

NON-MEASUREMENT SENSITIVE

MIL-M-24738(SH)

11 January 1990

## MILITARY SPECIFICATION

## MONITORS, HIGH TEMPERATURE MOTOR PROTECTION

This specification is approved for use by 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 establishes the design, performance, and test requirements for the motor thermal protection systems to be used in 60-hertz (Hz) and 400-Hz motors

1.2 Protection system The motor protection system consists of multiple thermistors installed in the motors and a monitor located at the motor terminal box

1.3 Classification Monitors and thermistors shall be classified as specified in 3.3.1 and 3.3.2

## 2. APPLICABLE DOCUMENTS

2.1 Government documents

2.1.1 Specifications, standards, and handbooks The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2)

## SPECIFICATIONS

## FEDERAL

PPP-F-320 - Fiberboard, Corrugated and Solid, Sheet Stock (Container Grade), and Cut Shapes

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

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## MILITARY

- MIL-S-901 - Shock Tests, H I (High Impact) Shipboard Machinery, Equipment, and Systems, Requirements for.
- MIL-E-917 - Electric Power Equipment, Basic Requirements (Naval Shipboard Use)
- MIL-E-2036 - Enclosures for Electric and Electronic Equipment
- MIL-P-15024 - Plates, Tags and Bands for Identification of Equipment
- MIL-P-15024/5 - Plates, Identification.
- MIL-E-17555 - Electronic and Electrical Equipment, Accessories, and Provisioned Items (Repair Parts). Packaging of
- MIL-L-19140 Lumber and Plywood, Fire Retardant Treated

## STANDARDS

## FEDERAL

- FED-STD-313 - Material Safety Data, Transportation Data and Disposal Data for Hazardous Materials Furnished to Government Activities

## MILITARY

- MIL-STD-108 - Definitions of and Basic Requirements for Enclosures for Electric and Electronic Equipment
- MIL-STD-167-1 - Mechanical Vibrations of Shipboard Equipment (Type I - Environmental and Type II - Internally Excited).
- MIL-STD-202 - Test Methods for Electronic and Electrical Component Parts
- MIL-STD-461 - Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference
- MIL-STD-740-1 - Airborne Sound Measurements and Acceptance Criteria of Shipboard Equipment
- MIL-STD-740-2 - Structureborne Vibratory Acceleration Measurements and Acceptance Criteria of Shipboard Equipment
- MIL-STD-810 - Environmental Test Methods and Engineering Guidelines
- MIL-STD-1285 - Marking of Electrical and Electronic Parts
- MIL-STD-1399, - Interface Standard for Shipboard Systems Electric Section 300 Power, Alternating Current (Metric)

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Naval Publications and Forms Center, (ATTN: NPODS), 5801 Tabor Avenue, Philadelphia, PA 19120-5099 )

2 1 2 Other Government documents, drawings, and publications The following other Government documents, drawings, and publications form a part of this document to the extent specified herein Unless otherwise specified, the issues are those cited in the solicitation

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DEPARTMENT OF LABOR, OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION  
(OSHA)

Code of Federal Regulations (CFR) 29, Part 1910.1200 - Occupational  
Safety and Health Standards.

(Application for copies should be addressed to the Occupational Safety and  
Health Administration, Office of Publications, 200 Constitution Avenue, N W , Room  
N3101, Washington, DC 20210 )

2.2 Non-Government publications. The following document(s) form a part of  
this document to the extent specified herein. Unless otherwise specified, the  
issues of the documents which are DOD adopted are those listed in the issue of the  
DODISS cited in the solicitation. Unless otherwise specified, the issues of  
documents not listed in the DODISS are the issues of the documents cited in the  
solicitation (see 6.2).

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ICS 1 - General Standards for Industrial Controls and Systems  
(DoD adopted)

ICS 2 - Standards for Industrial Control Devices, Controllers and  
Assemblies. (DoD adopted)

(Application for copies should be addressed to the National Electrical  
Manufacturers Association, 2101 L Street, N.W , Suite 300, Washington, DC 20037 )

(Non-Government standards and other publications are normally available from  
the organizations that prepare or 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 document and the references cited herein, the text of this document takes  
precedence. Nothing in this document, however, supersedes applicable laws and  
regulations unless a specific exemption has been obtained.

3 REQUIREMENTS

3.1 First article When specified (see 6.2), a sample shall be subjected to  
first article inspection (see 6.4) in accordance with 4.4.

3.2 System requirements. The system shall monitor electrical motor  
temperatures and interface with existing motor switching and control functions to  
provide automatic shutdowns when conditions warrant.

3.3 Construction The monitor, a solid state circuit with a plug-in relay,  
shall be in accordance with MIL-E-917, and the requirements of this specification.  
If any requirement specified herein conflicts with the requirements of MIL-E-917,  
the requirements of this specification shall govern. All material shall be as  
specified herein.

3.3.1 Thermistors Thermistors shall be as specified in 3.3.1.1 through  
3.3.1.4.

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3.3.1.1 Type Thermistors shall be positive temperature coefficient (PTC) type with a temperature coefficient of resistance at the switch point region of no less than 15 percent per degree Celsius ( $^{\circ}\text{C}$ ). Type I thermistors are for use with motor windings and type II are for use with motor bearings (see figures 1 and 2).

3.3.1.2 Rating Thermistor switch points shall correspond with the motor insulation class ratings of MIL-E-917 105 $^{\circ}\text{C}$ , 135 $^{\circ}\text{C}$ , 175 $^{\circ}\text{C}$ , and 200 $^{\circ}\text{C}$  (see 6.2).

