MILITARY SPECIFICATION

TEMPERATURE MONITOR EQUIPMENT
NAVAL SHIPBOARD

This amendment forms a part of MIL-T-15377F(SH), dated 26 April 1979, and 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.

PAGE 3

3.1: Delete and substitute:

"3.1 First article. When specified in the contract or purchase order, a sample shall be subjected to first article inspection (see 4.4 and 6.3)."

PAGE 12

3.8.2.2: Delete.

PAGE 13

4.4: Delete and substitute:

"4.4 First article inspection. First article inspection shall consist of the examination in 4.7 and tests specified in table I."

4.4.1, line 2: Delete "qualification" and substitute "first article".

4.4.2, lines 1 and 3: Delete "qualification" and substitute "first article".

4.4.2.1, lines 1 and 2: Delete "qualification" and substitute "first article".

4.4.2.2, lines 1 and 2: Delete "qualification" and substitute "first article".

Table I: Delete "Qualification" and substitute "First article".

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PAGE 18

6.2.1: Add as item (p):

"(p) When first article inspection is required (see 3.1)."

PAGE 19

6.3: Delete and substitute:

"6.3 First article. When a first article inspection is required, the items should be a first article sample. The first article should consist of one unit. The contracting officer should 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."

6.3.1: Delete.

Preparing activity:
Navy - SH
(Project 6685-N799)

MIL-T-15377F(SH)
26 April 1979
SUPERSEDING
MIL-T-15377E(SH)
25 October 1972
(See 6.6)

MILITARY SPECIFICATION

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NAVAL SHIPBOARD

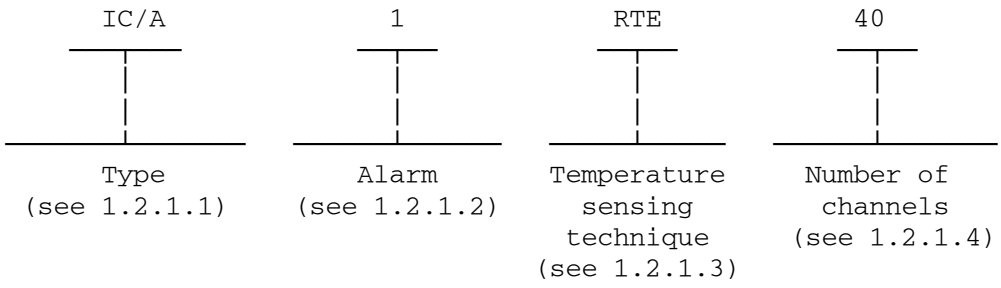
This specification is approved for use by the Naval Sea Systems Command, Department of the Navy, and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers temperature monitoring equipment which continuously monitor and selectively indicate at a central location, a number of temperatures at remote, equipment locations on board naval ships.

1.2 Classification.

1.2.1 Monitoring and selective temperature readout equipments. Equipment classification shall be of the following format, as specified (see 6.2.1 and 6.4):



1.2.1.1 Type. The equipment shall be designated by the 3 letter symbols as follows:

IC/A - Continuous, simultaneous monitoring of remote temperature sensors, for alarm andn also manual selective temperature readout.
IC/I - Manual selective temperature readout for measuring temperatures at several remote locations.
IC/S - Continuous, sequential scanning of remote temperature sensors for indication and alarm.

1.2.1.2 Alarm. The alarm technique shall be designated by a single number as follows:

1. Alarm on temperature above the set level or (exclusive or) below the set level as operator selected.
2. Alarm provision - temperature readout only.

1.2.1.3 Temperature sensing technique. The temperature sensing technique shall be designated by 3 letter symbols as follows:

RTE - Resistance temperature element, platinum.
TCE - Thermocouple temperature element, type K.

1.2.1.4 Number of channels. The number of channels, corresponding to the number of remote sensors that can be monitored shall be designated by its numerical value.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Naval Ship Engineering Center, SEC 6124, Department of the Navy, Washington, DC 20362 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

2. APPLICABLE DOCUMENTS

2.1 Issues of documents. The following documents of the issue in effect on date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein.

