

INCH- POUND

MIL-M-24605A(SH)

21 June 1988

SUPERSEDING

MIL-M-24605(SH)

22 May 1981

(See 6 8)

## MILITARY SPECIFICATION

## MONITOR, HEAT STRESS

This specification is approved for use within the Naval Sea Systems Command, Department of the Navy, and is available for use by all Departments and Agencies of the Department of Defense.

## 1. SCOPE

1.1 Scope. This specification covers an environmentally hardened portable instrument that transforms the surrounding thermal energy in a manner that can be electrically measured and converted to various parameters that include the dry bulb temperature (DBT), wet bulb temperature (WBT), globe temperature (GT), and a heat stress index. The heat stress monitor (HSM) may be microprocessor based

1.2 Classification. This portable monitor used for physiological heat stress determination shall be classified as specified (see 6.2.1), according to the following variables:

<u>Type</u>	<u>Displayed functions</u>
(see 1.2.1)	(see 1.2 2)

1.2.1 Type. The HSM shall be designated by the following three-letter symbol:

<u>Type</u>	<u>Symbol</u>
Heat stress monitor	HSM

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to Commander, Naval Sea Systems Command, SEA 5523, Department of the Navy, Washington, DC 20362-5101 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A

FSC 6665

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1.2.2 Displayed functions. The HSM shall display the functions that are contained in the designated category and represented by the following numerical symbol:

<u>Displayed functions</u>	<u>Symbol</u>
Category 1 (see 3.3.3.1.1)	1
Category 2 (see 3.3.3.1.2)	2

## 2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications and standards. The following specifications and standards form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of these documents shall be those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation.

## SPECIFICATIONS

## FEDERAL

W-C-596	- Connector, Plug, Receptacle and Cable Outlet, Electrical Power General Specification for.
W-C-596/13	- Connector, Plug, Electrical, General Purpose, Hospital Grade Grounding, 2 Pole, 3 Wire, 15 Amperes, 125 Volts, 50/60 Hertz.
W-C-596/76	- Connector, Cable Outlet, Electrical, Midget Locking, Specific Purpose, General Grade, Grounding, 2 Pole, 3 Wire, 15 Amperes, 125 Volts, 50/60 Hertz.
W-C-596/147	- Connector, Male Inlet Electrical, Specific Purpose, Grounding, 2 Pole, 3 Wire, 15 Amperes, 125 Volts, 50/60 Hertz.
JJ-S-750	- Strap, Webbing.
QQ-A-591	- Aluminum Alloy Die Castings.
PPP-F-320	- Fiberboard, Corrugated and Solid Sheet Stock (Container Grade), and Cut Shapes.

## MILITARY

MIL-T-27	- Transformers and Inductors (Audio, Power, and High Power Pulse), General Specification for.
MIL-R-29	- Resistors, Fixed, Meter Multiplier, External (High Voltage, Ferrule Terminal Type).
MIL-C-81	- Capacitors, Variable, Ceramic Dielectric General Specification for.
MIL-I-1361	- Instrument Auxiliaries, Electrical Measuring: Shunts, Resistors, and Transformers.
MIL-S-3786	- Switches, Rotary (Circuit Selector, Low Current Capacity), General Specification for.
MIL-S-3950	- Switches, Toggle, Environmentally Sealed, General Specification for.
MIL-C-4150	- Cases, Transit and Storage, Waterproof and Water-Vaporproof.