3.3.1.3 Thermistor leads The thermistor leads shall be flexible stranded copper of not less than size AWG 24 wire with an insulation rating of at least 600 volts. Type I and II thermistors shall be constructed as shown on figures 1 and 2.

3.3.1.4 Marking. The thermistor shall be marked to indicate the switching temperature rating in degrees Celsius, and shall satisfy the requirements of MIL-STD-1285.

3.3.2 Thermal monitor Thermal monitors shall be as specified in 3.3.2.1 through 3.3.2.4.

3.3.2.1 Enclosures The enclosure for type I monitors, internal mounting, shall be constructed to provide the necessary electrical isolation from adjacent components and electrical connections, while keeping the size to a minimum. Type II monitors shall be of metal construction suitable for marine applications and shall meet the requirements of MIL-STD-108 and MIL-E-2036. Provisions shall be made for securely mounting the monitor.

3.3.2.2 Painting Parts not fabricated of a corrosion-resisting material or having a corrosion-resistant treatment as specified in MIL-E-917 except for semiconductors, shall be painted as specified in MIL-E-917. Only one coat of gray enamel shall be applied to the outside of the enclosure. Touching-up will be permitted for marks or scratches due to factory handling.

3.3.2.3 Duty. The monitor shall sense the motor temperature continuously and shall, at the temperature set point, activate a minimum of one set each of normally closed and normally open contacts.

3.3.2.4 Weight The weight of the monitor shall be not greater than 5 pounds.

3.3.2.5 Dimensions. The enclosure dimensions of the monitors shall be not greater than 4.0 by 3.5 by 3.75 inches.

3.3.2.6 Mounting The monitor shall be attached to a plate for mounting. The dimensions of the plate shall be 5.0 by 2.5 by 0.25 inches. The plate shall have 4 holes, 0.31 inches diameter, placed symmetrically 1.5 by 4.25 inches apart.

3.3.2.7 Finish The finish shall be smooth and free of blurs, corrosion, and sharp corners.

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3.3.2.8 Safety. The monitor shall meet the safety requirements of MIL-E-917.

3.3.2.9 Hazardous materials. There shall be no use of hazardous materials except where no suitable substitute is available and prior approval has been obtained. The material shall have no adverse effect on the health of personnel when used for its intended purpose. Questions pertinent to this effect shall be referred by the contracting activity to the appropriate departmental medical service who will act as an advisor to the contracting agency.

3.3.2.9.1 Material safety data sheet (MSDS). The contracting activity shall be provided a material safety data sheet at the time of contract award. The MSDS shall be provided in accordance with the requirements of FED-STD-313. The MSDS shall be included with each shipment of the material covered by this specification (see 6.7).

3.3.2.10 Ventilation. Cooling of the monitor shall be natural convection from the enclosure.

3.3.2.11 Humidity. The monitor shall meet the requirements of MIL-STD-810 for humidity.

3.3.2.12 Warm-up. The monitor shall perform as specified herein immediately upon being energized.

3.3.2.13 Input. Input terminals shall be provided for connection of six thermistors in common leg configuration "parallel".

3.3.2.14 Automatic reset. The monitor shall have a factory selectable automatic reset of latching mode of operation.

3.3.2.15 Ambient temperature. The monitors shall operate in an ambient temperature range of 0 to 50°C with short term, emergency capability to 70°C.

3.3.2.16 Hysteresis. The monitor shall have a "resistance trip to resets" hysteresis of greater than 250 ohms to prevent cycling of the monitor.

3.3.2.17 Fail safe. The monitor shall operate (fail safe) on the short-circuiting of the thermistor input by a resistance of 10 ohms or less.

3.3.2.18 Output. The output of the monitor shall operate a relay mounted within the monitor enclosure. The relay shall be provided with one pair of normally open and one pair of normally closed contacts.

3.3.2.19 Monitor excitation. The monitor excitation shall be factory adjustable for single phase, 120 volts, 60 or 400 Hz, and shall operate with type I or II powers as specified in MIL-STD-1399, section 300.

3.3.2.20 Monitor relay. The monitor relay contacts shall operate a 5 ampere, 120 volt alternating current (Vac) or 28 volt direct current (Vac) control circuit.

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3 3 2 21 Monitor switching temperature The monitor shall switch within a plus or minus 5°C band of the thermistor switching temperature

3 3.2 22 Electrical isolation The monitor shall provide electrical isolation between the thermistor input, the monitor excitation, and the monitor output, and may operate with one of the thermistor input leads grounded

3.3 2 23 Current. The monitor circuiting shall limit the monitoring current supplied to the thermistor to less than 2 milliamps to eliminate self-heating.

3 3.2 24 Noise limits. The monitor shall not exceed noise limits in accordance with MIL-STD-740-1 and MIL-STD-740-2.

3.3.3 Markings. Markings shall be in accordance with 3 3 3 1 through 3 3 3 1 2

3.3.3.1 Connection diagram and identification plates Connection diagram and identification plates shall be in accordance with MIL-P-15024 and MIL-P-15024/5 The plates shall be brass or corrosion-resistant steel not less than 0 030 inch in thickness and marked by etching, engraving, stamping, or photo process The marking shall be not less than 0.003 inch deep

3.3 3 1.1 Connection diagram Each monitor shall be provided with a connection diagram plate mounted on the inside surface of the front cover

3 3 3 1 2 Identification plate Each monitor shall be provided with an identification plate mounted on the outside of the front cover The identification plate for the complete equipment assembly shall contain the information as shown on figure 3.

