

WARRANTY CLAUSE

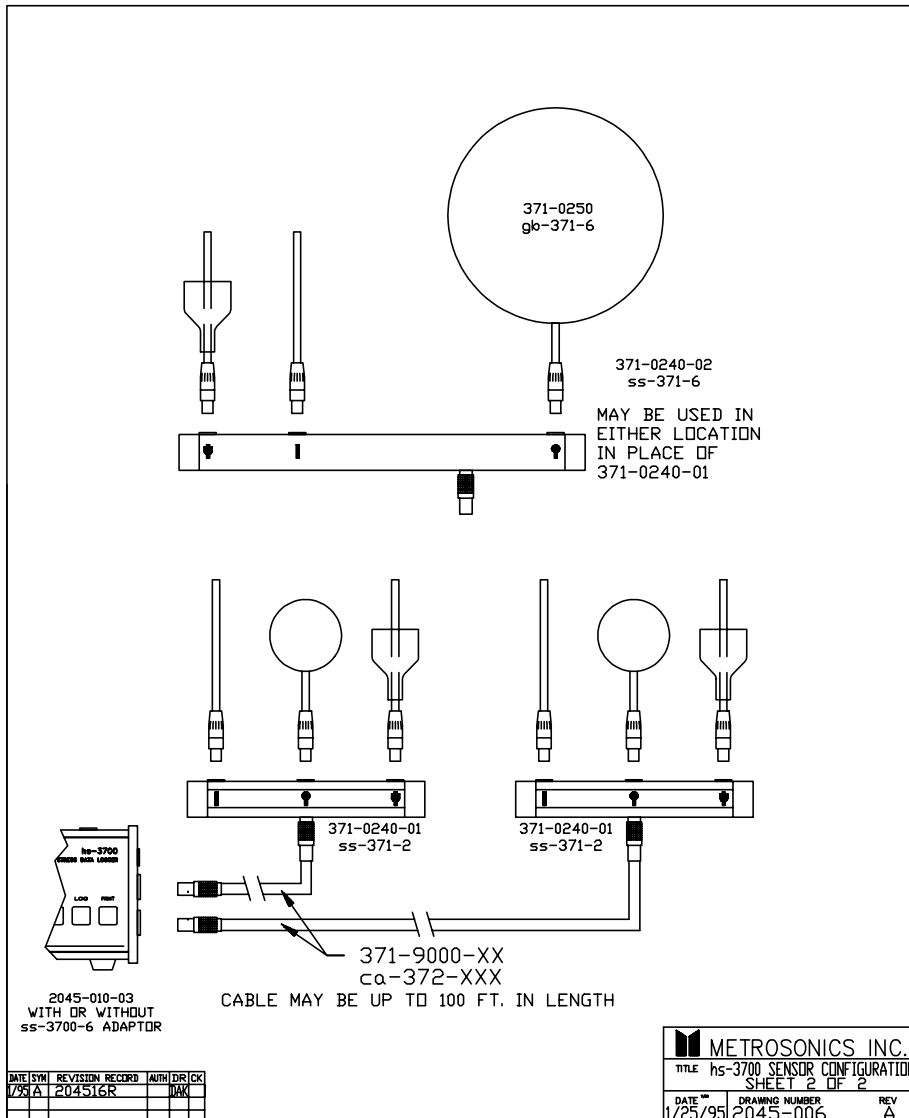
METROSONICS, INC. warrants each new instrument manufactured and sold to be free from defects in material, workmanship and construction, except for batteries which may be contained therein, and that when used in accordance with this owner's manual will perform to applicable specifications for a period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

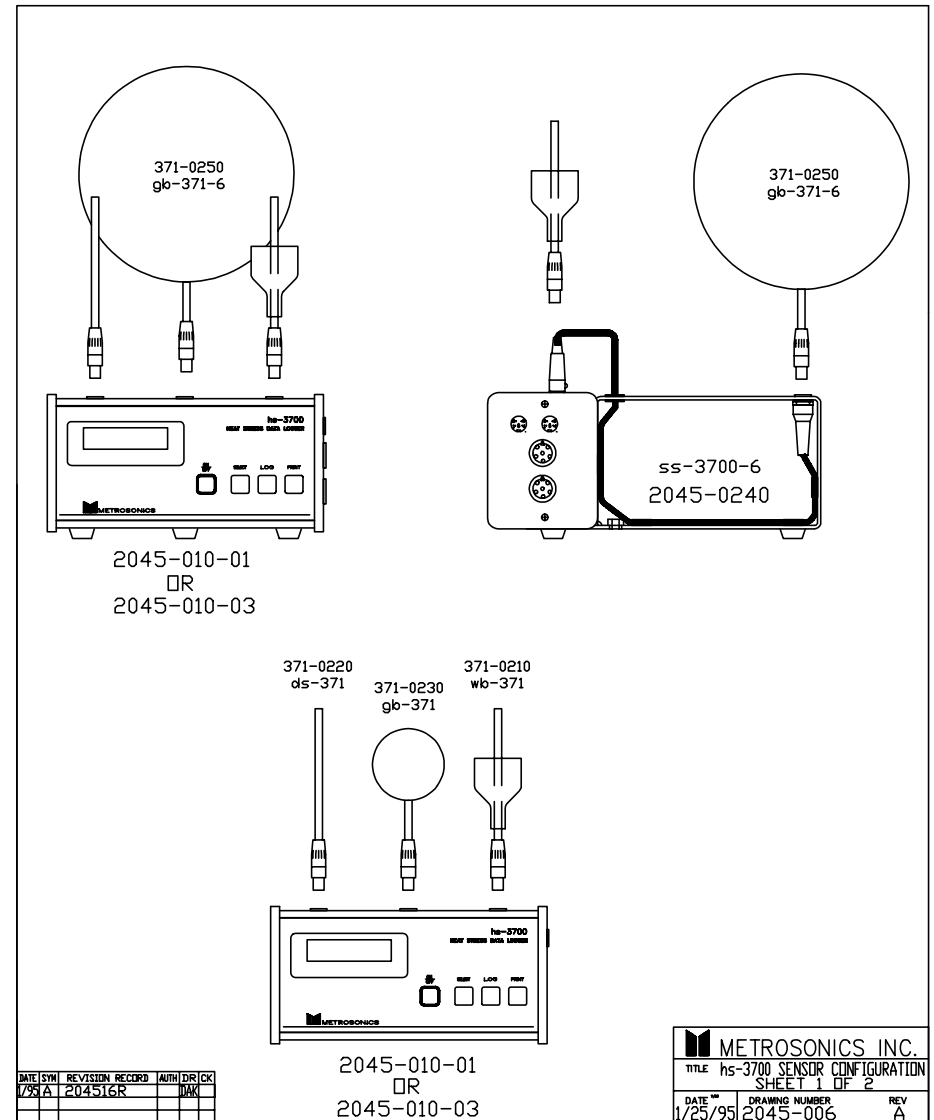
METROSONICS, INC. is not responsible for products which have been subject to misuse, alteration, accident or for repairs not performed by METROSONICS, INC.

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.

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APPENDIX 2 hs-3700 SENSOR CONFIGURATION



APPENDIX I 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 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.

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CHAPTER 8 COMPUTER/PRINTER REQUIREMENTS

There are only six communication requirements for any computer or printer to work with the hs-3700.

1. Serial RS-232 communications using at least the transmit (TX, pin2), receive (RX, pin3) and common ground (GND, pin7) lines.
2. Accept Xon/Xoff software handshaking to control the flow of characters. Xon/Xoff is also known as DC1/DC3 or Control-S/Control-Q.
3. Accept a standard baud rate between 300 and 9600 baud.
4. Accept the standard data format of 1 start bit, 8 data bits, 1 stop bit with no parity.
5. Accept the standard ASCII character set.
6. Support 80 column printouts.

If all six of these requirements are met, a computer or printer will function properly with the hs-3700.

NOTE: The RS-232 cable provided by Metrosonics (part #ca-701) **MUST** be used. This cable has a male and a female 25-pin connector. A switch is provided which swaps the transmit and receive lines. This eliminates the need for a null modem adaptor. A 25- to 9-pin adaptor is also provided.

ACCESSORIES

Part #	Description
ba-008	Replacement Batteries
ca-372-xx	Sensor Extension Cable (20, 50 or 100 ft.) (6, 15 or 30 M)
ca-701	RS-232 Interface Cable
dm-371	Demineralization Resins
mf-371	Mounting Fixture
ms-3700	Metrosoft Software
mt-371	Tripod
ps-371	Power Adaptor
sc-371-x	Storage Case
sk-371	Supply Kit
tc-371-x	Transit Case

CHAPTER 1 INTRODUCTION

The Metrosonics hs-3700 Portable Heat Stress Monitor is a rugged, microprocessor-based instrument intended for the determination of heat stress. It is an excellent solution for heat stress monitoring in areas where workers may be subjected to life threatening high levels of heat and humidity.