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- MIL-C-5015 - Connector, Electrical, Circular Threaded, AN Type, General Specification for.
- MIL-B-5423 - Boots, Dust and Water Seal (for Toggle and Push-Button Switches Circuit Breakers, and Rotary Actuated Parts), General Specification for
- MIL-C-5541 - Chemical Conversion Coatings on Aluminum and Aluminum Alloys.
- MIL-A-8625 - Anodic Coatings, for Aluminum and Aluminum Alloys.
- MIL-S-8805 - Switches and Switch Assemblies, Sensitive and Push (Snap Action), General Specification for.
- MIL-R-12934 - Resistors, Variable, Wire-Wound, Precision General Specification for.
- MIL-P-13949 - Plastic Sheet, Laminated, Metal Clad (For Printed Wiring Boards), General Specification for.
- MIL-C-14157 - Capacitor, Fixed, Paper (Paper-Plastic) or Plastic Dielectric, Direct Current (Hermetically Sealed in Metal Cases), Established Reliability, General Specification for
- MIL-P-15024 - Plates, Tags and Bands for Identification of Equipment.
- MIL-P-15024/5 - Plates, Identification.
- MIL-E-15090 - Enamel, Equipment, Light-Gray (Formula No. 111).
- MIL-R-15109 - Resistors and Rheostats, Naval Shipboard.
- MIL-F-15733 - Filters and Capacitors, Radio Frequency Interference General Specification for.
- MIL-S-15743 - Switches, Rotary, Enclosed.
- MIL-E-17555 - Electronic and Electrical Equipment, Accessories, and Provisioned Items (Repair Parts): Packaging of.
- MIL-F-18327 - Filters; High Pass, Low Pass, Band Pass, Band Suppression and Dual Functioning, General Specification for.
- MIL-L-19140 - Lumber and Plywood, Fire-Retardant Treated.
- MIL-F-19207 - Fuseholders, Extractor, Post Type, Blown Fuse Indicating and Nonindicating, General Specification for.
- MIL-F-19207/36 - Fuseholders, Extractor Post Type, Nonindicating, R.F. Shielded Type FHN55W.
- MIL-S-19500 - Semiconductor Devices General Specification for.
- MIL-C-19978 - Capacitors, Fixed, Plastic (or Paper-Plastic) Dielectric, (Hermetically Sealed in Metal, Ceramic, or Glass Cases), Established and Non-Established Reliability, General Specification for.
- MIL-T-21038 - Transformers, Pulse, Low Power, General Specification for.
- MIL-R-22097 - Resistor, Variable, Nonwire Wound (Adjustment Types) General Specification for.
- MIL-S-22473 - Sealing, Locking, and Retaining Compounds: (Single-Component).

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- MIL-S-22710 - Switches, Code, Indicating Wheel (Printed Circuit), (Thumbwheel and Push Button), General Specification for.
- MIL-F-23419 - Fuses, Instrument Type General Specification for.
- MIL-P-26514 - Polyurethane Foam Rigid or Flexible, for Packaging.
- MIL-M-28787 - Modules, Standard Electronic General Specification for.
- MIL-P-28809 - Printed Wiring Assemblies.
- MIL-C-28901 - Connectors, Electrical, Plugs, Tip (Test Point Plug, Banana Plug) General Specification for.
- MIL-C-28901/5 - Connectors, Electrical, Plugs, Tip, Single, Miniature, (Test Point Plug), .080.
- MIL-M-38510 - Microcircuits, General Specification for.
- MIL-C-39003 - Capacitors, Fixed, Electrolytic (Solid Electrolyte), Tantalum, Established Reliability, General Specification for.
- MIL-C-39024 - Connectors, Electrical: Jacks, Tip (Test Point, Panel or Printed Wiring Type), General Specification for.
- MIL-C-39024/10 - Jack, Tip (Test Point Type, Panel Type; Single Test Point (Threaded), Low Voltage, .080).
- MIL-I-46058 - Insulating Compound, Electrical (For Coating Printed Circuit Assemblies).
- MIL-P-55110 - Printed Wiring Boards General Specification for.
- MIL-T-55164 - Terminal Boards, Molded, Barrier Screw and Stud Types, and Associated Accessories, General Specification for.
- MIL-R-83248 - Rubber, Fluorocarbon Elastomer, High Temperature, Fluid, and Compression Set Resistant.
- MIL-C-83503 - Connectors, Electrical, Flat Cable, and/or Printed Wiring Board, Nonenvironmental, General Specification for.
- MIL-C-85049 - Connector Accessories, Electrical General Specification for.
- MIL-C-85049/1 - Connector Accessories, Electrical, Backshell, Cable Sealing, Straight, Grounding (Without Strain Relief), Category 4C (For MIL-C-5015 Solder Connectors).

## STANDARDS

## FEDERAL

- FED-STD-H28 - Screw-Thread Standards for Federal Services.
- FED-STD-H28/18 - Screw-Thread Standards for Federal Services, Section 18 Photographic Equipment Threads