3 4 Performance characteristics The performance requirements listed in this section are designed to provide basic information on the electrical performance of the monitor The input power for the monitor shall be 120 Vac, single phase, 60 or 400 Hz provided by an ungrounded supply. The monitor relay provides the capability of interrupting the control power to the motor once the motor winding temperature has reached the temperature rating of the insulation class The thermistor provides the signal determined by its switch point temperature as specified in 3 3.1.2

3 4 1 Thermistor dielectric Thermistor dielectric strength shall be not less than 100 megohms (see 4 6 2)

3.4 2 Thermal response rate Thermistors shall have a thermal response not exceeding 5 seconds to reach a resistance of 2600 ohms (see 4 6 3)

3 4 3 High potential. The monitor when subjected to a high potential test for resistance shall show no evidence of failure (see 4.6 4)

3 4 4 Environment The monitor when operated with ambient temperature varied from 0 to 50°C inclusive shall not deviate from the rated thermistor switch point by more than plus or minus 5°C (see 4 6 5)

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3 4 5 Electromagnetic interference The monitor when tested for susceptibility to electromagnetic interference shall operate with immunity (see 4 6 6)

3 4 6 System operation The motor thermal monitor systems shall respond to an over-temperature condition within plus or minus 5°C of the rated thermistor switch point Separate monitor configurations will be used for parallel operation (see 4.6.7 1) or series operation (see 4.6 7 2).

3 4 7 Inclined operation The monitor shall operate within limits specified herein when inclined at an angle of 45 degrees from the vertical in any direction (see 4.6.10)

3 4 8 Vibration The monitor shall withstand type I vibration in accordance with MIL-STD-167-1 without mechanical damage or malfunctioning (see 4.6 8)

3 4 9 Shock. The monitor shall withstand grade A high impact shock as specified in MIL-S-901 for light weight equipment without the use of shock mounts Devices shall function properly with rated voltage applied during and after the shock test (see 4 6 9)

3 5 Workmanship. Metal surfaces shall have a smooth finish and all details of manufacture, including the preparation of parts and accessories, shall be in accordance with the best practice for high quality electrical equipment Particular attention shall be given to neatness and thoroughness of soldering, wiring, impregnation of coils marking of parts, plating, lacquering, riveting, clearance between connections, ruggedness, and suitability of enclosure

#### 4 QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements (examinations and tests) as specified herein Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to ensure supplies and services conform to prescribed requirements

4.1.1 Responsibility for compliance. All items shall meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract Sampling inspection, as part of the manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material



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4.2 Classification of inspections The inspection requirements specified herein are classified as follows:

- (a) First article inspection (see 4.4).
- (b) Quality conformance inspection (see 4.5).

4.3 Inspection conditions. Unless otherwise specified herein, all inspections shall be performed in accordance with the test conditions specified in MIL-STD-202

4.3.1 Precautions. Precautions shall be taken during inspection to prevent condensation of moisture on components, except during the moisture-resistance test

4.4 First article inspection First article inspection shall consist of the tests and examination specified in 4.6 (see 6.3).

4.4.1 Failures One or more test failures shall be cause for first article inspection failure

4.5 Quality conformance inspection Quality conformance inspection shall consist of the tests and examination specified in table I (see 6.3)

TABLE I Quality conformance inspection

Inspection	Requirement	Test method
<u>Group A</u>		
Visual and mechanical examination	3.5	4.6.1
<u>Group B</u>		
Thermistor dielectric	3.4.1	4.6.2
Thermal response rate	3.4.2	4.6.3
Environment	3.4.4	4.6.5
Electromagnetic interference	3.4.5	4.6.6
System operation	3.4.6	4.6.7
Inclined operation	3.4.7	4.6.10
<u>Group C</u>		
Vibration	3.4.8	4.6.8
Shock	3.4.9	4.6.9
High potential	3.4.3	4.6.4



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4 5.1 Inspection of product for delivery Inspection of product for delivery shall consist of groups A and B inspections.

4.5 1 1 Inspection lot. An inspection lot shall be as specified and shall consist of all the monitors or thermistors of the same type produced under essentially the same conditions and offered for inspection during a period of 1 month

4.5.1 2 Group A inspection. Group A inspection shall be performed in 100 percent of the product supplied under the specification. Monitors that are out of tolerance shall be removed from the lot (see 6.8).

4.5.1.3 Group B inspection. Group B inspection shall be performed on sample units that have been subjected to and have passed the group A inspection

4 5 1.3.1 Disposition of sample units. Sample units which have passed all the group B inspection may be delivered on the contract or purchase order, provided they are within specified tolerance and meet requirements for visual and mechanical inspection.

4 5 2 Group C inspection. Group C inspection shall consist of the tests specified in table I, in the order shown. Group C inspection shall be performed on sample units of each type and selected from inspection lots which have passed groups A and B inspections.

4 5 2 1 Disposition of samples Sample units which have been subjected to group C inspection shall not be delivered on the contract or purchase order

4 6 Tests and examination Tests and examination shall be as specified in 4 6 1 through 4.6 10.