The hs-3700 comes equipped with three sensors needed to measure and record dry bulb (DB), wet bulb (WB) and globe temperature (GT). Two GT sensor versions are available: the standard 2-inch globe for measurement convenience, and an optional 6-inch globe for measuring in accordance with ISO standards.

A Remote Sensor Option is available for attaching accessory sensor assemblies with extension cables, and simultaneously monitoring a second, or even a third set of sensors. This can be utilized for monitoring the WBGT's at the ankles, torso and head levels of a worker, and then computing the Mean WBGT.

Dry bulb, wet bulb and globe temperature are accurately measured by the hs-3700, and are used to calculate either indoor or outdoor WBGT (Wet Bulb Globe Temperature) according to established formulas. WBGT is an empirical index representing the heat stress to which an individual is exposed.

Work level and clothing type (if applicable) are user-programmed into the hs-3700, along with the desired stay time or work/rest regimen criteria. The hs-3700 factors the WBGT with the level/type of work, to calculate and display the length of time a worker can safely stay in the area. At user option, stay times and work/rest regimens are directly displayed for EPRI, ACGIH, US Navy PHEL, or ISO criteria.

Four buttons control all hs-3700 functions. Operation is made simple with user-friendly menus and prompts. Various functions can be performed from the front panel keypad (a security mode is incorporated to prevent unauthorized access).

Unique microprocessor technology allows the hs-3700 to record more than 65,000 time history values of the measurements in its solid state memory for transfer to a printer or computer. Test intervals can be selected from 1 minute to 1 hour with 1 minute resolution.

The hs-3700 can be set to start recording data immediately, or at a preset future date and time on a daily or one-time basis. This latter option is called a "scheduled run". The hs-3700 can even be operated by remote control via RS-232 link from an external computer.

Fully formatted hard copy reports can be printed directly from the hs-3700 to a serial printer and used as incontestable documentation of the environment.

Packaging is consistent with the hostile environments which the hs-3700 is designed to measure. The extruded aluminum case and keypad are designed for rough handling and short term water immersion as per IEC standards.

A Programming Disk (ms-3700P) is provided free of charge with the hs-3700. ms-3700P allows you to customize the hs-3700 for specific monitoring applications.

ms-3700 Metrosoft software is also available for use with the hs-3700. This software includes many powerful features such as data retrieval and storage, database searching, evaluating stay times and work/rest regimens, creating graphs and reports, and more.

NOTE: If you have purchased ms-3700 Metrosoft, references in this manual to the Programming Disk also apply to Metrosoft. See your Metrosoft manual for more information.

We at Metrosonics are concerned that you receive the best possible use of your hs-3700. If at any time you have a question, comment, or suggestion concerning this or any of our other products, please don't hesitate to call our Customer Relations Department at (716)334-7300.

IMPORTANT!

Register your hs-3700 and ms-3700P Programming Disk **NOW** and receive the first year of software upgrades **FREE**. Either fill out the enclosed card or see "Warranty Registration" in Chapter 5 for quick instructions on using the on-line warranty card to register your products.

OUTPUT MODES

Formatted: Preformatted ASCII report for terminals or printers; time history and test specifics

Binary: High rate proprietary formatted data for transmission to computer systems (same data as formatted mode)

REAL TIME OUTPUT

Interval: Every 5 seconds or upon request

Display: Numerical value or graph may be displayed in the Programming Disk or ms-3700 Metrosoft

DIGITAL COMMUNICATIONS

Type: 4 wire RS-232, Xon/Xoff

Format: ASCII, 1 start, 8 data, 1 stop bit, no parity

Baud Rates: 300, 600, 1200, 2400, 4800, 9600

POWER

Internal Power: Six 1.5 volt alkaline batteries

Battery Life: 120 hours at 25°C

Data Retention: 30 days

External Power: 10 to 28 Vdc

PHYSICAL

Case Type: Anodized aluminum extrusion

Size: 7.7 x 3.75 x 3 inch (19.5 x 9.5 x 7.6 cm)

Weight: 2.5 lbs. (1.1 kg)

ENVIRONMENTAL

Operating Temperature: 0 to +74°C (+32 to +165°F)

Humidity: To 95% non-condensing; short term water immersion in accord with IEC Standards 529-1978

Intrinsic Safety Approval: In progress

Specifications subject to change without notice.

CHAPTER 7 SPECIFICATIONS & ACCESSORIES

SPECIFICATIONS

INPUTS

Temperature Sensors: Pt 100 RTDs

Range: 0 to +100°C (+32 to +212°F)

Accuracy: ±0.5°C (±0.9°F)

Globe Size: 2 inch (50mm) sphere; 6 inch (150mm) optionally available

CONTROLS

Keypad: 4 button sealed membrane (ON/OFF, SELECT, LOG, PRINT)

DIGITAL DISPLAY

Display Size and Type: 2 by 16 character alphanumeric LCD

Resolution: +0.1°C (+0.1°F)

Update Rate: 1/second

Parameters: Dry bulb temperature (DB), wet bulb temperature (WB), globe temperature (GT), indoor or outdoor WBGT, Mean WBGT, present stay time or work/rest regimen, date and time, battery voltage, test duration, remaining memory, area ID and user ID, scheduled run information

PROGRAMMING

Real Time Clock: MM/DD/YY, HH:MM:SS (maintains 0.01% accuracy)

Time History Period Length: From 1 to 60 minutes

Scheduled Run: Prescheduled future start time and duration for single or daily logging run

Area ID and User ID: Each from 0 to 9999

Stay Time or Work/Rest Regimen:

Navy PHEL Stay Time: 1 through 6, corresponding to light through heavy tasks

EPRI Stay Time: Metabolic rate (low, moderate and high) and clothing type

(work clothes, cotton coveralls, double cotton coveralls and cotton plus plastic)

ACGIH Work/Rest Regimen: Work load (light, moderate and heavy)

ISO Work/Rest Regimen: Metabolic rate (low, moderate, high and very high)

DATA STORAGE

Statistics Saved per Interval: Dry bulb temperature (DB), wet bulb temperature (WB), globe temperature (GT)

Maximum Intervals Saved: 21,800 (saving 3 statistics); 10,900 with 1 additional sensor assembly connected (saving 6 statistics); 7,200 with 2 additional sensor assemblies connected (saving 9 statistics)

CHAPTER 2 GETTING STARTED

The hs-3700 Portable Heat Stress Monitor is comprised of the Data Logger Module and three plug-in temperature sensors (wet bulb, dry bulb and globe temperature). Optionally one or two additional sets of temperature sensors may be attached to the hs-3700 via extension cables. The Data Logger Module is a microprocessor-based unit which includes both the monitoring and data logging functions.

Refer to Figure 2.1 for pushbutton control and for connecting sensors, the RS-232 cable, and the AC power adapter.

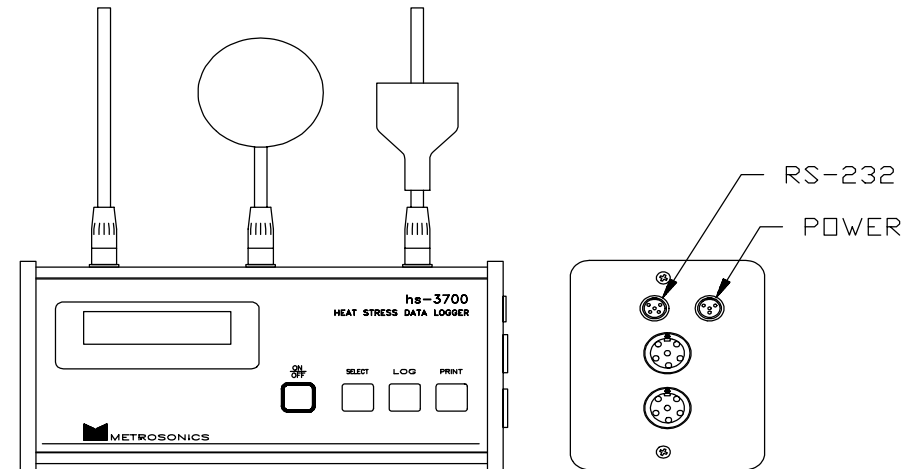


Figure 2.1: hs-3700 Front Panel and Connector Layout

CONNECTING THE PRIMARY TEMPERATURE SENSORS

The hs-3700 comes standard with one set of primary temperature sensors for measuring dry bulb, wet bulb and globe temperature. To connect these sensors to the hs-3700:

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 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, depress the locking tab located at the sensor's base, and pull the sensor straight up.

WARNING: Incorrect sensor positioning will invalidate readings taken by the hs-3700.

CHAPTER 6 SERVICE INFORMATION

CONNECTING OPTIONAL REMOTE SENSOR ASSEMBLIES

On the hs-3700 right endcap are connectors for attaching one or two optional remote temperature sensor assemblies via extension cables. Three sets of temperature sensors can be utilized for monitoring the WBGT's at the ankles, torso and head levels of a worker, and then computing the Mean WBGT.