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- MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes.
- MIL-STD-108 - Definitions of and Basic Requirements for Enclosures for Electric and Electronic Equipment.
- MIL-STD-130 - Identification Marking of U.S. Military Property.
- MIL-STD-198 - Capacitors, Selection and Use of.
- MIL-STD-199 - Resistors, Selection and Use of
- MIL-STD-202 - Test Methods for Electronic and Electrical Component Parts.
- MIL-STD-275 - Printing Wiring for Electronic Equipment.
- MIL-STD-278 - Welding and Casting Standard.
- MIL-STD-461 - Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference.
- MIL-STD-462 - Electromagnetic Interference Characteristics, Measurement of.
- MIL-STD-701 - Lists of Standard Semiconductor Devices.
- MIL-STD-1353 - Electrical Connectors, Plug-In Sockets and Associated Hardware; Selection and Use of.
- MIL-STD-1389 - Design Requirements for Standard Electronic Modules.
- DOD-STD-1399, Section 300 - Interface Standard for Shipboard Systems Electric Power, Alternating Current. (Metric)
- MS3102 - Connector, Receptacle, Electric, Box Mounting, Solder Contacts, AN Type.
- MS3106 - Connector, Plug, Electric, Straight, Solder Contacts, AN Type.
- MS51940 - Loops, Slide (for Equipage).

2.1.2 Other Government publications. The following other Government publications form a part of this specification to the extent specified herein. Unless otherwise specified, the issues shall be those in effect on the date of the solicitation.

**PUBLICATIONS****OFFICE OF THE CHIEF OF NAVAL OPERATIONS (OPNAV)**

5100.20 - Shipboard Heat Stress Control and Personnel Protection.

**NAVAL SEA SYSTEMS COMMAND (NAVSEA)**

0900-LP-001-7000 - Fabrication and Inspection of Brazed Piping Systems.

**DEPARTMENT OF TRANSPORTATION (DOT)**

Code of Federal Regulations (CFR) 29, Chapter 17, Part 1910 - Occupational Safety and Health Standards.

(The Code of Federal Regulations (CFR) is for sale on a subscription basis by the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402).

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(Copies of specifications, standards, and publications required by contractors in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting activity.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted shall be those listed in the issue of the DoDISS specified in the solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS shall be the issue of the nongovernment documents which is current on the date of the solicitation.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- A 249 - Standard Specification for Welded Austenitic Steel Boiler, Superheater; Heat-Exchanger, and Condenser Tubes.
- A 269 - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service (DoD adopted)
- A 276 - Standard Specification for Stainless and Heat-Resisting Steel Bars and Shapes. (DoD adopted)
- B 117 - Standard Method of Salt Spray (Fog) Testing. (DoD adopted)
- B 167 - Standard Specification for Nickel-Chromium-Iron Alloys (UNS N06600 and N06690) Seamless Pipe and Tube. (DoD adopted)
- G 21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi. (DoD adopted)

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.)

(Nongovernment standards and other publications are normally available from the organizations which prepare or which distribute the documents. These documents also may be available in or through libraries or other informational services.)

2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein (except for associated detail specifications, specification sheets or MS standards), the text of this specification shall take precedence. Nothing in this specification, however, shall supersede applicable laws and regulations unless a specific exemption has been obtained.

## 3. REQUIREMENTS

3.1 First article. When specified in the contract or purchase order, a sample shall be subjected to first article inspection (see 4.3 and 6.3).

3.2 Materials. Material for the parts that make up the HSM shall be as specified in table I.

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TABLE I. Materials.

Part	Material	Material references	Remarks
Battery	Rechargeable sealed nickel-cadmium cells, size AA	See 3.7.3.3.5	NEDA no. 10015
Carrying case	Aluminum	MIL-C-4150	Type I, style 1, class A
Carrying case foam	Polyurethane foam	MIL-P-26514	
Electrical components			See 3.7
Threaded fasteners	Corrosion-resisting steel	ASTM A 276	1/
Gaskets	Fluorocarbon rubber (250 degrees Fahrenheit (*F) maximum	MIL-R-83248	Flat gaskets type II
Globe thermometer	Metallic globe		Nonreflective black surface
Case enclosure	Aluminum	QQ-A-591	2/
O-rings	Fluorocarbon rubber	MIL-R-83248	O-rings, type I
Power cord		Type SJO	See 3.10(e)
Seal, entrance			See 3.2.2.1
Sheath, temperature sensor (wet bulb and dry bulb)	Inconel UNSN06600	ASTM B 167	
	316 stainless steel	ASTM A 249 ASTM A 269	
Wet bulb sensor wicks	Muslin or cotton		See 3.6 3
Water reservoir	Polyethylene clear plastic		See 3.6.2
Water reservoir refill bottle	Polyethylene clear plastic		See 3.10(b)

See footnotes at top of next page.