4 6.1 Visual and mechanical examination. The monitor shall be given a thorough examination to determine that it conforms to this specification and applicable drawings with respect to material, finish, workmanship, construction, assembly, dimensions, weight, marking of identification, and information plates

4.6 2 Thermistor dielectric Each thermistor shall be immersed in a conducting water bath (solution of tap water and a non-ionic wetting agent in a concentration sufficient to reduce the surface tension to a value of 31 dynes per centimeter (dyn/cm) or less) at 25°C, for a period of 5 minutes with 1000 Vdc applied between one lead of the thermistor and a stainless steel electrode immersed in the water. A series connected micrometer shall not show a leakage current greater than 10 microamperes (encapsulation resistance greater than 100 megohms).

4 6 3 Thermal response rate Test each thermistor for rate of thermal response. The response time of the thermistor shall be as specified in table II

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TABLE II Response time for standard cylinder

Bath medium	Test temperature range (°C)	Response time (seconds)
Glycol <u>1/</u>	-28 to 60	15 ± 1
Water	0 to 100	6 ± 0.2
Oil	83 to 260	40 ± 2
Salt <u>2/</u>	205 to 815	8 ± 0.2

1/ Fifty percent glycol, 50 percent water

2/ Noncorrosive low melting point mixture of nitrates and nitrites of sodium and potassium. The liquid shall be stable at all operating temperatures

4 6 3 1 Procedure The standard used in this test is called a standard cylinder (see figure 4). Connecting wires from the standard cylinder thermocouple wire shall terminate at an ice bottle, ice point reference junction or a reference junction compensated electronic indicator. If an ice bottle or ice point reference junction is used, the extension wires coming from the reference junction shall be connected to an indicator such as a potentiometer or a millivolt recorder. No matter what form of indicator is used, the indicator shall have a response time at least two times faster than the response time of the temperature rise that the standard cylinder will measure (see table II). Response time measurement shall be conducted by any method that times to an accuracy of 0.2 second or better. Two temperature baths shall be used in performing this test. The baths shall be sufficiently large or constructed in such a manner that the temperature bath liquid shall not be cooled by more than 1°C when either the standard cylinder or the thermistor is immersed. One of these baths, the hot bath, must contain a variable speed stirrer. Stirring shall be sufficient to ensure that the temperature gradient throughout the test portion of the bath does not exceed 0.3°C under steady-state load conditions. The cold-bath temperature shall be maintained at 25°C. The hot-bath temperature shall be maintained at

(thermistor switch temperature - 25°C)

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plus 25°C and held to within plus or minus 1°C. The starting temperature,  $T_1$ , of the thermistor shall be at  $25 \pm 5^\circ\text{C}$ . The stopping temperature,  $T_2$ , of the thermistor shall be the temperature at which the thermistor resistance equals 2600 ohms.

4 6 3 2 Setting up temperature bath conditions The conditions in the hot temperature bath liquid shall be set up so that the standard cylinder response time shall be within the limits specified in table II. Hot temperature bath liquid conditions and, thus, the standard cylinder response time, are changed by varying the stirring parameters. The standard cylinder shall be immersed in the

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temperature bath liquid to the bottom of the standard cylinder collar. The standard cylinder shall always be immersed in the hot temperature bath liquid in the same location and in the same orientation. The method used to determine the response time of the thermistor and of the standard cylinder shall be as follows: The thermistor (or standard cylinder) shall then be immersed in the hot temperature bath until there is no further indication of a temperature rise. The thermistor (or standard cylinder) shall then be immersed in the cold temperature bath until there is no further indication of a temperature decrease. The thermistor (or standard cylinder) shall again be immersed in the hot temperature bath. The timing for each immersion shall be started when the thermistor (or standard cylinder) indicator reaches temperature  $T_1$  (see table II) and stopped when the thermistor resistance equals 2600 ohms (or the standard cylinder temperature equals  $T_2$ ). The time it takes the standard cylinder to indicate the difference between temperatures  $T_1$  and  $T_2$  shall be defined as the response time. The response time of the thermistor is the time required for the thermistor resistance to rise to 2600 ohms. The response test shall be conducted by taking alternate response time measurements between the standard cylinder and the thermistor. Each alternation of the standard cylinder and then the thermistor response time measurements shall be defined as a trial. At least 6 trials shall be required. The standard cylinder response time shall be within the limits of table II for the trial to be considered valid.

4.6.4 High potential. The monitor shall be subjected to a high potential test of 1500 volts applied between any combination of the following points for a period of not less than 60 seconds:

- (a) Shorted thermistor inputs.
- (b) Line excitation connections.
- (c) Output power connections.
- (d) Case.

Any evidence of arcing, corona (visible, audible, or odorous), flash-over or punctured insulation shall be interpreted as failure of this test.

4.6.5 Environment. The function of this test is to check the electrical operation concurrently with ambient temperature susceptibility of the monitor. For this test, the monitor, in its enclosure, shall be operated in a temperature controllable chamber capable of attaining interior chamber temperatures from 0 to 50°C inclusive. Three thermistors shall be parallel-connected to the monitor with 2 thermistors at room temperature and one thermistor immersed in an oil bath with a thermometer and heated in  $10 \pm 1^\circ\text{C}$  increments from 25°C to a maximum of 10°C above the switch point of the thermistor, making sure that the thermistor temperature has stabilized after each 10-degree increment. With the monitor electronics stabilized to an ambient temperature of  $0 \pm 0.5^\circ\text{C}$ , the monitor shall be operated at rated input of 120 Vac and 60 Hz. The oil bath and thermistor temperature shall be increased to cause the monitor to indicate an over-temperature condition (see 6.3 and appendix).