Referring to Figure 2.1, attach the first optional remote sensor assembly to the bottom 12-pin connector (labeled Connector D on the hs-3700 back label). If appropriate, attach a second optional remote sensor assembly to the top 12-pin connector (labeled Connector C).

TEMPERATURE SENSOR CONSIDERATIONS

The dry bulb and globe sensors must remain dry for proper operation. Evaporative cooling of a wet sensor will artificially lower temperature measurements.

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 which came with the unit.

1. Slide a clean cotton wick over the sensor post, as far as it will go.
2. Slide a sponge over the wick as far as possible towards the bottom of the tulip-shaped reservoir. A dampened sponge may slide on easier.
3. Fill the reservoir with distilled or demineralized water until the sponge is saturated. The wick must remain wet whenever the hs-3700 is in use.

A wick should be replaced when worn or discolored. The wick and sponge are easier to remove when pulled straight up together and when dampened. A soiled wick or sponge may be carefully hand washed with a mild detergent, and then rinsed in distilled water.

Distilled water is recommended for use in the wet bulb reservoir. If distilled water is not available, ordinary tap water may be treated with demineralization resins (Metrosonics #dm-371).

1. Cover the bottom of the water supply bottle that came with the hs-3700 with the demineralization resins.
2. Fill the bottle with tap water.

In the event the hs-3700 needs repair 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-3700 to the factory for service, discuss all problems with the Service Department.

EXIT PROGRAMMING DISK

Exiting from the Programming Disk is very easy. Simply use these commands to exit a function, return to the Main Menu or exit the Programming Disk and return to DOS:

1. Press F10 to exit from a menu or screen and return to the previous screen and then continue to press F10 until you reach the desired Metrosoft screen OR hold down the <Ctrl> key and press F10 to go directly to the Main Menu.
2. Press F10 while at the Main Menu to exit the Programming Disk and return to DOS. You will be asked to verify that you wish to exit. Press Y (yes) to exit or press N (no) to redisplay the Main Menu.

ms-3700 METROSOFT FEATURES

The Programming Disk comes with a sample datafile, which allows you to try some of the powerful features that are available ONLY with ms-3700 Metrosoft. These include database searching, and creating graphs and reports. These functions can be accessed by pressing F3 (View Stored Test Results) in the Main Menu of the Programming Disk and then following the instructions on the screen. Please take a moment to try these features and see how much time you can save by letting us do your analysis for you.

ms-3700 also allows you to retrieve data from the hs-3700 or hs-371 and store it in a database. This function is labeled as F5 (Get/View Test Results From Monitor) in the Main Menu. The Programming Disk does NOT have the capability to perform data retrieval, and will give a message indicating this, if you press F5.

For more information on ms-3700 Metrosoft, please call Metrosonics Sales Department at (716) 334-7300.

3. Cover and shake for about 30 seconds.
4. The water is now ready for use in the wet bulb reservoir.

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

CALIBRATION

The hs-3700 is factory calibrated. Due to aging and drift of components, Metrosonics recommends that the unit be recalibrated annually. The cl-371 Calibrator permits a periodic check of the unit, however the temperature sensors require an extensive calibration facility with precision temperature baths referenced to NBS traceable thermometers.

The cl-371 is accurate to within $\pm 0.2^{\circ}\text{F}$ of the value indicated, and, combined with the accuracy of the hs-3700, an error of no greater than $\pm 0.9^{\circ}\text{F}$ should be obtained at 25°C ambient.

BATTERIES & EXTERNAL POWER

The hs-3700 Heat Stress Monitor is powered by six 1.5 volt alkaline batteries installed in an integral battery pack. Typical battery life is 120 hours.

When the battery becomes low and can power the hs-3700 for only a few more hours, the message "LOW BATTERY WARNING" will flash periodically. When this occurs, it is recommended that the hs-3700 be turned off immediately, and a new set of batteries be installed.

If the battery voltage drops too low, the hs-3700 will display the message "LOW BATTERY TURN OFF" and shut down all circuits except data memory, programming information and clock time. All information will be maintained for approximately 30 days, but prompt replacement of batteries is highly recommended.

If the hs-3700 completely loses power, all logged data and the real time clock setting will be lost. If this occurs, you **must** use either the ms-3700P Programming Disk or ms-3700 Metrosoft to reset the real time clock (see Chapter 5). If you have programmed the hs-3700 for settings other than the factory defaults, the hs-3700 will retain all programming selections you have made.

NOTE: Even when off, the hs-3700 draws power from the battery to maintain the clock settings and any recorded data.

NOTE: If the unit will not be used for an extended period of time, the batteries should be removed. Install new batteries when the unit is to be used again. In addition, if you wish to record data with real time indication, the hs-3700 must be reprogrammed to reset its real time clock (see "Programming the hs-3700" in Chapter 5).

The hs-3700 may be powered from external 120/240 VAC power using an optional Power Adaptor (Metrosonics #ps-371). Referring to Figure 2.1, plug the Power Adaptor cable into the 4-pin connector on the right side of the hs-3700 (labeled Connector B on the hs-3700 back label).

Replacing the Batteries

The procedure for replacing the batteries is very simple and can easily be performed within seconds. The hs-3700 will maintain its programming and recorded data during battery replacement provided that the replacement procedure does not take more than 2 minutes.

The hs-3700 MUST be turned off before replacing the batteries. If the hs-3700 is on when the batteries are removed, all programming and recorded data will be lost.

Follow these steps for battery replacement (be sure you have a fresh set of batteries ready before beginning this procedure):

1. Turn the hs-3700 off.
2. Unscrew the two left endcap screws with a phillips-head screwdriver, and then remove the endcap.
3. Disconnect the battery pack by pulling on the connector which attaches to the battery pack circuit board. Do **not** pull on the wires which go into the connector.
4. Slide the battery pack circuit board out of the unit.
5. Remove the old set of batteries (6) from the battery pack, and install a fresh set of 1.5 volt batteries, observing the polarity.
6. Slide the battery pack circuit board back into the hs-3700 case, and reconnect it.
7. Replace the left endcap and tighten the two screws. If the endcap is NOT seated correctly or the screws are NOT tightened correctly, the hs-3700 will NOT be watertight.

RS-232 CONNECTOR

To connect the RS-232 cable to the hs-3700, align the pins and plug the cable into the 5-pin connector on the right side of the unit (see Figure 2.1). The RS-232 cable is needed to obtain on-site reports on a serial printer, or for programming or data retrieval using the ms-3700P Programming Disk or ms-3700 Metrosoft software.

Create & Send A New Monitor Setup File

Follow these instructions to create a new Monitor Setup File and immediately send it to the hs-3700:

1. Fill in the Monitor Setup Form.
2. Press F3 (Program Monitor) and instructions will appear on your screen.
3. Connect the RS-232 cable from the hs-3700 to the computer's serial port and turn the hs-3700 on.
4. Press <Enter>. When Monitor programming is complete the message "The Heat Stress Monitor Has Been Programmed" will appear on your screen.

Retrieve & Send A Saved Monitor Setup File

Follow these instructions to retrieve a saved Monitor Setup File and send it to the hs-3700:

1. Press F4 (Program/Remotely Control Monitor) in the Main Menu.
2. Press F8 (Retrieve A Saved Monitor Setup File) in the Program/Remotely Control Monitor Menu. A listing of your saved Monitor Setup Files will be displayed.
3. Press ↓, ↑, → or ← to select the file you want to retrieve.
4. Press F2 to view the file. The completed Monitor Setup Form for this file will appear on the screen so you can review the settings.

NOTE: If you wish to see another file, press F10 to return to the listing of your saved Monitor Setup Files, select the desired file and press F2 to view it.

5. Press F3 (Program Monitor) and instructions will appear on your screen.
6. Connect the RS-232 cable from the hs-3700 to the computer's serial port, and turn the hs-3700 on.
7. Press <Enter>. When Monitor programming is complete the message "The Heat Stress Monitor Has Been Programmed" will appear on your screen.

Deleting a Saved Monitor Setup File

You may remove Monitor Setup Files that you no longer need. Follow these instructions to delete Monitor Setup Files:

1. Press F4 (Program/Remotely Control Monitor) in the Main Menu.
2. Press F8 (Retrieve A Saved Monitor Setup File) in the Program/Remotely Control Monitor Menu. A listing of your saved Monitor Setup Files will be displayed.
3. Press ↓, ↑, → or ← to select the file you want to delete.
4. Press F3 to delete the file. You will be asked to verify that you want to delete this file. You must type in Y (yes) to delete the file.

Area and User ID

Choose any value from 0 to 9999 to uniquely identify the area and/or the user to be monitored. Both the area ID and the user ID will appear in printed hs-3700 reports.

Custom Header

This is a 50 character header which will appear at the start of hs-3700 reports.

Saving Setup Files

After filling in the Monitor Setup Form, you may save the setup on disk for future use. The files created are called Monitor Setup Files. This allows you to recall a specific test setup and quickly program additional hs-3700's in precisely the same way. Valuable time is saved because you don't have to remember the settings or recreate them every time you need to program an hs-3700. You can create as many Monitor Setup Files as you require and recall them as needed.