SPECIFICATIONS

MILITARY

MIL-P-117 - Bags, Sleeves and Tubing - Interior Packaging.
MIL-S-901 - Shock Tests, H.I. (High-Impact); Shipboard Machinery, Equipment and Systems, Requirements for.
MIL-I-983 - Interior Communication Equipment, Naval Shipboard; Basic Design Requirements for.
MIL-S-3786 - Switches, Rotary (Circuit Selector, Low-Current Capacity), General Specification for.
MIL-S-3950 - Switch, Toggle, General Specification for.
MIL-B-5423 - Boots, Dust and Water Seal (for Toggle and Push-Button Switches and Rotary Actuated Parts), General Specification for.
MIL-T-7928 - Terminals, Lug: Splices, Conductor: Crimp Style, Copper, General Specification for.
MIL-S-8805 - Switches and Switch Assemblies, Sensitive and Push (Snap Action), General Specification for.
MIL-Q-9858 - Quality Program Requirements.
MIL-M-10304 - Meters, Electrical Indicating, Panel Type, Ruggedized General Specification for.
MIL-P-15024 - Plates, Tags and Bands for Identification of Equipment.
MIL-P-15024/5 - Plates, Identification.
MIL-F-15160 - Fuses, Instrument, Power, and Telephone - General Specification for.
MIL-S-15291 - Switches, Rotary, Snap Action.
MIL-S-15743 - Switches, Enclosed Rotary, Snap Action.
MIL-M-16034 - Meters, Electrical-Indicating (Switchboard and Portable Types).
MIL-E-16366 - Terminals, Electrical Lug and Conductor Splices, Crimp Style.
MIL-E-17555 - Electronic and Electrical Equipment, Accessories, and Repair Parts; Packaging and Packing of.
MIL-S-18396 - Switches, Meter and Control, Naval Shipboard.
MIL-F-19207 - Fuseholders, Extractor Post Type, Blown Fuse Indicating and Non-indicating General Specification for.
MIL-F-19207/1 - Fuseholders, Extractor Post Type, Blown Fuse Indicating, Type FHL10U.
MIL-F-19207/2 - Fuseholders, Extractor Post Type, Blown Fuse Indicating, Type FHL11U.
MIL-S-21604 - Switches, Rotary, Multipole and Selector Type, 1 to 10 Ampere.
MIL-S-22710 - Switches, Rotary (Printed Circuit), (Thumbwheel, Inline, and Pushbutton) General Specification for.
MIL-S-22885 - Switch, Push Button, Illuminated, General Specification for.
MIL-S-24236 - Switch, Thermostatic, (Metallic and Bimetallic), General Specification for.
MIL-M-24359 - Meters, Millimeters, Direct Current Panel Mounting (Edgewise Types).

MIL-T-24388 - Thermocouple and Resistance Temperature Element Assemblies (Naval Shipboard).
MIL-R-39027 - Readouts, Incandescent Type, General Specification for.
MIL-T-55156 - Terminals, Lug, Splices, Conductor: Screw Type, General Specification for.
MIL-T-55164 - Terminal Boards, Molded, Barrier, Screw and Stud Types, and Associated Accessories, General Specification for.
MIL-S-55433 - Switch Capsules, Dry Reed Type, General Specification for.

STANDARDS

MILITARY

MIL-STD-108 - Definitions of and Basic Requirements for Enclosures for Electrical and Electronic Equipment.
MIL-STD-167-1 - Mechanical Vibrations of Shipboard Equipment (Type I - Environmental and Type II - Internally Excited).
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.
DOS-STD-1399 - Section 300 - Interface Standard for Shipboard Systems, Electric Power, Alternating Current.
MS 90363 - Box, Fiberboard, With Cushioning Insert, Limited Re-use (For Items 10 pounds or Less).

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

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

AMERICAN NATIONAL STANDARDS INSTITUTE, INC. (ANSI)
C96.1 - Temperature Measurement Thermocouples.
Y32.16 - Reference Designations for Electrical and Electronic Parts and Equipments.

(Application for copies should be addressed tot he American National Standards Institute, Inc., 1430 Broadway, New York, New York 10018.)

(Technical society and technical association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.)

3. REQUIREMENTS

3.1 Qualification. Equipments and components furnished under this specification shall be products which are qualified for listing on the applicable qualified products list at the time set for opening of bids (see 4.4 and 6.3).

3.2 Detail requirements. Detail requirements applicable to individual specific equipments shall be as specified on the applicable manufacturer's drawing (see 3.8.2).

3.3 General description.

3.3.1 Monitor equipment. Monitoring equipment, in conjunction with the temperature sensor assemblies of MIL-T-24388 and interconnecting cabling comprise a temperature measuring and alarm system. In order to warn operating personnel of abnormal temperature conditions, the system shall energize an audible and visual alarm when the temperature at a particular location is below or above a preset limit. Monitoring of temperatures shall be accomplished by measuring the electro-motive force (emf) output of thermocouples or by measuring the signal output due to changes in resistance of temperature sensing elements. Temperature monitoring equipments shall actuate external audible alarms specified herein.

