

WARRANTY CLAUSE

METROSONICS, INC. warrants each new instrument manufactured and sold to be free from defects in material, workmanship and construction, except for batteries which may be contained therein, and that when used in accordance with this owner's manual will perform to applicable specifications for a period of one year after original delivery.

If examination by METROSONICS, INC. discloses that the product has been defective, then our obligation is limited to repair or replacement, at our option, of the defective unit or its components.

METROSONICS, INC. is not responsible for products which have been subject to misuse, alteration, accident or for repairs not performed by METROSONICS, INC.

Instruments must be returned properly packed with transportation charges prepaid to METROSONICS, INC.; return transportation charges will be F.O.B. factory. No parts shall be returned unless a return authorization number is received, which will be furnished by request.

The foregoing warranty constitutes METROSONICS, INC. sole liability, and is in lieu of any other warranty, of merchantability or fitness. METROSONICS, INC. shall not be responsible for any incidental or consequential damages arising from any breach of warranty.

Appendix III

ao-3600

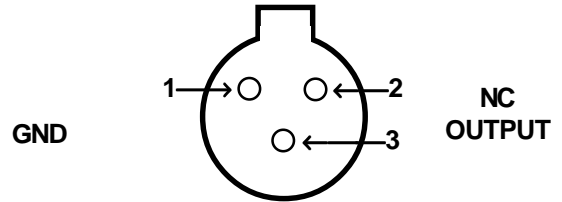
ANALOG OUTPUT OPTION

Analog Output to datalogger (dl-3200) or recorder.

SPECIFICATIONS:

Output Level: 10 mv/degree of displayed reading

Accuracy: ± 0.7 degrees



OUTPUT CONNECTOR

scheduled for early morning before 8 a.m. or after 6 p.m.; (3) race sponsors must provide fluids; (4) runners should be encouraged to drink 300-360 mL of fluids 10 to 15 minutes before the race; (5) fluid ingestion at frequent intervals during the race should be permitted with water stations at 2-3 km intervals for races 10 km or longer, and runners should be encouraged to drink 100-200 mL at each water station; (6) runners should be instructed on recognition of early signs and symptoms of developing heat illness; and (7) provision should be made for care of heat-illness cases.

In these recommendations the WBGT is the heat stress index of choice. The red flag high risk WBGT index value of +23 to +28°C (+73.4 to +82.4°F) would indicate all runners must be aware that heat injury is possible, and any person particularly sensitive to heat or humidity should probably not run. An amber flag is moderate risk with a WBGT of +18 to +23°C (+64.4 to +73.4°F). It is assumed that the air temperature and humidity and solar radiation are likely to increase during the day.

* American College of Sports Medicine, Prevention of heat injuries during distance running - ACSM position statement. Med. Sci. Sports Exer. 1984; 16:IX-XIV.

TABLE OF CONTENTS

	Page
CHAPTER 1: INTRODUCTION	1
CHAPTER 2: GETTING STARTED	2
Connecting the Sensors	4
Battery	7
CHAPTER 3: OPERATION	8
ON/OFF	8
Selecting Temperature Scale	10
CHAPTER 4: SERVICE INFORMATION	11
CHAPTER 5: SPECIFICATIONS AND ACCESSORIES	12
APPENDIX	
I WORK AREAS	14
II ATHLETIC ACTIVITIES	21

Appendix II

ATHLETIC ACTIVITIES

In July 1984, the American College of Sports Medicine (ACSM) published a position statement on "Prevention of Heat Injuries During Distance Running."*

To be competitive, the long distance runner must be in excellent physical condition, exceeding the physical fitness of most industrial workers. For long distance races such as the marathon, the fastest competitors run at 12 to 15 miles per hour, which must be classified as extremely hard work. When the thermal environment reaches even moderate levels, over-heating can be a problem.

To reduce the risk of heat-induced injuries and illnesses, the ACSM has prepared a list of recommendations which would serve as advisory guidelines to be followed during distance running when the environmental heat load exceeds specific values. These recommendations include (1) races of 10 km or longer should not be conducted when the WBGT exceeds 28°C (82.4°F); (2) all summer events should be

Work-Rest Regimen:

The permissible exposure limits specified in Figure 3 and Figure 4 are based on the assumption that the WBGT value of the resting place is the same or very close to that of the workplace. Where the WBGT of the work area is different from that of the rest area a time-weighted average value should be used for both environmental and metabolic heat. When time-weighted average values are used, the appropriate curve on Figure 4 is the solid line labeled "continuous".

Chapter 1 INTRODUCTION

The Metrosonics hs-3600 Heat Stress Monitor is a portable instrument for measuring the high humidity, temperature and radiant heat conditions that can cause heat stroke and other heat induced illnesses.