Follow these instructions to save a Monitor Setup File:

1. Fill in the Monitor Setup Form as needed.
2. Press F2 (Save Setup).
3. You will be prompted to enter a filename without an extension (the software automatically gives the file the extension .CFG). Enter up to 8 characters and press <Enter>.

The Monitor Setup File is saved on the data drive and directory that you specified when you filled in the Configure Metrosoft Form.

NOTE: If you enter a filename that already exists, you may either overwrite it or enter a different filename.

Sending Test Setup Information to the hs-3700

There are two ways to program the hs-3700. You can either create a new Monitor Setup File and immediately send it to the hs-3700, or you can retrieve a saved Monitor Setup File and send it to the hs-3700.

NOTE: The hs-3700 may even be reprogrammed after it has logged data, without having any effect on the data previously recorded.

Real Time Clock

Metrosoft automatically sets the real time clock (RTC) of the hs-3700 to the current time at your computer when a Monitor Setup File is sent to the hs-3700. Make sure that your computer's clock has been set to the correct time before programming the hs-3700.

DEFAULT PROGRAMMING SETTINGS

The hs-3700 comes to you factory programmed for common conditions, allowing immediate operation. You can change the settings by using either the Programming Disk or ms-3700 Metrosoft (see Chapter 5).

The following is a list of the settings programmed at Metrosonics factory:

Temperature Scale: °F

Security Code: 1234

WBGT Type: Indoor

Printer Baud Rate: 9600

Stay Time or Work/Rest Regimen Criteria: US Navy PHEL

Clothing: Work Clothes (applies to EPRI stay time only)

Work Level: 1

Type of Scheduled Run: None

Time History Period Length: 1 minute

Area ID: 0

User ID: 0

Custom Header: None (blank)

Clock Time: Not set

REAL TIME CLOCK

The date and time are NOT programmed into the hs-3700 at the factory. If you want to record data with real time indication, you MUST use either the Programming Disk or ms-3700 Metrosoft to set the real time clock. The real time clock of the hs-3700 is automatically set to the current date and time at your computer when the hs-3700 is programmed. Since the hs-3700 retains all programming information, including the real time clock setting, this step only needs to be done once. See Chapter 5 in this manual for information on programming the hs-3700.

CHAPTER 3

WBGT, STAY TIME, AND WORK/REST REGIMEN

WBGT & MEAN WBGT

The most important environmental factors affecting the heat balance of the body and its physiological adjustments are air temperature, humidity, and radiation from surrounding objects. These factors are known to produce physiological changes in humans that are influenced by health status, work load and intensity, and by the amount and type of clothing.

The Wet Bulb Globe Temperature (WBGT) is the most widely accepted measure of environmental heat stress, and is utilized in the computation of stay time and work/rest regimen. Two measures of WBGT are an indoor and an outdoor index, defined in ISO/DIS 7243.

The hs-3700 Heat Stress Monitor measures the dry bulb (DB), wet bulb (WB) and globe temperatures (GT). Based upon these measures, the hs-3700 computes the indoor and outdoor WBGT.

Indoor WBGT is defined as follows:

$$WBGT_{in} = 0.7WB + 0.3GT$$

Indoor WBGT is used to assess heat stress in an enclosed workspace having no solar radiation.

Outdoor WBGT is defined as follows:

$$WBGT_{out} = 0.7WB + 0.2GT + 0.1DB$$

Outdoor WBGT pertains to heat stress in environments involving direct or indirect solar radiation.

The hs-3700 factors the WBGT with the type of work and clothing worn (if applicable) to compute and display the length of time a worker may safely remain in an area. This is expressed either as stay time or work/rest regimen, at user option. The hs-3700 displays the stay time or work/rest regimen which, when not exceeded, permits reversibility of the physiological strain without detectable harm (provided a rest period is allowed). The stay times and work/rest regimens built into the hs-3700 are described later in this chapter.

Three sets of temperature sensors may be connected at one time to the hs-3700. These may be used together to monitor the WBGT's at the ankles, torso and head levels of a worker, and to compute Mean WBGT. The hs-3700 computes Mean WBGT from the following equation:

$$\text{Mean WBGT} = \frac{WBGT_{head} + (2 \times WBGT_{torso}) + WBGT_{ankles}}{4}$$

Clothing

If you have selected EPRI stay time, this field becomes accessible. Choose the type of clothing worn by workers in the area to be monitored. You may choose from WC (work clothes), CC (cotton coveralls), DC (double cotton coveralls) or CPP (cotton plus plastic).

Work Level/Load/Metabolism

Each type of stay time or work/rest regimen requires that you define the type of work being performed in the area to be monitored. Typically, the type of work is expressed on a scale from light to heavy work. Depending upon the type of stay time or work/rest regimen you have selected, choose the work level in this field.

- Navy: From 1 (light tasks) to 6 (heavy tasks)
- EPRI: Low, mod (moderate) or high metabolic rate
- ACGIH: Light, mod (moderate) or heavy work load
- ISO: Low, mod (moderate), high or very high metabolic rate

Scheduled Run

You can program the hs-3700 to automatically turn on and begin recording at a specific date and time, and then stop recording after a certain length of time. This is called a scheduled run, which may be set to run once or every day at the same time. This allows you to program the hs-3700 in advance and then run a test without actually being there.

Follow these steps to set up a scheduled run:

1. Select single or daily in the type of scheduled run field. Notice that the fields below light up when the scheduled run is activated.
2. If setting up a single scheduled run, enter the date you want the test to begin in the scheduled run date field.
3. Enter the time you want the test to begin in the scheduled run time field.
4. Enter the amount of time you want the test to run for in the scheduled run duration field.
5. If desired, you may program the hs-3700 to turn itself off immediately after the test is complete. To do this, simply select "yes" for the Turn Off When Done field.

Period Length

The time history period length determines how often the hs-3700 will store data values in memory. If, for example, you choose a period length of five minutes, the hs-3700 will store temperature values once every 5 minutes.

A shorter period length will provide more detailed time history data, which will appear in your reports. A longer period length requires less memory, thereby offering longer logging sessions.

You may enter any length from 1 to 60 minutes, in 1 minute steps.

Use the following commands to make selections in the Monitor Setup Form:

- Press ↓ or <Enter> to move to the next field
- Press ↑ to move to the previous field
- Press → or ← to scroll through choices for a field
- Type information in fields that do not offer choices when → or ← are pressed
- Press F2 to save the Monitor Setup File for future use
- Press F3 to program the hs-3700 with the current setup
- Press F10 to return to the Program/Remotely Control Monitor Menu (you will be asked if you are sure you want to exit Monitor programming - answer "Y" for yes)

The following list provides information on each selection in the Monitor Setup Form:

Security Code

The hs-3700 allows you to enable secure mode by simultaneously pressing the PRINT and ON/OFF keys. In order to exit secure mode, you MUST know the 4-digit code that was programmed into the hs-3700 (see "Secure Mode" in Chapter 4 for details).

The unit comes programmed with the secure code 1 2 3 4. If desired, you may choose your own 4-digit code. You may enter the numbers 1, 2, 3 and/or 4 in any sequence. Then, simply reprogram the hs-3700 and the new code will be the only code that can be used to exit secure mode.

Temperature Scale

This field allows you to select whether you wish the hs-3700 to display the temperature readings in °F or °C.

WBGT Type

Select either Indoor or Outdoor WBGT in this field, depending on the type of workplace the hs-3700 will be used in. Refer to Chapter 3 for details on WBGT.

Printer Baud Rate

This selection allows you to determine the baud rate at which reports will be printed when outputting directly from the hs-3700 to a serial printer. You may select 300, 600, 1200, 2400, 4800 or 9600 baud.

Type of Stay Time

As discussed in Chapter 3, the hs-3700 is capable of factoring the present WBGT level to arrive at stay time or work/rest regimen. In this field, choose from Navy stay time, EPRI stay time, ACGIH work/rest regimen, or ISO work/rest regimen. Note that for EPRI stay time ONLY the clothing field lights up.

Additionally the hs-3700 uses the present Mean WBGT value to report the mean stay time or work/rest regimen.

In accordance with ISO 7243-1982, place the three sets of sensors, in relation to the floor, as follows:

SENSOR #	WORKER POSITION:	
	STANDING	SITTING
1 (ankles)	0.1m (0' 4")	0.1m (0' 4")
2 (torso)	1.1m (3' 7")	0.6m (2' 0")
3 (head)	1.7m (5' 7")	1.1m (3' 7")

Sensor 1 is the primary, or integral, set of dry bulb, wet bulb and globe temperature sensors which connect to the top of the hs-3700. Sensors 2 and 3 are optional temperature sensor assemblies which connect via extension cables to the side of the hs-3700.

US NAVY PHEL STAY TIMES

The Physiological Heat Exposure Limit (PHEL) Chart shown in Figure 3.1 was developed for the United States Navy by A. R. Dasler, Ph.D., Commander, Medical Service Corps., Head of the Navy's Heat Stress Division. Dr. Dasler's paper ("*Heat Stress, Work Function and Physiological Heat Exposure Limits in Man*") has been published in the National Bureau of Standards (NBS) Special Publication 491 ("*Thermal Analysis - Human Comfort - Indoor Environments*").