4.6.6 Electromagnetic interference. This test is to verify that the monitor can remove power from a motor once an over-temperature condition has been sensed while operating in conjunction with the showering arc electrical noise generator as described in NEMA ICS 1-109. Fixed-gap contacts such as Signalite URD 10 and

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4 0 for fixed peak 2000 volt and 4000 volt pulses, respectively, shall be used in lieu of those indicated in NEMA ICS 2-230.43 Using the cable and cable assembly attach wires labeled 1 and 3 to the output terminals of the showering arc generator and to the spark gap G as shown. Attach wires labeled 2 and 4 to one sensor connection of the monitor and to one thermistor Physically, the spark gap G should be located in the same package as the other electronics of the showering arc electrical noise generator Schematically, the thermistor is connected to the same end of the multi-conductor cable as the spark gap G, and monitor electronics are connected to the same end of the cable as the transformer, capacitor, and so forth, of the showering arc electrical noise generator Physically, place the unshielded monitor electronics within a 1 foot (30.5 cm) distance of the unshielded showering arc generator. With the monitor at room ambient ( $25 \pm 5^\circ\text{C}$ ), attach two thermistors directly to the monitor and attach a third as stated above immerse the third thermistor in the oil bath with the thermometer as described in 4.6.1 5 Energize the monitor with rated input voltage of 120 Vac and rated frequency of 60 Hz. Energize the showering arc generator using the 2000 volt spark gap for G Apply heat to the oil while monitoring the thermometer temperature (see 6 3 and appendix)

4 6 7 System operation The following tests and procedures are to evaluate the motor thermal protection systems's capability to respond to an over-temperature condition with plus or minus  $5^\circ\text{C}$  of the rated thermistor switching point

4 6 7 1 Parallel Install 3 thermistors and 3 thermocouples at a convenient location in the stator of a 440-Vac, 3-phase, 60-Hz, 20-horsepower (or larger) induction motor Each thermistor and its associated thermocouple shall be installed in close proximity to each other Connect the motor to its power source using 200 feet (61 meters) of unshielded cable Connect the 3 thermistors to the monitor using 4-conductor unshielded cable Connect the 3 thermistors to the monitor using 4-conductor unshielded cables 200 feet (61 meters) long Connect one lead of each thermistor together at the motor Tie the motor power and thermal sensor cables closely together with no space between them, simulating a wire tray cable run No space is required between the 200 feet (61 meters) of cable and the floor or a grounded wire tray Apply rated input voltage and frequency to the motor and monitor By providing external heat, locking the rotor, or other means, raise the motor temperatures sensed by the thermistors and cause the monitor to respond to an over-temperature condition

4.6.7.2 Series. Repeat the test with 3 thermistors wired in a series at the motor and use only 2 wires of the 4-wire cable to the monitor

4 6 8 Vibration test The monitor shall be mounted so as to simulate actual installation and shall be tested in accordance with type I (environmental vibration) specified in MIL STD 167 1

4 6 9 Shock test Shock tests shall be conducted in accordance with grade A, class I, type C for light weight equipment in accordance with MIL-S-901 The monitor shall be mounted so as to simulate actual installation Output during the test shall be monitored

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4 6.10 Inclined operation test The monitor shall be tested for inclined operation and rated voltage and frequency. Inclination of the monitor in the following positions shall not affect the performance requirements

- (a) Inclined 45 degrees forward.
- (b) Inclined 45 degrees backward
- (c) Inclined 45 degrees to the right side.
- (d) Inclined 45 degrees to the left side.

4 7 Electromagnetic emission The monitor shall be subjected to testing in accordance with MIL-STD-461, table A4 for surface ships and table A5 for submarines.

4.8 Toxicological product formulations The contractor shall have the toxicological product formulations and associated information available for review by the contracting activity to evaluate the safety of the material for the proposed use.

4 9 Inspection of packaging Sample packs, and the inspection of the preservation, packing, and marking for shipment, stowage, and storage shall be in accordance with the requirements of section 5 and the documents specified therein

## 5. PACKAGING

(The packaging requirements specified herein apply only for direct Government acquisition For the extent of applicability of the packaging requirements of referenced documents listed in section 2, see 6.8.)

5 1 General5 1 1 Navy fire-retardant requirements.

- (a) Treated lumber and plywood Unless otherwise specified (see 6 2), all lumber and plywood including laminated veneer material used in shipping container and pallet construction, members, blocking, bracing, and reinforcing shall be fire-retardant treated material conforming to MIL-L-19140 as follows:

Levels A and B - Type II - weather resistant.  
Category 1 - general use.

Level C - Type I - non-weather resistant  
Category 1 - general use

- (b) Fiberboard Fiberboard used in the construction of class-domestic, non-weather resistant fiberboard and cleated fiberboard boxes including interior packing forms shall meet the flamespread index and the specific optic density requirements of PPP-F-320 and amendment thereto

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5.2 Packaging requirements The packaging (preservation, packing and marking) requirements shall be in accordance with MIL-E-17555 for the level of preservation (A, B, C, or commercial), level of packing (A, B, C, or commercial) and marking including bar coding and other packaging acquisition options therein as specified (see 6.2 and 6.6)

5.3 Material safety data sheet A copy of the material safety data sheet shall be attached to the shipping document for each destination (see 3.3.2.9.1)

## 6 NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory)

6.1 Intended use Motor thermal protection systems are intended to provide protection from damage caused by a high temperature. The monitor will sense both winding and bearing high temperatures, and will secure the affected equipment.