This simple to operate instrument contains all three temperature sensors needed to instantly compute the WBGT indoor and outdoor indices. The three individual temperatures and both indices can be displayed in either °C or °F on the easy-to-read LCD.

Extremely rugged, the hs-3600 is packaged in a lightweight aluminum extrusion, which is gasketed to withstand rough handling and harsh environments.

An output option is available which allows data to be recorded by connecting the hs-3600 to a datalogger (such as Metrosonics dl-3200). **Call Metrosonics Sales Department at (716) 334-7300 for more information on this option.**

Chapter 2 GETTING STARTED

The hs-3600 is composed of 4 assemblies:

- Signal processing assembly
- Dry bulb sensor
- Wet bulb sensor
- Globe sensor

The instruments' circuitry is housed in an aluminum extrusion. Each sensor assembly has a plug-in connector allowing disassembly for storage.

An internal switch is used to select the desired temperature scale (Centigrade or Fahrenheit) (see "Selecting Temperature Scale" later in this chapter).

One front panel switch is used to turn the hs-3600 on and off, and to select the desired temperature to display.

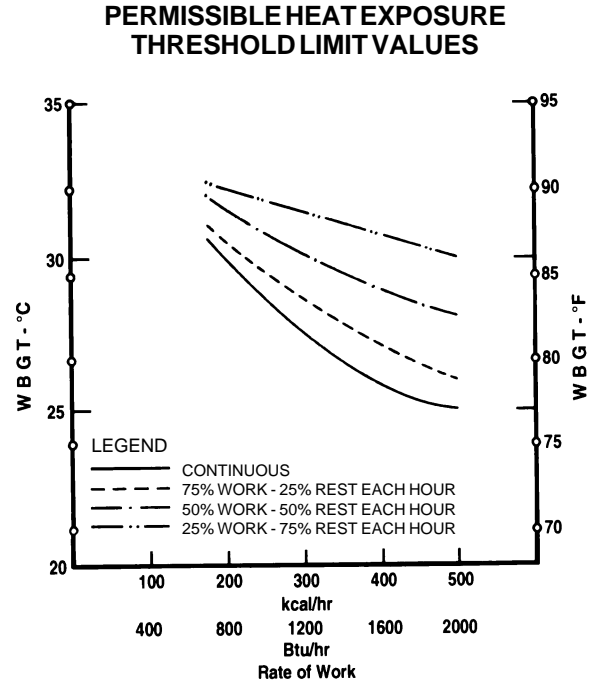


Figure 4

ACGIH Charts:

These Threshold Limit Values (TLVs) refer to heat stress conditions under which it is believed that nearly all workers may be repeatedly exposed without adverse health effects. The TLVs shown in Figure 3 are based on the assumption that nearly all acclimatized, fully clothed workers with adequate water and salt intake should be able to function effectively under the given working conditions without exceeding a deep body temperature of 38°C.

PERMISSIBLE HEAT EXPOSURE THRESHOLD LIMIT VALUES (Values are given in °C WBGT)

Work-Rest Regimen	Work Load		
	Light	Moderate	Heavy
Continuous Work	30.0	26.7	25.0
75% Work - 25% Rest, each hour	30.6	28.0	25.9
50% Work - 50% Rest, each hour	31.4	29.4	27.9
25% Work - 75% Rest, each hour	32.2	31.1	30.0

Figure 3

The available temperature selections are:

- Naturally aspirated wet bulb temperature (WB)
- Globe temperature (GT)
- Dry bulb temperature (DB)
- Indoor wet bulb globe temperature (WBGT in = .7WB + .3 GT)
- Outdoor wet bulb globe temperature (WBGT out = .7WB + .2GT + .1DB)

CONNECTING THE SENSORS

To connect the sensors to the hs-3600:

1. Look at the symbols located on the top of the unit to determine the appropriate connector for each sensor. With the instrument display facing you, the dry bulb is located on the left, the globe in the center, and the wet bulb is on the right.
2. Align the black locking tab on the sensor base with the locating groove on the connector, and then plug-in the sensor.
3. To remove a sensor assembly, depress the locking tab located at the connector's base, and pull the sensor straight up.

Wet Bulb Sensor Preparation

The wet bulb sensor requires some preparation each time the instrument is used. You will need to place a clean cotton wick over the sensor tube and a sponge in the reservoir area. For proper operation, the sponge and wick **MUST** be kept damp with distilled or demineralized water. Ordinary tap water can be demineralized using the demineralization resins that came with the unit.