The PHEL Chart has six curves based upon metabolic rates (MR) from 88.5 W/m² to 146.5 W/m², corresponding to work levels 1 (light) to 6 (heavy). The hs-3700 uses the present WBGT to derive stay time from the PHEL Chart. Stay time is expressed in 5 minute increments, from a minimum of 0:05 to a maximum of 8:00.

The type of work being performed and the hourly work/rest regimen define the applicable PHEL curve (Figure 3.1) for the stay time computation. Refer to Figure 3.2 to determine the correct PHEL curve based upon the work level and the work/rest regimen.

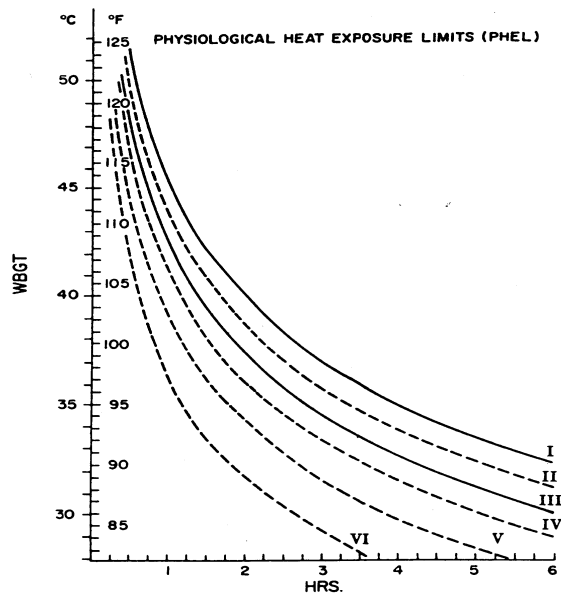


Figure 3.1: US Navy PHEL Curves

*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.

PHYL 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 9 of ASHRAE Handbook of Fundamentals.

Figure 3.2: PHEL Curves for Intermittent Work/Rest

View Temperature In Real Time

The Programming Disk allows you to view the temperature readings on your computer screen as they occur, either in graphical or tabular form. The table shows the present date and time, temperature readings, WBGT, and stay time or work/rest regimen. In the graph, you may view any one of several temperature values updated every 2 seconds in real time. Data above the limit line value are shown in red.

Follow these steps to view data in real time:

1. Check your Configure Metrosoft Form to make sure that the Programming Disk is set up for the correct communications port (COM1 or COM2) and instrument type (hs-3700).
2. Press F4 (Program/Remotely Control Monitor) in the Main Menu.
3. Press F7 (View Temperature In Real Time) in the Program/Remotely Control Monitor Menu. The View Temperature in Real Time Form will appear. Fill out this form as desired, selecting either table or graph.
4. Connect the RS-232 cable from the hs-3700 to the computer's serial port and turn the hs-3700 on.
5. Press F2 to view data in real time.
6. Press F10 or the <Esc> key when you wish to stop viewing the real-time data.

Programming the hs-3700

The hs-3700 comes to you factory programmed for our default settings. If you wish to create your own settings for collecting data, you will need to create Monitor Setup Files.

Monitor Setup Files can be created within seconds. Metrosonics software uses fill-in-the-form programming. This means all you have to do is "fill in a form" by choosing the settings you want for a given test. This information is then sent to the hs-3700 and the test is run. It's that easy!

To program the hs-3700:

1. Check your Configure Metrosoft Form to make sure that the Programming Disk is set up for the correct communications port (COM1 or COM2) and instrument type (hs-3700).
2. Press F4 (Program/Remotely Control Monitor) in the Main Menu.
3. Press F9 (Create A New Monitor Setup File) in the Program/Remotely Control Monitor Menu and the Monitor Setup Form will appear on your screen.
4. Make selections for each field on this form to create whatever settings you need.
5. Connect the hs-3700 to the computer's serial port with the RS-232 cable, turn the hs-3700 on, and then press F3.

NOTE: Since the hs-3700 remembers the last test setup sent to it, you do not need to reprogram the hs-3700 unless a change is required or if the battery loses power or is removed.

2. Press F4 (Program/Remotely Control Monitor) in the Main Menu.
3. Press F5 (Clear All Data At The Monitor) in the Program/Remotely Control Monitor Menu and instructions will appear on your screen.
4. Connect the RS-232 cable from the hs-3700 to the computer's serial port and turn the hs-3700 on.
5. Press <Enter>. The question "Are You Sure You Want to Clear Data (Y/N)?" will appear.

NOTE: If this question is answered with "N", the data will NOT be cleared and the clear data procedure will be aborted.

6. Type Y to clear the data. If the computer is properly communicating with the hs-3700, the message "Command Successful" will appear.
7. Press any key to continue.

NOTE: Data CANNOT be cleared while logging.

Enter or Exit Secure Mode

You may use the Programming Disk to remotely place the hs-3700 in a secure mode, or to exit secure mode (see "Secure Mode" in Chapter 4 for details).

To use secure mode, follow these steps:

1. Check your Configure Metrosoft Form to make sure that the Programming Disk is set up for the correct communications port (COM1 or COM2) and instrument type (hs-3700).
2. Press F4 (Program /Remotely Control Monitor) in the Main Menu.
3. Press F6 (Enter or Exit Secure Mode at the Monitor) in the Program/Remotely Control Monitor Menu and instructions will appear on your screen.
4. Connect the RS-232 cable from the hs-3700 to the computer's serial port and turn the hs-3700 on.
5. Press <Enter>. The computer will determine the status of secure mode at the hs-3700.
 - a. If the hs-3700 is NOT currently in secure mode, simply answer Y (yes) in response to the question "Enter Secure Mode (Y/N)?", and the hs-3700 will be placed in secure mode.
 - b. If secure mode is current enabled at the hs-3700, answer Y (yes) in response to the question "Exit Secure Mode (Y/N)?". You will be prompted to type the 4-digit secure code (1234 is the default code). After you type the correct code, press <Enter>, and secure mode will be exited at the hs-3700.

EPRI STAY TIMES

The Electrical Power Research Institute (EPRI) has developed a table giving recommended ranges of stay times for workers. The hs-3700 factors the present WBGT with the user-programmed metabolism level and clothing type to determine EPRI stay time from the data in Figure 3.3. In Figure 3.3, ranges are in minutes or hours, and an entry of NL means No Limit (i.e. the stay time exceeds 8 hours).

WBGT (Botsball) °C	(Botsball) °F	Work Clothes Metabolism			Cotton Coveralls Metabolism			Double Cottons Metabolism			Cottons Plus Plastics Metabolism		
		Low	Med	High	Low	Med	High	Low	Med	High	Low	Med	High
50 (47)	122 (116)	15-30	0-10		5-15	0-5		5-15					
48 (45)	118 (112)	20-45	5-15		15-30	5-10		10-20					5-15
46 (43)	115 (109)	20-45	5-20		20-45	5-15		15-30	0-10				15-20
44 (41)	111 (105)	30-60	10-25		20-45	5-20		20-45	5-15				15-30 0-10
42 (39)	108 (102)	45-90	15-30	5-10	30-60	10-25		20-45	5-20				20-45 5-15
40 (37)	104 (99)	60-90	15-45	10-20	45-90	15-40	5-10	30-60	10-25				20-45 5-20
38 (35)	100 (95)	90-120	20-45	15-30	60-90	15-45	10-25	45-90	15-30	5-10			30-60 10-25
36 (33)	97 (92)	2h-4h	30-60	15-40	90-120	25-45	15-30	60-90	15-45	10-20			45-90 15-30 5-10
34 (31)	93 (88)	3h-8h	45-90	20-45	2h-4h	30-60	15-45	90-120	20-45	15-30			60-90 15-45 10-20
32 (29)	90 (85)	NL	90-120	30-60	3h-8h	60-100	25-50	2h-4h	30-60	15-40			90-120 20-45 15-30
30 (27)	86 (81)	NL	2h-4h	60-120	NL	1h-2h	30-90	3h-8h	45-90	20-45			2h-4h 30-60 15-40
28 (26)	82 (78)	NL	NL	2h-4h	NL	1h-4h	1h-3h	NL	90-120	30-60			3h-8h 45-90 20-45
26 (24)	79 (75)	NL	NL	4h-8h	NL	NL	3h-8h	NL	2h-4h	60-120			90-120 30-60
24 (22)	75 (71)	NL	NL	NL	NL	NL	NL	NL	NL	2h-4h			2h-4h 60-120
22 (20)	72 (68)	NL	NL	NL	NL	NL	NL	NL	NL	4h-8h			NL 2h-4h
20 (18)	68 (64)	NL	NL	NL	NL	NL	NL	NL	NL	NL			NL 4h-8h
<20	<68	NL	NL	NL	NL	NL	NL	NL	NL	NL			NL

Figure 3.3: EPRI Stay Times

(Ranges of stay times in minutes (or "h" for hours) for different WBGT's (and Botsball readings) in °C and °F by combinations of clothing ensemble and metabolism).