6.2 Acquisition requirements Acquisition documents must specify the following:

- (a) Title, number, and date of this specification
- (b) Issue of DoDIBS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.1.1 and 2.2)
- (c) When first article inspection is required (see 3.1).
- (d) Type of monitor and thermistor (see 3.3.1.1).
- (e) Rating of thermistor (see 3.3.1.2)
- (f) Type of enclosure (see 3.3.2.1)
- (g) When fire-retardant material is not required (see 5.1.1(a))
- (h) Level of preservation, packing, marking, and other packaging acquisition options required (see 5.2)

6.3 Consideration of data requirements The following data requirements should be considered when this specification is applied on a contract. The applicable Data Item Descriptions (DID's) should be reviewed in conjunction with the specific acquisition to ensure that only essential data are requested/provided and that the DID's are tailored to reflect the requirements of the specific acquisition. To ensure correct contractual application of the data requirements, a Contract Data Requirements List (DD Form 1423) must be prepared to obtain the data, except where DoD FAR Supplement 27.475-1 exempts the requirement for a DD Form 1423.

<u>Reference Paragraph</u>	<u>DID Number</u>	<u>DID Title</u>	<u>Suggested Tailoring</u>
4.4	DI-T-4402	First article inspection report	- - -
4.5	DI-T-5329	Inspection and test reports	-----
4.6.5, 4.6.6, and appendix	DI-MISC-80653	Test reports	-----



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The above DID's were those cleared as of the date of this specification. The current issue of DoD 5010.12-L, Acquisition Management Systems and Data Requirements Control List (AMSDL), must be researched to ensure that only current, cleared DID's are cited on the DD Form 1423

6.4 First article. When first article inspection is required, the contracting officer should provide specific guidance to offerors whether the items should be a preproduction sample, a first article sample, a first production item, a sample selected from the first \_\_\_ production items, a standard production item from the contractor's current inventory (see 3.1), and the number of items to be tested as specified in 4.4. The contracting officer should also include specific instructions in acquisition documents regarding arrangements for examinations, approval of first article test results, and disposition of first articles. Invitations for bids should provide that the Government reserves the right to waive the requirement for samples for first article inspection to those bidders offering a product which has been previously acquired or tested by the Government, and that bidders offering such products, who wish to rely on such production or test, must furnish evidence with the bid that prior Government approval is presently appropriate for the pending contract. Bidders should not submit alternate bids unless specifically requested to do so in the solicitation.

6.5 Provisioning Provisioning Technical Documentation (PTD), spare parts, and repair parts should be furnished as specified in the contract.

6.5.1 When ordering spare parts or repair parts for the equipment covered by this specification, the contract should state that such spare parts and repair parts should meet the same requirements and quality assurance provisions as the parts used in the manufacture of the equipment. Packaging for such parts should also be specified.

6.6 Conditions for use of level B preservation When level B preservation is specified (see 5.2), this level of protection should be reserved for the acquisition of monitors for resupply worldwide under known favorable handling, transportation, and storage conditions.

6.7 Material Safety Data Sheets. Contracting officers will identify those activities requiring copies of completed Material Safety Data Sheets prepared in accordance with FED-STD-313. The pertinent Government mailing addresses for submission of data are listed in FED-STD-313.

6.8 Sub-contracted material and parts The packaging requirements of referenced documents listed in section 2 do not apply when material and parts are acquired by the contractor for incorporation into the equipment and lose their separate identity when the equipment is shipped.

6.9 Group A inspection lot tolerance percentage Lots having greater than 10 percent total rejects, due to exceeding the specified limits of 4.6.1, should not be furnished.



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6 10 Subject term (key word) listing.

Motor thermal protection system  
Thermistor  
Thermocouple

Preparing activity  
Navy - SH  
(Project 6625-N910)

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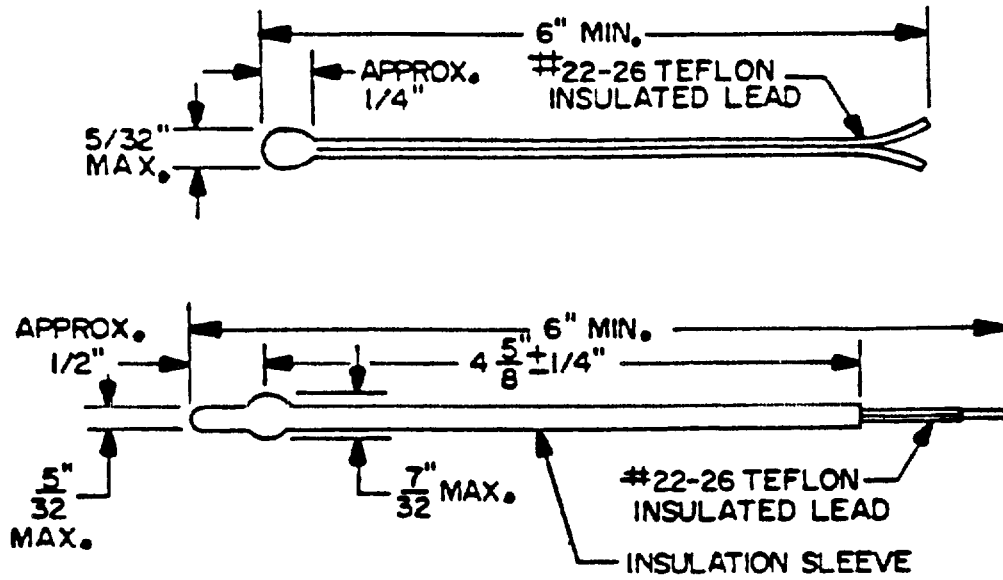


FIGURE 1. Type I thermistor.