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- 1/ Unless retained by other methods, retaining compound in accordance with grade C of MIL-S-22473 shall be used.
- 2/ Aluminum shall be prepared for protection against corrosion by chromate conversion coatings in accordance with MIL-C-5541 or by anodizing in accordance with type I or II of MIL-A-8625. Aluminum shall then contain a finish which shall include a flash air-dry primer and a gray enamel finish coat. The finish coat shall be in accordance with type II of MIL-E-15090

3.2.1 Recovered materials. Unless otherwise specified herein, all equipment, material, and articles incorporated in the products covered by this specification shall be new and may be fabricated using materials produced from recovered materials to the maximum extent practicable without jeopardizing the intended use. The term "recovered materials" means materials which have been collected or recovered from solid waste and reprocessed to become a source of raw materials, as opposed to virgin raw materials. None of the above shall be interpreted to mean that the use of used or rebuilt products is allowed under this specification unless otherwise specifically specified.

3.2.2 Nonmetal materials. When used for seals, protective finishes on nonmetals shall be moisture and flame resistant, shall not support fungus growth, and shall not be adversely affected by the ambient environments specified in the construction and performance requirements of this specification

3.2.2.1 Entrance seals. Entrance seals shall not chemically react, degrade, or outgas when subjected to the following: air, distilled water, seawater, salt, petroleum and silicone-based oils, oil solvents, prolonged (greater than 1 month) periods of exposure to ambient temperatures, prolonged periods of exposure to elevated temperatures (up to 200°F), and exposure to prolonged cycling periods from ambient to elevated temperatures. The entrance seal shall be airtight, non-hygroscopic, fungus resistant, and able to form a chemical bond with the insulation of the wiring harness sufficient to meet the above sealing requirements.

3.2.3 Fungus proof. Unless otherwise specified herein, equipment, material, and articles incorporated in the products covered by this specification shall use only fungus inert materials. If all states or grades of a material are not fungus inert, then verification is required to show that the state or grade of the material being used is fungus inert. Verification shall be made by means of passing the fungus test specified in ASTM G 21 for 28 days without any visible growth of fungus. Certification based upon test data from a qualified source shall be sufficient evidence of acceptability. When specified in the contract or order, a certificate of compliance shall be prepared (see 6.2.2).

3.2.3.1 Fungus inert. The following materials are considered to be fungus inert for purposes of this specification: acrylics, acrylonitrile-styrene, acrylonitrile-vinyl-chloride copolymer, asbestos, ceramics, chlorinated polyether, fluorinated ethylenepropylene copolymer (FEP), glass, metals, mica, silicone-glass fiber plastic laminate, phenolic-nylon fiber plastic laminate, diallyl phthalate, polyacrylonitrile, polyamide, polycarbonate, polyester-glass fiber laminates, polyethylene (high density - above 0.940), polyethylene terephthalate, polyimide, polymonochlorotrifluoroethylene, polypropylene, polystyrene, polysulfone, polytetrafluoroethylene, polyvinylidene chloride, silicone resin, siloxane-polyolefin polymer, and siloxane-polystyrene.



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**3.2.3.2 Fungus resistant.** The following materials are among those considered to be fungus resistant for purposes of this specification and must be verified to be fungus inert: acrylonitrile-butadiene-styrene (ABS), acetal resins, cellulose acetate, cellulose acetate butyrate, epoxy-glass fiber laminates, epoxy-resin, lubricants, melamine-formaldehyde, organic polysulphides, phenol-formaldehyde, polydichlorostyrene, polyethylene (low and medium density - 0.940 and below), polymethyl methacrylate, polyurethane (the ester types are particularly susceptible), polyricinoleates, polyvinyl chloride, polyvinyl chloride-acetate, polyvinyl fluoride, rubbers (natural and synthetic) and urea-formaldehyde.

**3.2.4 Restricted materials.** Restrictions for materials incorporated in the parts and products covered by this specification shall be as specified in 3.2.4.1 through 3.2.4.3.

**3.2.4.1 General restrictions.** Unless otherwise specified for a particular use within, the following types or kinds of materials shall not be used: cellulose-acetate, cellulose nitrate, cellulose regenerate, cork, felts, hair, wool, asbestos compounds, jute, leather, linen, magnesium and magnesium alloy, organic fiberboard, paper and cardboard, plastic (using cotton, linen, or wood flour as a filler), wood, or fungus nutrients. Equipment, material, and articles incorporated in the parts and products covered by this specification shall not contain mercury, cadmium, asbestos, glass, radioactive material, or polychlorinated biphenyl (PCB).