ACGIH WORK/REST REGIMEN

The hs-3700 may be set up to use the precepts documented in the American Conference of Governmental Industrial Hygienists (ACGIH) brochure "*Threshold Limit Values and Biological Exposure Indices for 1986-1987*" (second printing) to determine an acceptable work/rest regimen based upon the present WBGT value and work load. The regimen is expressed as a ratio of percent work vs. percent rest each hour. As shown in Figure 3.5, the hs-3700 will report one of several possible work/rest regimens.

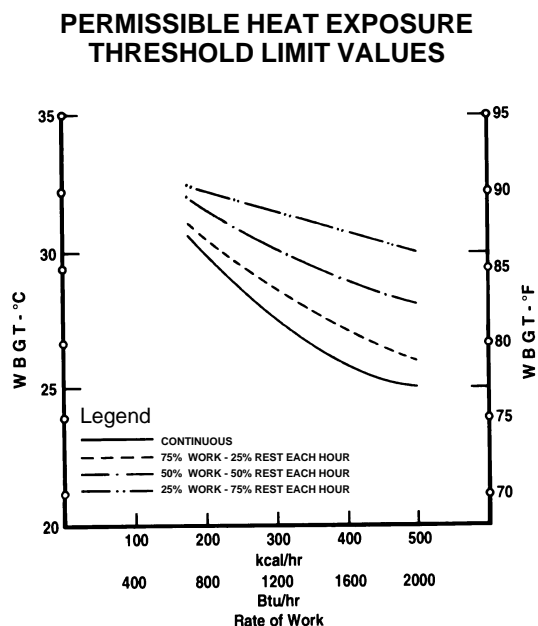


Figure 3.4: ACGIH Threshold Limit Value (TLV) Curves

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 3.5: ACGIH Permissible Heat Exposure Threshold Limit Values (TLVs) (Shown in °C WBGT)

This table assumes that the resting metabolic rate is 90 kcal/hour, and that the WBGT value of the resting place is the same or very close to that of the workplace.

Begin Logging

The Programming Disk allows you to send a command to the hs-3700 to start logging. This is especially useful if the hs-3700 has been placed in secure mode and you wish to start logging (see "Enter or Exit Secure Mode" later in this section).

Follow these steps to begin logging at the hs-3700:

1. Check your Configure Metrosoft Form to make sure that the Programming Disk is set up for the correct communications port (COM1 or COM2) and instrument type (hs-3700).
2. Press F4 (Program/Remotely Control Monitor) in the Main Menu.
3. Press F3 (Begin Logging At The Monitor) in the Program /Remotely Control Monitor Menu and instructions will appear on your screen.
4. Connect the RS-232 cable from the hs-3700 to the computer's serial port and turn the hs-3700 on.
5. Press <Enter>. If the computer is properly communicating with the hs-3700, the message "Command Successful" will appear.
6. Press any key to continue.

Exit Logging

The Programming Disk also allows you to send a command to the hs-3700 to stop logging. This is especially useful if the hs-3700 has been placed in secure mode and you wish to stop logging (see "Enter or Exit Secure Mode" later in this section).

Follow these steps to exit logging at the hs-3700:

1. Check your Configure Metrosoft Form to make sure that the Programming Disk is set up for the correct communications port (COM1 or COM2) and instrument type (hs-3700).
2. Press F4 (Program /Remotely Control Monitor) in the Main Menu.
3. Press F4 (Exit Logging At The Monitor) in the Program/Remotely Control Monitor Menu and instructions will appear on your screen.
4. Connect the RS-232 cable from the hs-3700 to the computer's serial port and turn the hs-3700 on.
5. Press <Enter>. If the computer is properly communicating with the hs-3700, the message "Command Successful" will appear.
6. Press any key to continue.

Clear All Data

The Programming Disk allows you to send a command to the hs-3700 to clear all recorded time history data.

Follow these steps to clear data at the hs-3700:

1. Check your Configure Metrosoft Form to make sure that the Programming Disk is set up for the correct communications port (COM1 or COM2) and instrument type (hs-3700).

PROGRAM/REMOTELY CONTROL THE hs-3700 MONITOR

The Programming Disk allows you to connect the hs-3700 to your computer where you can perform the following functions:

- Program (Configure) the Instrument
- Verify Communication Between the Computer and the hs-3700
- Start or Stop Logging at the hs-3700
- Clear All Data at the hs-3700
- Enter or Exit Secure Mode at the hs-3700
- View Temperature in Real Time

To access the above functions:

1. Press F4 (Program/Remotely Control Monitor) in the Main Menu. The Program/Remotely Control Monitor Menu will appear on your screen.
2. Press the appropriate function key for the task you wish to perform and follow the instructions on the computer screen. See the next sets of instructions for step by step information on each function in this menu.

Verify Communication

Before programming the hs-3700, we recommend you verify that the computer is properly hooked up and communicating with the hs-3700.

Follow these steps to verify communication with the hs-3700:

1. Check your Configure Metrosoft Form to make sure that the Programming Disk is set up for the correct communications port (COM1 or COM2) and instrument type (hs-3700).
2. Press F4 (Program/Remotely Control Monitor) in the Main Menu.
3. Press F2 (Verify Communication With The Monitor) and instructions will appear on your screen.
4. Connect the RS-232 cable from the hs-3700 to the computer's serial port and turn the hs-3700 on.
5. Press <Enter>. If the computer is properly communicating with the hs-3700, the message "Communication Established" will appear. If communication fails, a message will appear on the screen, with a list of instructions. If this occurs, check each of the items on the list and try communicating again.

NOTE: The RS-232 cable may have a two-position slide switch at the 25-pin serial connector. If so, the switch must be correctly positioned to communicate with the hs-3700. If unable to communicate, move the switch to the other position.

6. Once communication is established, press any key to continue.

ISO WORK/REST REGIMEN

The hs-3700 may alternatively be set up to use the results shown in International Standard (ISO) 7243-1982, "Hot Environments - Estimation of the Heat Stress on Working Man, Based on the WBGT Index" (first edition) to determine an acceptable work/rest regimen based upon the present WBGT value and metabolic rate. The regimen is expressed as a ratio of percent work vs. percent rest each hour. As shown in Figure 3.6, the hs-3700 will report one of several possible work/rest regimens.

Work/Rest Regimen	METABOLIC RATE			
	Low	Moderate	High	V. High
Continuous Work	30.8	28.3	26.6	25.4
75% Work/25% Rest (each hour)	31.3	29.1	27.6	26.6
50% Work/50% Rest (each hour)	31.9	30.2	28.9	28.0
25% Work/75% Rest (each hour)	32.6	31.6	30.7	30.0

Figure 3.6: ISO Permissible Heat Exposure Threshold Limit Values (TLVs)
(Shown in °C WBGT)

This table assumes that the resting metabolic rate is 90 kcal/hour, and that the WBGT value of the resting place is the same or very close to that of the workplace.

CHAPTER 4 OPERATING THE hs-3700

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 on installing the batteries and temperature sensor connection and preparation.

PUSHBUTTONS

The hs-3700 has 4 buttons, which are used to control all unit operations. Pressing the buttons individually or in groups allows you to perform various functions.

When pressed individually, the functions of the 4 buttons are:

ON/OFF	Turn the unit on and off
SELECT	View present temperature levels, stay time, and unit setup
LOG	Start and stop logging (recording data)
PRINT	Output a report to a serial printer

When pressed and held down, the following function is implemented:

ON/OFF	Clear all recorded data
---------------	-------------------------

When pressed in groups, the following function is implemented:

ON/OFF & PRINT	Enter or exit secure mode
---------------------------	---------------------------

Warranty Registration

Register your Heat Stress Monitor and Programming Disk and receive the first year of software upgrades **FREE**. Simply follow this set of quick instructions to use our on-line warranty card:

1. Press F2 (Configure Metrosoft) in the Main Menu and the Configure Metrosoft Form will appear.
2. Press F3 (Register Warranty) and the Warranty Registration Form will appear on your screen.
3. Press \uparrow , \downarrow or \langle Enter \rangle to move from field to field and type the appropriate information into the form.
4. When the form is complete, press F2 to print the form, and then mail it to: Metrosonics, Inc., P.O. Box 23075, Rochester, NY 14692.
5. Press F10 to exit the Warranty Registration Form and return to the Configure Metrosoft Form.
6. Press F10 again to return to the Main Menu.

Monitor Type

This field is used to select the type of monitor (video display terminal) used on your computer. You may select either monochrome or color.

Instrument Model

The Programming Disk can be used to set up not only the hs-3700 Heat Stress Monitor, but also Metrosonics hs-371 Monitor. This field is used to select which instrument you wish to program. (If hs-3700 is selected, the baud rate is automatically set to 9600 baud. If hs-371 is selected, you must also select the appropriate baud rate - see below).