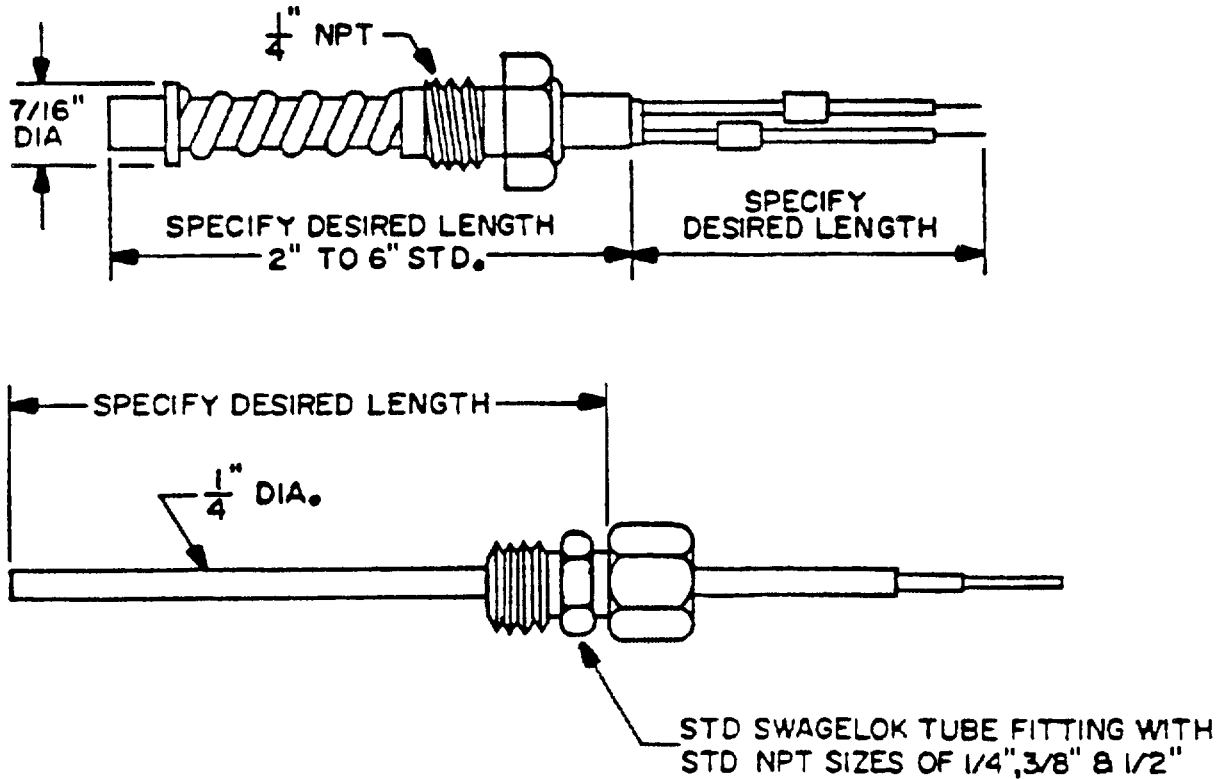


FIGURE 2 Type II thermistor

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⊕ MOTOR HIGH TEMPERATURE MONITOR ⊕

