGT Indoors)
WBGT_o (WBGT Outdoors)

- Screen 4: RH (Relative Humidity)
HI (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 it's allowable range
- The temperature is outside of it's 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 wind speed are taken into account by measuring the amount of evaporative cooling taking place at a thermometer covered with a moistened wick. The hs-32 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 into 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 the six-inch diameter globe. The hs-32 uses a two inch globe for faster response time. The temperature of the two inch globe is correlated to match that of a six inch globe.

As an option a sensor bar with a six inch 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 help to shield it from radiant heat.

Relative Humidity Sensor

A relative humidity sensor is located 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 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 200 feet (61 meters) may be used without a decrease in accuracy provided the environment doesn't 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 by pressing and releasing the On/Off Select key. The upper right hand corner of the display shows the sensor bar currently selected. 1 refers to the top sensor bar and 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.

Tri Sensor Weighted Average

Per the recommendations outlined in ISO 7243:1989, when a temperature in a 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 following formula:

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

The hs-32 always assigns the top sensor bar the double weighting. The calculation results are shown if a WBGT display has been selected and if three sensor sets are connected.

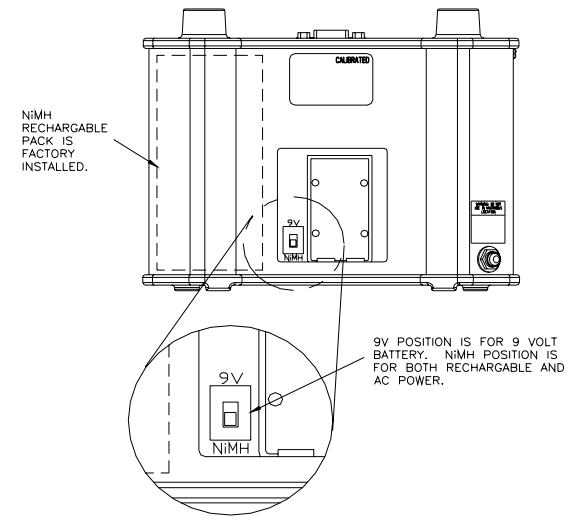
7 Operational Check

A verification module, part # 054-544, may be used to check the operation of the hs-32. Remove the top sensor bar and plug the verification module into the sensor jack located on the top of the unit. With the hs-32 set to read degrees Celcius, verify that the displayed readings match those printed on the side of the module within +/- 0.5°C.

If the readings are not within tolerance, have the unit serviced and calibrated.

8 Power Options

There are 3 options for powering the hs-32: a 9 volt alkaline battery, a NiMH (Nickel Metal Hydride) rechargeable 6-cell pack and an AC adapter. A door on the back of the unit allows access to the 9 volt battery. If a rechargeable battery is installed in the unit, and it requires servicing, it can be accessed by removing the screws and the bottom panel of the unit.



The 2-position switch located in the battery compartment must be set by the user to enable the desired power option if a change is required. The “up” position is for the 9 volt battery. The “down” position allows for AC operation or operation from the rechargeable battery, if installed. In this position 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. After the unit has been turned on, the battery voltage can be displayed at any time by pressing the up or down arrow keys to move through the displayed items until the battery voltage screen appears in the display. If, while operating, the battery voltage drops below 6.4 volts, the display will automatically switch to the screen display showing the battery voltage along with a low battery message. At this point the unit will continue to operate for approximately 8 hours. When the battery voltage drops to 6.2 volts or below, the unit will automatically shut down.

Approved 9 Volt Batteries

Eveready: Energizer 522, EN22, 6LR61
Duracell: MN1604
Panasonic: 6LR61, 6AM6X
Rayovac: A1604
UltraLife: U9V

Charging The NiMH Battery Pack

Warning: Recharge batteries only in a non-hazardous environment!

The NiMH rechargeable battery pack is located within the instrument. To insert or remove the battery pack requires removing the bottom panel of the instrument.

The NiMH rechargeable battery pack is charged in the instrument using an AC adaptor P/N 015-910. A discharged battery pack requires an "overnight" charge of 16 hours. Leaving the AC adaptor plugged in for extended lengths of time or when operating the instrument, will not damage the rechargeable batteries.

9 Using The hs-32

The hs-32 should be placed at a height of 3.5 feet (1.1m) for standing individuals or 2 feet (0.6m) for seated individuals. Tripod mounting is recommended to get the unit away from anything that might block radiant heat or block 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 _{OUT} , WBGT _{Weighted Average} (If 3 sensor sets), Relative Humidity, Heat Index and Humidex. Temperatures are displayed in °C or °F.
Languages:	English, French, Spanish, Italian, German
Housing:	Designed to be water resistant in a light rain or mist.
Size:	Height 9.2" (23.5cm) Width 7.2" (18.3cm) Depth 3.0" (7.5 cm) (Dimensions include mounted sensor array)
Weight:	2.6lbs (1.2kg) with sensor assembly mounted.
Sensor Types:	Temperature – 1000 ohm platinum RTD Humidity – integrated circuit with capacitive polymer sensor.
Accuracy:	Temperature: +/- 0.5°C to 100°C Relative Humidity: +/- 5%
Operational Temperature Range:	Sensor Assembly: -5°C to 100°C Electronics: -5°C to 60°C
Operational Relative Humidity Range:	0 to 100% (Extended exposure to humidity values > 90% can cause a reversible shift of 3%)
Power Options:	9V alkaline battery, 7.2V NiMH rechargeable battery pack or AC adaptor wall power cube. (AC adaptor will operate the unit or recharge the internal NiMH rechargeable battery pack.)
Battery Life:	9V alkaline: 140Hrs Rechargeable NiMH battery Pack: 300Hrs (Adding additional sensor bars to the unit reduces battery life)

Charge Time: NiMH pack in unit: 16 hrs

Remote Sensor Bars: (2) additional remote sensor bars may be utilized by connecting optional remote cables to the 15pin D-sub connectors located on the side of the instrument. The top sensor bar can be run remotely as well.

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.

Appendix A: Heat Exposure Tables

Examples of Permissible Heat Exposure Threshold Limit Values
 [Values are given in °C and (°F) WBGT]*

Work Demands	Light	Moderate	Heavy	Very Heavy
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

Work Demands	Light	Moderate	Heavy	Very Heavy
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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Appendix B: Accessories

6 Foot Shielded Remote Sensor Cable	053-924
25 Foot Shielded Remote Sensor Cable	053-925
100 Foot Shielded Remote Sensor Cable	053-926
200 Foot Shielded Remote Sensor Cable	053-927
120VAC to 9VDC adaptor	015-910
220VAC to 9VDC adaptor	015-680
Verification Module	053-923
Tripod	059-045
Replacement Wicks	056-679
Water Bottle 2 oz.	056-068
Sensor Array with 2" Globe	056-795
Sensor Array with 6" Globe	056-780

Quest Service Policy

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.

International Customers

Contact your local, factory-authorized distributor from whom the product was purchased. To obtain the name of the local factory-authorized distributor, contact us via email at service@quest-technologies.com, via telephone at +(1)-262-567-9157 or via fax at +(1) 262-567-4047.

U.S.A Customers Only

- **Go to the service section of our web site at www.quest-technologies.com.**
- **Contact us via email at service@quest-technologies.com**
- **Contact us at (800) 245-0779. Office hours are 8:00 AM to 5:00 PM U.S. Central Time.**

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.



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