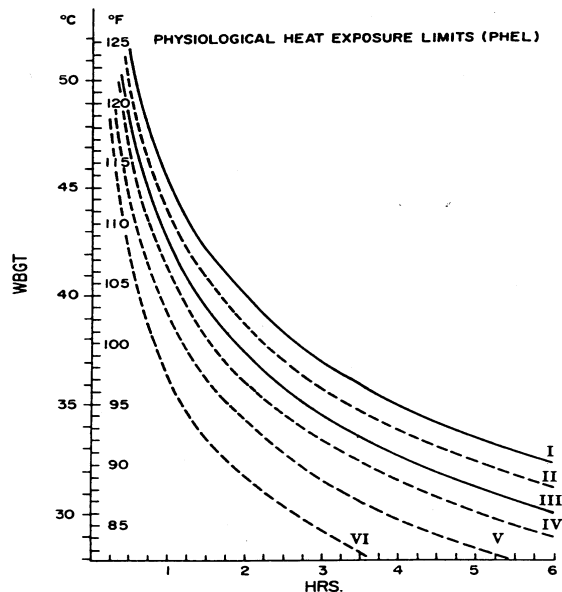


Figure 2

*Obtained from a paper written by: Commander, Medical Service Corps., U.S. Navy, Heat Stress Division - A.R. Dasler, Ph.D., at the Naval Medical Research Institute, Bethesda, Maryland, entitled: Heat Stress, Work Function and Physiological Heat Exposure Limits in Man.

PHEL CURVES FOR INTERMITTENT WORK-REST

Physical Activity*	Work O ₂ Consump. (L/min)	No. Minutes Work/No. Minutes Rest				
		10/50	20/40	30/30	40/20	50/10
Standing	0.50	--	--	--	--	I
Average Light Work	0.75	--	I	II	III	IV
Upper Light to Lower Moderate Work	1.00	--	II	IV	VI	--
Average Moderate Work	1.25	I	III	VI	--	--
Upper Moderate to Lower Heavy Work	1.50	II	V	--	--	--
Average Heavy Work	1.75	II	VI	--	--	--
Upper Heavy to Lower Very Heavy Work	2.00	III	--	--	--	--
Average Very Heavy Work	2.25	IV	--	--	--	--
Upper Very Heavy Work	2.50	IV	--	--	--	--

*As Indicated in Table 5 of ASHRAE Handbook of Fundamentals.

Figure 1

To prepare the wet bulb sensor:

1. Slide the wick over the sensor, as far as it will go.
2. Slide the sponge over the covered sensor so that it is in the reservoir area.
3. Pour distilled or demineralized water over the sponge until it is saturated (dampening the sponge will facilitate water passage over the wick).

To remove the wick and sponge:

1. Pull the wick straight upwards off the sensor.
2. Once the sponge is out of the reservoir area, pull on the sponge to slide the wick and sponge off the sensor.

Demineralizing Tap Water

To demineralize tap water:

1. Cover the bottom of the water supply bottle that came with the hs-3600 with the demineralization resins.
2. Fill the bottle with tap water.
3. Cover and shake for about 30 seconds.

NOTE: The resins may be used for several refills of tap water. Replace resins when blue resins become light brown.

IMPORTANT!

Individual sensors are serialized for a given unit. The serial numbers are located on the base of each sensor and on the back of the unit. Interchanging sensors between units may induce errors of up to 1.0°C (1.8°F). If a sensor is broken, the entire unit should be returned to Metrosonics, Inc. for a replacement as recalibration is necessary.

5. Draw a vertical line from the intersection of the desired curve and the horizontal line, to the axis labeled "HRS" This value is the total length of time that a person could perform the task, with the work/rest cycle chosen.

As an example, assume that an individual is to perform a task defined as "Average Moderate Work". Table 1 recommends 3 different work/rest cycles:

- 10 min work/50 min rest (Curve I)
- 20 min work/40 min rest (Curve III)
- 30 min work/30 min rest (Curve VI)

If the WBGT value, as read on the hs-3600 is 95°F, a horizontal line drawn from 95°F through the curves of Figure 2 reveal the following:

Curve	Work Level Cycle	Stay Time
I	10 min work/50 min rest	4.1 hrs
III	20 min work/40 min rest	3 hrs
VI	30 min work/30 min rest	1.25 hrs

If the individual chooses the 20 minute work/40 minute rest cycle, he should remain in the given environment no longer than 3 hours, total.

Appendix I

WORK AREAS

The WBG_{Tin} and WBG_{Tout} values may be correlated to a suggested length of "Stay-Time" for an individual performing various tasks, under various Physiological Heat Exposure Limits (PHEL). Charts have been published, and are based upon extensive testing of large samples of people working in various environments. These charts are statistical averages, and should be used ONLY as a guide; any particular individual may not fit a particular curve.

PHEL Charts:

To use the PHEL charts:

1. Obtain the WBG_T value from the hs-3600, in the environment the work is to be performed in.
2. Using Figure 2, draw a horizontal line from the WBG_T axis through the curves.
3. Determine the degree or work effort to be performed, from Figure 1. Note which curve numbers (I thru VI) are recommended.
4. Decide which curve to follow, based upon the work/rest cycle desired from Figure 1.