3.3.2 Selective temperature readout equipment. Selective temperature readout equipment, in conjunction with temperature sensor assemblies of MIL-T-24388 and interconnecting cabling comprise a temperature measuring system. In order to enable operating personnel to measure a number of temperatures at remote points, the system shall enable the operator to manually select the desired point to be measured, convert the selected temperature sensor output to a signal proportional to temperature, and

display this signal on a meter calibrated in temperature (deg. F). Readout of temperatures shall be accomplished by measuring the output of thermocouples or by measuring the signal output due to changes in resistance of temperature sensing elements.

3.3.3 Excitation current. The maximum current through resistance temperature elements shall be 6 milliamperes (mA), direct current (d.c.).

3.4 Enclosure assembly.

3.4.1 Temperature monitor equipment. Equipment enclosure assembly shall be of sheet metal, splash-proof construction, in accordance with MIL-STD-108, and shall be suitable for either panel or bulkhead mounting. Mounting features, cable entrance plates or stuffing tubes, as applicable, materials and components shall be in accordance with MIL-I-983.

3.4.1.1 Continuous parallel monitoring (IC/A). Enclosure assembly for IC/A monitor equipment shall contain one temperature readout module and the number of alarm modules required to provide the number of alarm channels specified, up to a maximum of 60. Modules shall be readily removable from the enclosure assembly by means of integral plug-in features assembly shall not be required to accomplish removal of any module.

3.4.1.1.1 Temperature readout module. The temperature module shall be a temperature readout device and associated circuits. Necessary controls shall be located on the front panel of the module.

3.4.1.1.2 Alarm module (IC/A and IC/I). Indicator lights and controls shall be located on the front panel of each alarm module to perform the following functions:

(a) Power on light (white lens).
(b) Alarm light for each temperature monitoring channel (red lens).
(c) External alarm cut-out (silence) switch for each temperature monitoring channel.
(d) Alarm set potentiometer.
(e) External alarm cut-out (silence) switch for temperature monitoring channels (one per equipment).
(f) Alarm circuit reset switch; one per module (if required).
(g) Test switch to verify continuity of alarm circuit, alarm light, and temperature sensor (one per module).
(h) Read (indicate) light on each temperature monitoring channel to light when it has been selected at the readout module.

Multiposition switches may be utilized to combine control functions specified.

3.4.1.1.3 Access (IC/A). Electrical connection between alarm and readout modules, and between modules and the other circuits within the enclosure assembly shall be by means of quick-disconnect connectors. Required auxiliary circuits, such as the power supply, shall be located, within the enclosure assembly, in such a location as to be readily accessible from the front of the enclosure assembly. Required controls and indicators, associated with the power supply, shall be on the front panel. Fold down or slide drawer chassis construction may be used. Terminals and terminal boards shall be provided for interconnection to ships power, temperature sensors, and external audible alarm. Cable entrance plates or stuffing tubes, as applicable, shall be in accordance with MIL-I-983. These terminals shall also be located to be accessible from the front of the enclosure assembly. Three 8 foot long cable assemblies shall be provided and stowed securely inside each equipment enclosure. With these cable assemblies, it shall be possible to remove any one alarm module and the power supply, readout, alarm, and calibration modules to operate the equipment in a normal manner on a work bench away from the installed console. These cable assemblies shall only be required to obtain access for special testing, trouble shooting, and repair.

3.4.2 Manual selective temperature readout equipment (IC/I). Enclosure assembly shall contain the temperature indicating meter, selector switch for selecting the desired temperature sensor to be read, all required, associated functional circuits and parts and terminals for interconnection to external power and temperature sensors. Cable entrance plates or stuffing tubes, as applicable, shall be in accordance with MIL-I-983.

3.4.3 Continuous scanning monitoring (IC/S). Enclosure assembly for IC/S shall contain a readout, a micro processor, input multiplexers, A/D converters, and alarm circuits required to provide the number of channels specified, up to a maximum of 60. Operating controls and the readout shall be accessible from the front panel. A provision shall be included whereby the function of the front panel controls can be disabled to prevent tampering by unauthorized personnel.