**3.2.4.2 Carcinogens.** Certain chemicals have been identified in the occupational safety and health act (OSHA) as cancer-producing substances (carcinogens). Before using any materials which might contain these chemicals, they should be evaluated in accordance with the CFR title 29, chapter XVII, part 1910.

**3.2.4.3 Gases or fumes.** Materials or combinations of materials used shall not liberate gases which combine with the atmosphere to form an acid or corrosive alkali, nor shall they liberate toxic or corrosive fumes which would be detrimental to the performance of the HSM or to the health of the operator. The materials also shall not liberate gases which will produce an explosive atmosphere.

**3.3 Operating parameters.** Operating parameters shall be as specified in 3.3.1 through 3.3.6.

**3.3.1 Displayed functions.** The HSM shall perform and display the following functions:

- (a) Measurement of DBT.
- (b) Measurement of WBT.
- (c) Measurement and calculation of GT
- (d) Calculation of the wet bulb globe temperature (WBGT) index.
- (e) Lookup table for exposure time.
- (f) Performance of an electronic circuit check on items (a) through (e).

**3.3.2 Calculation and lookup functions.** Calculation and lookup functions shall be as specified in 3.3.2.1 through 3.3.2.3.1.

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3.3.2.1 Globe temperature. The HSM shall convert the measured GT to one corresponding to a 6-inch Vernon globe thermometer. The accuracy of this converted and displayed value (hereinafter called GT) shall meet the accuracy requirements specified in 3.14.3.1 and the usage requirement specified in 3.5.5(e).

3.3.2.2 WBGT index. Under steady-state conditions, the HSM shall provide the WBGT index within the accuracy specified in 3.14.3.1 and in accordance with the following formula:

$$\text{WBGT index} = 0.7 \text{ WBT} + 0.2 \text{ GT} + 0.1 \text{ DBT}$$

3.3.2.3 Exposure time. The exposure time is based on the six physiological heat exposure limit (PHEL) curves shown on figure 1. The lookup table shown on figure 2 was developed from these curves and shall be the lookup table that is incorporated into the HSM. The lookup table shall use the calculated WBGT index and one of the six selected work conditions (PHEL-I through PHEL-VI) as the input functions. The exposure time for the selected work condition shall be displayed as X:YY, where X is the number of hours and YY is the number of minutes.

3.3.2.3.1 Exposure time applicability. The exposure time shall be the maximum permissible duration that an individual shall remain at the work station. This duration is a function of the environmental conditions (as calculated by the WBGT index) and the work condition (the degree of physical exertion required to perform the task). Each of the six PHEL curves (see figure 1) correspond to a different work condition varying from light (PHEL-I) to strenuous (PHEL-VI) physical work. The PHEL curves are accurate for a normal, healthy individual who has had adequate rest (6 hours of sleep in the last 24 hours) and adequate recovery time from previous heat stress exposure (2 hours of recovery for every 1 hour of exposure or 4 hours maximum). An individual at the work station shall wear work clothes composed of at least 35 percent cotton fiber that do not contain starch, and if necessary, can be quickly penetrated with water. OPNAV 5100.20 shall be specified as the source for PHEL curve selection. Figure 2 provides a lookup table for the calculated exposure time based upon the PHEL curves.

3.3.3 Front panel switches. The front panel shall contain the layout, and the switches and displays shall be labeled as shown on figure 3.

3.3.3.1 Displayed function switch. The function to be displayed shall be selected by means of this switch. This switch shall contain either the category 1 or the category 2 functions (see 1.2.2).

3.3.3.1.1 Category 1. Category 1 shall be items (a) through (d) as specified in 3.3.1.

3.3.3.1.2 Category 2. Category 2 shall be items (a) through (e) as specified in 3.3.1.

3.3.3.1.3 Mode switch. Depending upon the selected position of this switch, either the displayed function or an electronic check of the circuitry for the displayed function shall be contained in the digital display.

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3.3.3.3 Power switch. (See 3.7.5.2).

3.3.4 Measurement ranges. The HSM shall include the following ranges of measurement:

<u>Measurement</u>	<u>Range</u>
DBT	65 - 165°F
WBT	65 - 165°F
GT	65 - 165°F
WGBT index	65 - 165°F
Exposure time	0:00 - 8:00 (hour:minute)

3.3.5 Ambient conditions. The HSM shall operate within the accuracy specified in 3.14.3.1 in ambient temperatures from 65 to 165°F and air velocities from 50 to 1000 feet per minute.