Instrument Baud Rate

This is the baud rate used when Metrosoft is communicating with the instrument. If the model selected is hs-3700, the baud rate is automatically set to 9600 and this field is inaccessible. This baud rate has no effect on the baud rate used by the hs-3700 when printing directly to a serial printer.

When the model selected is hs-371, this field becomes accessible. In this case, you must select the same baud rate that the instrument has been set to.

Instrument Communications Port

This is the serial port that will be used when Metrosoft communicates with the Heat Stress Monitor. You may select either COM1 or COM2.

Fields For Datafiles Only

Several fields in the Configure Metrosoft Form are only needed for retrieving and viewing datafiles. These fields must be properly selected for viewing the sample datafile included on the Programming Disk.

The following lists the fields names that are only necessary for reviewing the sample datafile:

- Displayed File Listing Format
- Plotter Type (Serial)
- Plotter Port
- Plotter/Serial Printer Baud
- All Printer Setup Options
- Temperature Scale
- WBGT Type
- All Data Analysis Options For Graphs and Reports (Resolution, Draw Grid Lines, Limit Line Value, Range, Real-Time Value to Graph, Recorded Data Options, etc.)

The field "Store Test into Separate File" applies ONLY to data retrieval, a feature which is ONLY valid with ms-3700 Metrosoft. When using the Programming Disk this field may be ignored.

ON/OFF

The hs-3700 does NOT require any warm-up time; it is fully operational and accurate when turned on. However, if the hs-3700 is moved to a new area, allow the sensors time to stabilize their temperature before taking readings. Typical response times, for wide temperature changes, are as follows:

- Wet bulb: less than 5 minutes
- Globe: less than 15 minutes
- Dry bulb: less than 5 minutes
- WBGT: less than 15 minutes

Turning the hs-3700 On

1. Ensure that the correct temperature sensors are connected to the instrument, observing the symbols on the unit. Incorrect sensor positioning invalidates readings taken by the hs-3700.
2. Press and release ON/OFF. The unit will turn on and automatically begin a system check, during which the instrument model number and serial number are displayed:

Example:

```
hs-3700 V1.0  
SN 1234...WAIT
```

As part of the system check, the hs-3700 determines which temperature sensor assemblies are connected. For this reason, you should plug in all temperature sensors prior to turning the hs-3700 on. It is assumed that sensors will not be removed or connected while the hs-3700 is on.

3. After the system check, the present date, time and battery voltage will be displayed. This is called the "Main Screen":

Example:

```
6/15 @ 12:15:45  
Vbat= 8.1V (OK)
```

You must use either the Programming Disk or ms-3700 Metrosoft to set the hs-3700 real time clock (see Chapter 5). Until the clock has been set, "TIME NOT SET" will appear on the top line of the Main Screen. When the battery voltage becomes low, the Main Screen displays "LOW" after the voltage level. In this case, it is recommended that you immediately turn the hs-3700 off and install a new set of batteries (see "Batteries & External Power" in Chapter 2).

Turning the hs-3700 Off

1. To turn the hs-3700 off, while viewing the Main Screen, press and release ON/OFF. The display will blank and the hs-3700 will turn off.

NOTE: The hs-3700 may not be turned off while logging. This is to prevent logging from accidentally being stopped. See "Log" later in this chapter.

NOTE: The hs-3700 may not be turned off while secured. See "Secure Mode" later in this chapter.

NOTE: When the hs-3700 is NOT logging and no key is pressed for 10 minutes, the unit will automatically turn off to conserve battery life.

Setup Restored

When the hs-3700 is turned on, if this is the first time you use the hs-3700, or if the battery pack completely loses power or is removed for several minutes, the following message will be displayed:

SETUP RESTORED
...PRESS ANY KEY

The purpose of this message is to inform you that the real time clock is NOT set, and the setup the hs-3700 was last (most recently) programmed for is being used.

You **MUST** acknowledge this message by pressing any key. Then, if you wish to set the real time clock, you may do so using either the Programming Disk or ms-3700 Metrosoft (see Chapter 5).

Factory Defaults

It is very unlikely that the following message be displayed when the hs-3700 is turned on:

FACTORY DEFAULTS
...PRESS ANY KEY

The purpose of this message is to inform you that the instrument is NOT properly calibrated. If this occurs, press any key to acknowledge this message, turn the hs-3700 off, and then call the Metrosonics Service Department at 716-334-7300. The hs-3700 can **ONLY** be calibrated by Metrosonics personnel.

WARNING: The hs-3700 will continue to function after this message is displayed, however, it should **NOT** be used.

SETTING UP THE PROGRAMMING DISK FOR YOUR COMPUTER

Press F2 (Configure Metrosoft) in the Main Menu, and the Configure Metrosoft Form will appear.

This form allows you to set up the Programming Disk for the type of computer system you have. This step **MUST** be performed the first time you use the Programming Disk to make sure that the software knows what kind of hardware setup you have.

Since the software saves the setup until you change it, you do not have to repeat this step unless a change is desired or if you are using a different COM port, disk drive, or directory name.

Use the following instructions to fill in the Configure Metrosoft Form:

- Press ↓ or <Enter> to move to the next field
- Press ↑ to move to the previous field
- Press → or ← to scroll through choices for a field
- Type information for fields that do not offer choices when → or ← are pressed
- Press F2 to save the setup
- Press F3 to fill out the warranty registration
- Press F10 to return to the Main Menu

NOTE: If you press F10 without saving the setup, the software will remember your changes until you exit the program. Once you exit the software program, the Configure Metrosoft Form will automatically revert to the last saved setup.

The following list provides information on the selections in the Configure Metrosoft Form which are pertinent to programming an hs-3700:

Disk Drive For Recorded Data

This tells the software which disk drive you will be using to store Monitor Setup Files and the sample datafile. You may enter any letter from A to Z. Generally A and B are floppy drives, and C is the hard disk.

Directory

This tells the software which subdirectory (if any) you will be using to store Monitor Setup Files and the sample datafile.

When typing the directory name **DO NOT** type in the disk drive. Metrosoft will bracket (\...\) the name if necessary. Invalid subdirectory name characters (spaces, periods, and some special symbols) are beeped.

If you do not have a subdirectory, leave this field blank.

NOTE: Metrosoft does NOT create the subdirectory for you. You must do so from the operating system. If you are using a hard drive, we recommend that you create a subdirectory for Monitor Setup Files and the sample datafile (see your DOS manual for details on creating subdirectories).

CHAPTER 5 PROGRAMMING DISK (ms-3700P)

The ms-3700P Programming Disk allows you to program the hs-3700 with your own settings. As an option ms-3700 Metrosoft is available. In addition to programming the hs-3700, this enhanced software program allows you to store datafiles, create graphs & reports, search your data base, and more! Call Metrosonics Sales Department for more information at (716) 334-7300.

The Programming Disk contains a sample datafile, which allows you to see the database, report generation and graphing capabilities offered in ms-3700 Metrosoft. See "ms-3700 Metrosoft Features" later in this chapter for more information.

In addition to programming the hs-3700 Heat Stress Monitor, the Programming Disk also allows you to program hs-371 Heat Stress Monitors.

IMPORTANT!

Register your Monitor and Programming Disk **NOW** and receive the first year of software upgrades **FREE**. Either fill out the enclosed card or see "Warranty Registration" later in this chapter for quick instructions on using the on-line warranty card to register your products.

STARTING THE PROGRAMMING DISK

1. Boot MS-DOS Version 3.0 or higher.
2. Insert the Programming Disk into the floppy drive.
3. Type the following command:

M<Enter>

The Metrosonics Logo will appear followed by the Main Menu. Press any key while the logo is on the screen and the Main Menu will appear faster.

NOTE: If desired, you may copy the Programming Disk into a directory on your hard drive. Then, to start the Programming Disk, simply change to the directory and type M<Enter>.

SELECT

The SELECT button allows viewing the instrument setup, and present temperature levels and stay times or work/rest regimens. Repeatedly press SELECT to step through various information screens. While viewing any screen accessible via SELECT, you may press ON/OFF to directly redisplay the Main Screen (present date, time and battery voltage).

1. Make sure the hs-3700 is turned on and displaying the Main Screen.
2. Press and release SELECT and the hs-3700 will display Mean WBGT, updated in real-time once per second.

Example:

```
MEAN WBGTin  
91.0°F
```

This is either indoor or outdoor Mean WBGT, based upon the present setup.

NOTE: This screen appears only when all three sets of temperature sensors are connected to the hs-3700. This screen is skipped if only one or two sets of temperature sensors are connected.

3. Press and release SELECT again and the hs-3700 will display mean stay time or work/rest regimen, updated in real-time once per second.

Example:

```
MEAN STAY: 6:45  
WORK LEVEL: 4
```

Based upon the present setup, the hs-3700 will show either US Navy stay time, EPRI stay time, ACGIH work/rest regimen or ISO work/rest regimen. The programmed work level and clothing type (if applicable) are shown on the bottom line of this screen.