FSN  SERIAL

VOLTS  HERTZ  AMPS

NAVAL SEA SYSTEM COMMAND

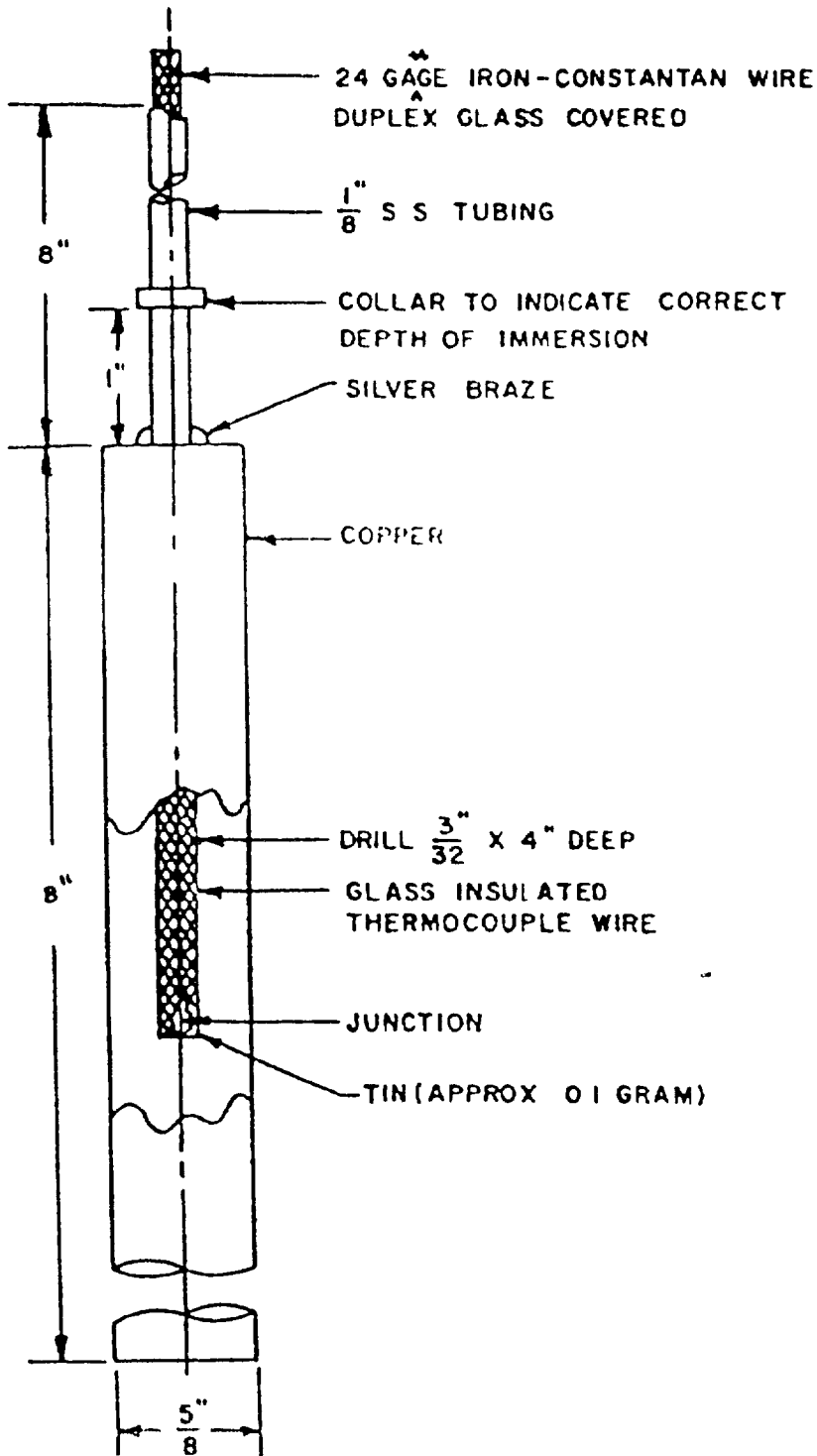
NAME OF MANUFACTURER

INSP CONTRACT NO.

⊕ U.S. ⊕

FIGURE 3 Identification plate

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FIGURE 4 Standard cylinder

## MIL-M-247J8(SH)

## APPENDIX

## TEST REPORT TECHNICAL CONTENT REQUIREMENTS

## 10 SCOPE

10 1 Scope This appendix details the format and general record-keeping requirements of the environmental test, electromagnetic interference test, and system over-temperature condition test. This appendix is mandatory only when data item description DI-MISC-80653 is cited on the DD Form 1423

## 20. APPLICABLE DOCUMENTS

This section is not applicable to this appendix

## 30 TECHNICAL CONTENT

30 1 Environmental test record-keeping After following the instructions of 4 6 5, record, in a table similar to the sample shown in table III, the temperature indicated by the thermometer when the over-temperature condition is sensed. At the same electronics ambient temperature of  $0 \pm 0.5^\circ\text{C}$ , repeat the increase in thermistor temperature for the variations in input voltage and input frequency specified in table III. Complete table III by recording thermometer temperature when the monitor responds to over-temperature conditions. Increase the monitor electronics ambient temperature in  $5^\circ\text{C}$  temperature increments to 50 degrees inclusive. Deviation from the rated thermistor switch point of the results indicated in table III shall not exceed plus or minus  $5^\circ\text{C}$ .

TABLE III Thermometer temperatures for variations in input power

Voltage and frequency	90% Rated + 0% -1%	Rated ±1%	110% Rated +10%
95% Rated +0% -1/2%			
Rated ± 1/2%			
105% Rated +1/2% -0%			
<hr/> Spark gap (as applicable)			<hr/> Monitor ambient $^\circ\text{C}$

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30.2 Electromagnetic interference test record-keeping After following the instructions of 4 6 6, on a chart similar to that of table III, record the temperature at which the monitor responds to an indication of over-temperature as sensed by the thermistor. In the same manner, complete the chart for the indicated variations in input voltage and frequency. Complete a second chart substituting the 4000 volt spark gap for the 2000 volt spark gap

30.3 System over-temperature condition tests record-keeping After following the instructions of 4.6 9, record the thermocouples temperatures and the thermistor voltages at the monitor, at the time of response to the over-temperature condition.

## STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

*(See Instructions Reverse Side)*

1. DOCUMENT NUMBER

MIL-M-24738 (SH)

2. DOCUMENT TITLE

MONITORS, HIGH TEMPERATURE MOTOR PROTECTION

3. NAME OF SUBMITTING ORGANIZATION

4. TYPE OF ORGANIZATION (Mark one)

 VENDOR USER MANUFACTURER OTHER (Specify) \_\_\_\_\_

5. ADDRESS (Street, City, State, ZIP Code)

## 5. PROBLEM AREAS

a. Paragraph Number and Wording

b. Recommended Wording

c. Reason/Rationale for Recommendation

## 6. REMARKS

7a. NAME OF SUBMITTER (Last, First, MI) - Optional

7b. WORK TELEPHONE NUMBER (Include Area Code) - Optional

8. MAILING ADDRESS (Street, City, State, ZIP Code) - Optional

9. DATE OF SUBMISSION (YYMMDD)

(TO DETACH THIS FORM, CUT ALONG THIS LINE)



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