3.3.6 Storage conditions. The HSM shall withstand storage temperatures of minus 10 to plus 175°F and relative humidities from 10 to 100 percent without any deterioration in performance.

3.4 Mechanical construction. Mechanical construction shall be as specified in 3.4.1 through 3.4.2.10.4.

3.4.1 Dimensions and weight. The dimensions and weight specifications specified herein are only those of the HSM and do not include the carrying case or accessories.

3.4.1.1 Dimensions. The HSM shall be not greater than 7.5 inches in height, 5 inches in width, and 4 inches in depth. These dimensions do not include the globe thermometer that shall be connected to the top of the enclosure.

3.4.1.2 Weight. The HSM weight shall not exceed 5 pounds.

3.4.2 Enclosure. The enclosure shall be as specified in 3.4.2.1 through 3.4.2.10.4.

3.4.2.1 Electrical compartment. An externally accessible electrical compartment shall be provided that contains sufficient clearance for removal and installation of the electrical components. Each electrical input to and output from the electrical compartment shall be made by one penetration through the compartment wall by means of a wiring harness.

3.4.2.1.1 Electrical compartment cover. A separate electrical compartment cover shall be secured to the HSM by four captive screws with standard slotted heads. The compartment shall contain a tightfitting gasket. Loading of the gasket shall be limited to that which is necessary to effect a seal.

3.4.2.1.2 Electrical compartment wire harness entrance seal. The wiring harness shall penetrate the electrical compartment through an entrance seal. This entrance seal shall meet the entrance seal requirements specified in 3.2.2.1.

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3.4.2.1.3 Electrical compartment heat dissipation. Ventilation openings are not permitted for heat dissipation.

3.4.2.2 Battery compartment. An externally accessible battery compartment shall be provided to facilitate removal and installation of the batteries. The battery compartment shall provide sufficient clearance for mechanical disassembly or for cleaning if the batteries should leak or deteriorate.

3.4.2.2.1 Battery compartment cover. A separate battery compartment cover shall be secured to the HSM by four captive screws with standard slotted heads. Loading of the gasket shall be limited to that necessary to effect a seal.

3.4.2.2.2 Battery compartment power wire entrance seal. The battery power wires shall penetrate the battery compartment through an entrance seal. This entrance seal shall meet the requirements specified in 3.2.2.1 and shall withstand fumes, gases, electrolyte leakage and other battery by-products.

3.4.2.3 Humidity temperature sensor compartment. The HSM shall contain a separate compartment that contains the DBT sensor, the WBT sensor, and the items specified in 3.5.5.

3.4.2.3.1 Accessibility. The interior of the humidity temperature sensor compartment shall be accessible to the extent that the following functions can be performed with a minimum of effort:

- (a) Draining and refilling the water reservoir.
- (b) Removing and installing the wick on the WBT sensor and into the water reservoir.
- (c) Observing the low and full lines on the water reservoir.
- (d) Removing and installing the DBT sensor, the WBT sensor, and the aspirating fan without the use of special tools.

3.4.2.3.2 Humidity temperature sensor compartment cover. A separate humidity temperature sensor compartment cover shall be secured to the HSM by four captive screws that have standard slotted heads.

3.4.2.3.3 Leakage. The humidity sensor compartment shall be located and constructed so that any water leakage shall not enter the other compartments.

3.4.2.3.4 Aspiration. The compartment shall permit the fan (required for WBT sensing) to function as an aspirator (see 3.6.1).

3.4.2.3.5 Humidity temperature sensor compartment wire harness entrance seal. The wiring harness shall penetrate the electrical compartment through an entrance seal. This seal shall meet the entrance seal requirements specified in 3.2.2.1.

3.4.2.4 Straps. The HSM shall contain a detachable shoulder strap and a permanently affixed wrist strap. These straps shall be attached to the HSM through the strap support brackets (see 3.4.2.5). The straps shall conform to JJ-S-750.

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3.4.2.4.1 Shoulder strap. The shoulder strap shall consist of an assembly that contains a strap, two hooks and a bar loopslide as shown on figure 4. The shoulder strap shall be adjustable and have a maximum length of  $36 \pm 1$  inches. The two hooks shall be configured as shown on figure 4 with the hook material conforming to ASTM A 276. The bar loopslide shall conform to MS51940, style 2, construction B, with a  $1-1/16$  inch strap width slot.