BATTERY

The hs-3600 is powered by a 9 volt alkaline battery, with a nominal lifetime of 250 hours. When the battery becomes low, an arrow (←) will appear on the hs-3600 display.

Battery Replacement

The procedure for replacing the battery is very simple and can easily be performed within seconds.

To change the battery:

1. Turn the hs-3600 off.
2. With the instrument display facing you, unscrew the left side endcap screw and then remove the endcap.
3. Tilt the unit slightly so that the battery slides out of the battery holder.
4. Slide the fresh battery, terminal first, into the battery compartment, with the + and - terminals matching the diagram on the inside of the unit.
5. Replace the endcap and tighten the screw. If the endcap is NOT seated correctly or the screw is NOT tightened correctly, the hs-3600 will NOT be watertight.

Chapter 3 OPERATION

The instructions in this chapter assume you have reviewed Chapter 2 in this manual. If you have NOT reviewed Chapter 2, you should do so at this time.

These instructions also assume that you have followed the instructions in Chapter 2 (i.e. you have installed a battery and connected the sensor assemblies).

ON/OFF

One switch controls the basic functions of the hs-3600. To turn the unit on and begin displaying temperature readings, simply rotate the switch located on the front panel, from the "OFF" position to the desired temperature function:

- **WB:** Wet bulb temperature
- **GT:** Globe temperature
- **DB:** Dry bulb temperature
- **WBG_{Tin}:** Indoor wet bulb globe temperature
- **WBG_{Tout}:** Outdoor wet bulb globe temperature

ACCESSORIES

ba-004 Replacement Batteries: Four each standard 9 volt alkaline batteries. MN-1604A type battery recommended for normal operation and longer battery life.

dm-371 Demineralization Resins: Ten each 20 gram packages of resins used to demineralize tap water for Wet Bulb use

mf-371 Mounting Fixture: Rugged wall mounting fixture for hs-3600

mt-371 Tripod: Sturdy, collapsible tripod to hold hs-3600 Heat Stress Monitor during field measurements.

sc-360 Storage Case: Carrying case for hs-3600 and operating supplies

sk-371 Supply Kit: Includes one water supply bottle, ten replacement wicks and four replacement sponges.

ca-300 Analog Output Cable (for Analog Output Option ONLY)

Chapter 5

SPECIFICATIONS AND ACCESSORIES

SPECIFICATIONS

Operating Range: 0 to +70°C (+32 to +158°F)

Measurement Accuracy: ±0.5°C (±0.9°F)

Measurement Resolution: 0.1°C (0.1°F)

Display: 3½ digit LCD, 0.4 inch (10mm) height, "←"
low battery indicator

Update Rate: 1/second

Battery: 9 volt alkaline, NEDA type 1604A; nominal
battery life is 400 hours.

Tripod Mount: ¼-20 UNC thread

Case: Aluminum extrusion, 7.5 x 2 x 2 inches
(19 x 5 x 5 cm)

Environmental: Watertight, short term immersion in
accordance with IEC Standard 529-1978. 0 to 90% non
condensing humidity; -40 to +70°C storage temperature

ETL Classified for use in hazardous locations:
Division I, Class I, Groups A, B, C & D, Class II, Groups
E, F & G, Class III.

Total Weight (including sensors): 1.2 lbs. (0.5 kg)

Specifications subject to change without notice.

To turn the hs-3600 off, simply rotate the switch
back to the off selection.

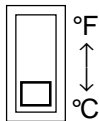
The hs-3600 does NOT require any warm-up time;
it is fully operational and accurate when turned on.
However, if the monitor is moved to a new area, allow the
sensors time to stabilize their temperature before tak-
ing readings. Typical response times, for wide tempera-
ture changes, are as follows:

- Wet Bulb: <5 min
- Globe: <15 min
- Dry Bulb: <5 min
- WBGT_{in}: <15 min
- WBGT_{out}: <15 min

SELECTING TEMPERATURE SCALE

Centigrade or Fahrenheit temperature scales are indicated on the display. A switch, located inside the instrument allows selecting which temperature scale will be displayed. To change between the two scales:

1. Turn the hs-3600 off.
2. With the instrument display facing you, unscrew the left side endcap screw and then remove the endcap. A yellow slide switch will be exposed (located to the right of the battery compartment).
3. Push the switch down for °C or up for °F as indicated in the following drawing.



4. Replace the endcap and tighten the screw.

Chapter 4 SERVICE INFORMATION

In the event the hs-3600 needs repair or service, call the Metrosonics Service Department at (716) 334-7300.

The Service Department will try to determine the cause of the apparent malfunction and provide the necessary support to correct the problem.

In some cases, problems (or misunderstandings) can be corrected over the phone, therefore, before returning the hs-3600 to the factory for service, discuss all problems with the Service Department.