NOTE: This screen appears only when all three sets of temperature sensors are connected to the hs-3700. This screen is skipped if only one or two sets of temperature sensors are connected.

4. Press and release SELECT again and the unit will show the wet bulb (WB) and dry bulb (DB) temperature levels for the first set of sensors connected to the hs-3700. This information is updated in real-time once per second.

Example:

```
WB[1]= 89.7°F  
DB[1]= 91.6°F
```

5. Press and release SELECT again and the unit will show the globe temperature (GT) level and the WBGT value computed for the first set of sensors connected to the hs-3700. This information is updated in real-time once per second.

Example:

```
GT[1]= 95.1°F  
WBGTin = 91.3°F
```

This is either indoor or outdoor WBGT, based upon the present setup.

6. Press and release SELECT again and the hs-3700 will display stay time or work/rest regimen computed from the WBGT of the first set of sensors connected to the hs-3700. This information is updated in real-time once per second.

Example:

```
STAY[1]: 6:30  
WORK LEVEL: 4
```

Based upon the present setup, the hs-3700 will show either US Navy stay time, EPRI stay time, ACGIH work/rest regimen or ISO work/rest regimen. The programmed work level and clothing type (if applicable) are shown on the bottom line of this screen.

7. Repeat steps 4-6 to view real-time data for one or two additional sets of optional temperature sensors (if any).
8. Press and release SELECT again and the unit will show the duration of the present (most recent) test (see "Log" later in this chapter). This information is updated in real-time once per second while logging.

Example:

```
TEST NUMBER    1  
2 DAYS 10:30:45
```

9. Press and release SELECT again and the unit will show the instrument's remaining memory capacity for storing recorded data (see "Log" later in this chapter). This information is updated in real-time once per second while logging.

Example:

```
REMAINING MEMORY  
4 DAYS 14:12:30
```

10. Press and release SELECT again and the hs-3700 will display the programmed area and user ID numbers.

Example:

```
AREA ID=1234  
USER ID=1234
```

11. Press and release SELECT again and the unit will show the programmed scheduled run information (see "Log" later in this chapter).

Example:

```
SCH. RUN: SINGLE  
6/13 @ 12:00:00
```

12. Press and release SELECT again to return to viewing the Main Screen (present date, time and battery voltage).

NOTE: If no code or an incorrect code is entered, the message "WRONG SECURE CODE" will be displayed followed by the Main Screen.

NOTE: If you cannot remember the code, try using 1234 (the default code for the instrument).

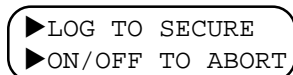
SECURE MODE

The hs-3700 may be secured to protect your data. Secure mode, when enabled, will not allow the unit to turn off; it will also not allow you to exit datalogging or clear recorded data. Secure mode may be enabled or disabled either from the hs-3700 keypad, or using the Programming Disk or ms-3700 Metrosoft (see Chapter 5).

The hs-3700 comes to you programmed with a security code of 1234. You may change this code using the Programming Disk or ms-3700 Metrosoft (see Chapter 5). You do NOT enter the code to enable secure mode, however you MUST enter the code to disable (exit) secure mode. This assures that only authorized personnel can disable secure mode.

To place the unit in secure mode:

1. Simultaneously press and release the ON/OFF and PRINT buttons. The following instructions will be displayed:



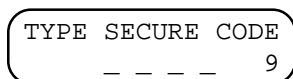
▶ LOG TO SECURE
▶ ON/OFF TO ABORT

2. If you do NOT wish to place the hs-3700 in secure mode, press and release ON/OFF to abort this procedure.

If you DO wish to place the unit in secure mode, press and release LOG. The message "SECURE MODE ENABLED" will be displayed, and then the hs-3700 will display the Main Screen.

When you are ready to exit secure mode, follow these steps:

1. Simultaneously press and release the ON/OFF and PRINT buttons. A screen asking you to enter the 4-digit secure code will be displayed with a 9 second countdown timer:



TYPE SECURE CODE
_ _ _ _ 9

2. You have 9 seconds to enter your 4-digit code. To enter the code, use the following keypresses as appropriate:

ON/OFF = 1
SELECT = 2
LOG = 3
PRINT = 4

For example, if your secure code were 1234, you would press ON/OFF (1), then SELECT (2), then LOG (3), and then PRINT (4).

After the correct secure code is entered, the message "SECURE MODE EXITED" will be displayed followed by the Main Screen.

LOG

While the hs-3700 is logging, it samples all temperature levels and records these in memory at a fixed time interval called the time history period length. Using the Programming Disk or ms-3700 Metrosoft, the period length is user-selectable from one minute to one hour in one minute steps.

Start and Stop Logging

You may initiate datalogging either via manual keypress, or automatically via a pre-programmed "scheduled run". A scheduled run is set up using either the Programming Disk or ms-3700 Metrosoft (see Chapter 5).

To manually initiate datalogging:

1. Press and release LOG to start logging. The hs-3700 will display "DATA LOGGING" momentarily. "DATA LOGGING" will be flashed periodically as a reminder that logging is in progress.
2. Press and release LOG a second time to stop logging. The hs-3700 will display "LOGGING DONE" momentarily.

NOTE: The hs-3700 CANNOT be turned off while logging is in progress. If ON/OFF is pressed during logging, the message "NOT ALLOWED WHILE LOGGING" is displayed.

NOTE: The hs-3700 can be placed in secure mode using the Programming Disk or ms-3700 Metrosoft (see Chapter 5). While in secure mode, the LOG button CANNOT be used to stop logging. The only way to stop logging while in secure mode is by using either the Programming Disk or ms-3700 Metrosoft (see Chapter 5).

PRINT

The PRINT button allows you to print a formatted report which shows all programmed parameters and a complete time history of all recorded data. The following information is shown for each time history period:

- Date and time of samples
- User and area ID numbers
- Wet bulb, dry bulb and globe temperature values, indoor or outdoor WBGT, and stay time or work/rest regimen
- Mean WBGT (shown only when three sets of temperature sensors are connected to the hs-3700)

A sample report is shown in Figure 4.1.

To output a report:

1. After logging is complete, connect the RS-232 cable to the 5-pin connector on the right side of the hs-3700, and to a serial printer.
2. Press and release PRINT, and the report will be output.
3. Press and release ON/OFF if you wish to terminate printing in progress.

NOTE: The hs-3700 baud rate **MUST** match the baud rate your serial printer is set for. Use the Programming Disk or ms-3700 Metrosoft to set the hs-3700 baud rate (see Chapter 5).

NOTE: If the report does not print, change the slide position of the switch on the RS-232 cable and try to print the report again.

NOTE: Serial printing is done using 1 start bit, 8 data bits, 1 stop bit, and no parity. Software handshaking (Xon/Xoff) is required to control the flow of characters to the printer.

```
METROSONICS hs-3700 SN11003 V1.0
REPORT PRINTED 06/06/94 AT 14:23:03
PERIODS LOGGED: 6063
WORK LOAD: Mod      WBGT TYPE: Indoor  SCALE: degF

PER  DATE      TIME      USER  AREA  WB    DB    GT    WBGT  WK/RST
 1  4/08/94  15:30:12  5678  1234  81.5  82.4  81.7  81.6  75/25%
 2  4/08/94  15:31:12  5678  1234  82.1  82.8  82.5  82.2  75/25%
 3  4/08/94  15:32:12  5678  1234  82.5  83.1  83.2  82.7  50/50%
 4  4/08/94  15:33:12  5678  1234  83.0  83.4  83.6  83.2  50/50%
 5  4/08/94  15:34:12  5678  1234  83.1  83.4  84.0  83.4  50/50%
 6  4/08/94  15:35:12  5678  1234  83.4  83.5  84.2  83.6  50/50%
 7  4/08/94  15:36:12  5678  1234  83.5  83.5  84.2  83.7  50/50%
 8  4/08/94  15:37:12  5678  1234  83.7  83.5  84.4  83.9  50/50%
 9  4/08/94  15:38:12  5678  1234  83.7  83.5  84.5  83.9  50/50%
10  4/08/94  15:39:12  5678  1234  83.7  83.4  84.5  83.9  50/50%
11  4/08/94  15:40:12  5678  1234  83.8  83.3  84.5  84.0  50/50%
```

Figure 4.1: Sample Printed Report

CLEARING DATA

Clearing data erases ALL previously recorded time history data from the hs-3700. Data cannot be cleared while logging or when the hs-3700 is in secure mode. Follow these instructions to clear the data:

1. Make sure the hs-3700 is turned on and displaying the Main Screen (present date, time and battery voltage).
2. Press and hold ON/OFF. The display will shut off momentarily, and then the following message and countdown timer will be displayed:

CLEAR DATA IN 9
RELEASE TO ABORT

3. Continue to hold ON/OFF. The timer will count down to 1, then data will be cleared and the following message will be displayed:

ALL DATA
CLEARED

If you release ON/OFF before the timer counts down to 1, the data will NOT be erased.

NOTE: You may also clear data with the Programming Disk or ms-3700 Metrosoft (see Chapter 5).