3.4.2.4.2 Wrist strap. The wrist strap shall be as specified in 3.4.2.4, except that the width shall be  $3/8 \pm 1/32$  inch. One end of the wrist strap shall be placed through the wrist strap support bracket and sewn together. The other end shall be sewn near the wrist strap support bracket to form the loop.

3.4.2.5 Strap support brackets. The strap support brackets shall be an integral part of the cast aluminum enclosure.

3.4.2.5.1 Shoulder strap support brackets. The shoulder strap support brackets shall be located on the left and right vertical surfaces as shown on figure 3 and positioned midway between the front and back vertical surfaces. Each strap support bracket shall be at least  $1/2$ -inch thick, shall be not more than  $1/2$ -inch deep, and shall contain a clearance hole for the metal link (see 3.4.2.5.2).

3.4.2.5.2 Metal link. A metal link shall be attached to each shoulder strap support bracket. The metal link shall be rectangular in configuration and shall have a circular cross section. The diameter of the circular cross section shall be at least 0.12 inch. The material for the metal link shall conform to ASTM A 276. The metal link attachment shall be set so that the break in the metal link either is positioned midway inside the shoulder strap support bracket or is welded closed.

3.4.2.5.3 Wrist strap support bracket. The wrist strap support bracket shall be located on the left vertical surface as shown on figure 3 and positioned midway between the front and back vertical surfaces. The wrist strap support bracket shall be at least  $1/4$ -inch thick and at least  $1/4$ -inch deep.

3.4.2.6 Globe thermometer receptacle. The globe thermometer receptacle shall be located on the top vertical surface as shown on figure 4. The globe thermometer receptacle shall be part number MS3102R-12S-3S in accordance with MS3102 for a temperature sensor containing two connecting wires, or shall be part number MS3102R-14S-7S in accordance with MS3102 for a temperature sensor containing three connecting wires.

3.4.2.7 Tripod mounting provision. The HSM shall have a recessed fitting to accept a photographic tripod screw mount. The threads of the fitting shall be  $1/4$ -20 unified coarse thread, class 3, in accordance with FED-STD-H28 and FED-STD-H28/18.

3.4.2.8 Mechanical stability. The HSM shall be constructed to preclude tipping during normal operation and handling.

3.4.2.9 Corners. Each corner shall be rounded to preclude injury to personnel or damage to other material. Each corner shall be adequately reinforced to protect the HSM from damage.

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3.4.2.10 Methods of attachment. Methods of attachment shall be as specified in 3.4.2.10.1 through 3.4.2.10.4.

3.4.2.10.1 Brazing. Brazing shall be in accordance with NAVSEA 0900-LP-001-7000.

3.4.2.10.2 Welding. Welding shall be in accordance with MIL-STD-278.

3.4.2.10.3 Threads. Threads shall be in accordance with FED-STD-H28.

3.4.2.10.4 Fastening devices. Screws, pins, bolts, and similar parts shall be installed with means for preventing loss of tightness. When subjected to removal or adjustment, these parts shall not be swaged, peened, staked, or otherwise permanently deformed.

3.5 Temperature sensors. The HSM shall contain three temperature sensors that measure the DBT, WBT, and GT.

3.5.1 Principle of operation. The three types of temperature sensors shall respond to a temperature change electrically. Filled systems and bimetallic-actuated principles shall not be used.

3.5.2 Interchangeability. Each GT shall be interchangeable with the other, both physically and in performance. Each GT shall be compatible so that replacement or substitution shall be possible without the need to perform any calibration adjustments. This requirement shall also apply to DBT and WBT sensors.

3.5.3 DBT sensor. The DBT sensor shall be located near the intake air opening inside the humidity temperature sensor compartment so that the DBT sensor shall be:

- (a) Shielded from radiant heating.
- (b) Exposed to the airflow provided by the aspirating fan that has not passed the WBT sensor wick.
- (c) Not exposed to the airflow that has passed the WBT sensor wick.

3.5.4 WBT sensor. The WBT sensor shall be located inside the humidity temperature sensor compartment so that the WBT is:

- (a) Shielded from radiant heating.
- (b) Exposed to an airflow across its sheath (especially the portion covered by the wick) with a velocity that is not less than 480 feet per minute. The WBT sensor shall contain a provision to ensure that the wick will be placed on the sheath to at least the minimum immersion depth.