3.4.4 Identification plates. Identification plates shall be in accordance with MIL-P-15024 and MIL-P-15024/5.

3.4.4.1 Temperature monitor equipment (IC/A). One identification plate shall be provided for each enclosure assembly. Individual identification plates shall be provided on each module (alarm and indicator unit) showing the location of the associated temperature sensing element next to each alarm light and identifying the function of controls and indicators located on the front of each module. As an alternate, identification plates showing location of temperature sensor elements may be provided on the overall equipment frame adjacent to each module location. Plates shall also provide for indicating the proper scale to sue on the readout for each channel if a dial type meter is used. Adjustment, calibration, setting, and standardization controls, located within the enclosure assembly shall also be identified by means of identification plates. Temperature sensor connection terminals shall be marked to correspond with the position identification for monitor point.

3.4.4.2 Selective temperature readout equipment (IC/I). The position of all selector switches shall be marked to identify the temperature sensor selected to be measured. Adjustment, calibration, and sensor connection terminals located within the enclosure assembly shall be identified and marked.

3.4.4.3 Continuous scanning monitoring (IC/S). The equipment display shall identify the location of the temperature element when an alarm condition occurs.

3.5 System requirements.

3.5.1 Temperature monitor equipment (IC/A). IC/A temperature monitor equipment shall provide for continuous parallel monitoring of up to 60 temperature sensors (see 6.2.1). Equipment shall be modular, with individual modules having plug-in features as specified in 3.4.1.1. There shall be at least 3 types of modules:

(a) Monitor and alarm.
(b) Readout.
(c) Power supply module.

Each monitor and alarm module shall monitor 4 temperature sensors. Equipment shall be capable of operating, as specified herein, with each of the 60 temperature alarm set points adjusted for a different temperature setting. Any alarm may be activated regardless of the state of any other alarm. For purposes of standardization, the factory setting shall be approximately 200 deg. F for points, unless otherwise specified (see 6.2.1).

3.5.1.1 Visual alarm. Each monitor point shall be uniquely associated with a specific remote temperature sensor, and shall have its own individual indicating light. When the temperature at the point being monitored reaches a predetermined temperature setting (alarm point), the indicator light shall be energized and remain energized until manually reset.

3.5.1.2 Audible alarm. One relay having 5 ampere minimum rating DPDT contacts in accordance wit the requirements of MIL-I-983 shall b e provided for supplying 115 volts alternating current (a.c.) power for actuating an external audible alarm simultaneously with activating the visual alarm. Alarm relay contacts shall be wired to the panel terminal boards in the cable entrance stuffing box. The audible alarm shall be activated when any one or more of the temperatures being monitored reaches the predetermined (alarm) setting. Each channel shall provide a manual switch for cutting out the audible alarm for its own monitoring point, but this cut-out shall not prevent any of the other channels from sounding the audible alarm should the temperature at any other monitored point reach the predetermined (alarm) setting. A single, master cut-out switch with associated indicator light shall be provided, which will disable the sounding of the external audible alarm of the entire system.

3.5.1.3 Independent action. The monitoring and alarm action of individual points shall be independent of each other. The action of indicating an alarm condition at one or more monitor points shall not prevent the system (equipment) from indicating an alarm condition or other monitor points.

3.5.1.4 Temperature readout. The temperature readout device and channel selector switch shall be provided in a readout module. The selector switch shall be depressed to turn so that momentary contact is not made with intermediate channels. The continuous, automatic monitor and alarm capability of the system shall not be affected by the selection of a temperature sensor for reading. When a channel temperature reading is being taken, the alarm feature of all points including the one being measured shall be maintained. The operation of the readout module shall not depend on balancing motors, slidewires, potentiometers or similar devices. The use of potentiometers shall be limited to test adjustment, and calibration purposes

only.

3.5.1.5 Test feature. A test switch shall be provided for each monitor and alarm module for testing the alarm lights and continuity of each temperature sensor and alarm circuits of that module. When the switch is operated to the "test" position, the channel alarm light shall indicate an alarm condition. Failure of the channel alarm light on the module to light shall indicate an open circuit in the lamp, temperature sensor or in the associated alarm circuit. This test operation shall not change the normal state of the alarm relays or external relays.

3.5.1.6 Fail safe design. The IC/A temperature monitor equipment shall have an inherent "fail safe" feature. An open circuit in the external temperature sensor or its connecting cabling shall result in an alarm condition.