3.5.5 Globe thermometer. The globe thermometer construction and location shall meet the following criteria:



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- (a) The diameter of the globe shall be not greater than 2 inches.
- (b) The globe extension shall be constructed with a nonmetallic material that will permit minimal heat conduction to or from the globe. The globe thermometer temperature sensor connecting wires inside the globe extension shall be shielded to protect against electromagnetic interference (EMI).
- (c) A plug connector located at the bottom of the globe extension shall be used to mechanically secure and electrically connect the globe thermometer to the HSM. The plug connector shall be MS3106-12S-3P in accordance with MS3106 for a temperature sensor containing two connecting wires, or shall be MS3106R-14S-7P in accordance with MS3106 for a temperature sensor containing three connecting wires. The MS3106R-12S-3P plug may have a cable connector assembly part number MIL-C-85049/1-4B in accordance with MIL-C-85049 and MIL-C-85049/1. Likewise, the MS3106R-14S-7P plug may have a cable connector assembly part number MIL-C-85049/1-6B in accordance with MIL-C-85049 and MIL-C-85049/1.
- (d) The globe thermometer shall plug into the top surface of the HSM and shall be located in a position where it is not exposed to airflow produced by the aspirating fan.
- (e) The globe thermometer shall be constructed for measurement in a hemispherical uniform radiant heat field, centered over the HSM with its axis coincident with the vertical axis of the HSM.

3.6 WBT sensor support items. The components contained in the humidity temperature sensor compartment for the purpose of supporting the function of the WBT sensor shall be in accordance with 3.6.1 through 3.6.4.

3.6.1 Aspirating fan. A motor and fan for aspirating the WBT sensor shall produce an air velocity across the temperature sensor of not less than 480 feet per minute. The motor and fan shall be direct-coupled and the combination shall be considered an aspirating fan. The aspirating fan and humidity temperature sensor compartment shall be constructed so that the airstream is directed across the temperature sensors before reaching the motor. The motor shall be sturdy in construction, require no lubrication in service, and be of a readily available standard commercial design.

3.6.2 Spill-resistant water reservoir. A water reservoir for wetting the wick surrounding the WBT sensor shall contain the following features:

- (a) A water reservoir capacity that shall maintain a wetted-wick for a minimum 8-hour period of continuous operation.
- (b) Full and low level lines with the words FULL and LOW appearing above each line. The full line shall not appear below the level required for 8 hours of continuous operation.
- (c) A spill-resistant configuration so that the HSM can be inclined 90 degrees from the vertical in any direction without any leakage from a filled water reservoir.
- (d) A configuration that permits removal and installation of a wick with minimum effort.
- (e) A method and configuration that permits draining and refilling the water reservoir without disconnecting other components



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3.6.3 Wick. The WBT sensor wick shall contain the following features:

- (a) Sewn or woven into a tube made from chemically clean muslin or bleached cotton.
- (b) Treated so that absorption of water is still readily achieved.
- (c) One end shall fit snugly over the WBT sensor; the other end shall fit into the water reservoir.
- (d) The length shall extend from at least the minimum immersion depth of the WBT sensor to the lowest part of the water reservoir plus 1/2 inch.
- (e) The wick shall be securely fastened to the WBT sensor.

3.6.4 Radiant heat shield. If necessitated by the humidity temperature sensor compartment construction, the DB or WBT sensors shall be isolated from external radiant heat sources at the air intake opening by radiant heat shields. The radiant heat shield shall be as thin as is consistent with sturdiness and the ability to withstand hard usage. The material for the radiant heat shields shall contain a reflective finish to minimize the influences of radiant heat. The radiant heat shield shall be constructed so that the wick on the WBT sensor can be wetted, removed, and installed with ease.

3.7 Electrical construction. Electrical portions of the HSM shall be constructed as specified in 3.7.1 through 3.7.5.9.

3.7.1 Discrete components. Electrical parts shall conform to table II and 3.7.1.1 through 3.7.1.3.

TABLE II. Requirements for electrical parts.

Components	Specification	Remarks
Capacitors		Select from
fixed, tantalum,	MIL-C-39003	MIL-STD-198
solid electrolytic		
fixed, plastic	MIL-C-19978	
dielectric	MIL-C-14157	
variable, ceramic		
dielectric	MIL-C-81	
Connectors		Select from
cable	MIL-C-5015	MIL-STD-1353
flat cable	MIL-C-83503	
Filters	MIL-F-15733	EMI protection
	MIL-F-18327	other uses: Class,
		R, S, or V, life
Fuses	MIL-F-23419	expectancy X
		Style FM09,
Fuse holder	MIL-F-19207	characteristic A
		MIL-F-19207/36,
		type FHN55W