3.5.1.7 Calibration and setting of alarm point. Design of the IC/A temperature monitor equipment shall be such as to facilitate calibration and adjustment of the individual alarm set points. Self calibration capability shall be an inherent design feature. Test jacks shall be provided to facilitate direct connection to external instrumentation for test, calibration and trouble shooting. Calibration, alarm set point adjustment and access tot he test jacks shall not required assembly, or changes to the electrical wiring connections.

3.5.1.8 Cold junction compensation. Cold junction compensation for equipments for thermocouple sensing shall be self-contained, automatic and shall be referenced to 32 deg. F.

3.5.1.9 Lead length compensation. Equipments for resistance temperature sensing shall provide input terminals for 3 wire sensor configuration. A means shall be provided to compensate for the resistance of interconnecting wiring between sensor and monitor equipment. This compensating provision and associated sensor input terminal configuration shall be so arranged that it can be easily by-passed (removable jumper, alternate terminals or similar means) for use with 2 wire resistance temperature elements. Equipment for thermocouple sensing shall provide for thermocouple lead length compensation. Accuracy, calibration and response time shall be independent of thermocouple extension lead length.

3.5.1.10 Size and weight. Individual modules (alarm or readout) shall not exceed 6 inches in height, 3 inches in width and 12 inches in depth. Total weight per module shall not exceed 12 pounds. The equipment assembly, containing the required number of alarm modules, the readout module and power supply module, shall not exceed 20 inches in width, and 14 inches in depth. The height and weight, determined by the number of temperatures the equipment is designed to monitor, shall be as specified (see 6.2.1). The equipment assembly, containing the required number of alarm modules to monitor 60 temperatures shall not exceed 51 inches in height. Total weight shall not exceed 36 inches in height and weight shall not exceed 150 pounds.

3.5.2 Selective temperature readout equipment (IC/I). Equipment shall provide for the manual selection of any one of several remotely located temperature sensors and converting the signal output of the selected sensor to the signal required for display on a readout device, calibrated in degrees of temperature (deg. F). The operation of the readout equipment shall not depend on balancing motors, slidewires, potentiometers or similar devices. Use of potentiometers shall be limited to test, adjustment and calibration purposes only. The equipment shall facilitate calibration without disassembly or changes to the electrical siring connections. Test jacks shall be provided to permit direct connection to test and calibration instruments. An inherent "fail safe" feature shall be incorporated which will result in a offscale (high or low) reading to signal a failure in the manual selector, associated readout circuits or an open or short in the external temperature sensor.

3.5.3 Size and weight. Selective temperature readout equipment assembly shall not exceed 12 inches in width, 12 inches in height, and 14 inches in depth. The total weight shall not exceed 40 pounds.

3.5.4 Continuous scanning monitoring, indicating, and alarm equipment (IC/S). IC/S temperature monitor equipment shall provide for continuous scanning via micro processor of up to 60 temperature sensors (see 6.2.1). Equipment shall be modular, with individual modules having plug-in features. The equipment shall scan at a rate which will allow all channels to be scanned in five seconds or less. Alarm set points and temperature input characteristics shall be reprogramable from the front panel. The equipment shall be capable of annunciating alarms regardless of number (up to 60) and regardless of previous alarm history.

3.5.5 Number of readout points (IC/A, IC/I and IC/S). The number of remote resistance temperature sensors or remote thermocouple temperature sensors monitored by the equipment shall be a specified (see 6.2.1).

3.6 Performance requirements.

3.6.1 Calibration and accuracy. Temperature monitoring equipments, selective temperature readout equipments, and continuous scanning temperature monitoring equipment shall comply with the calibration and accuracy requirements specified in 3.6.1.1 through 3.6.1.2.1. Equipment performance requirements specified herein are specified on the basis of simulating the signal output of the appropriate temperature sensors and applying this signal to the input terminals (temperature sensor terminal points) of the equipments (see 4.8.1).

3.6.1.1 Accuracy of alarm set point. Temperature monitoring equipment (IC/A, IC/I, and IC/S) shall permit the setting of the alarm point at any value over the designated temperature span. The error band of the alarm level setting shall be one-half the error band of the temperature readout on any full scale range (see 3.6.1.2).

3.6.1.2 Accuracy of readout. The readout error of the equipment shall not exceed plus or minus 2 percent of the readout range as defined by 3.6.1.2.1 for any readout range setting. The temperature indicated on the readout device shall be within plus or minus 2 percent of the temperature equivalent to the simulated temperature sensor output in ohms or millivolts, as applicable.

3.6.1.2.1 Readout ranges. Readout ranges shall be provided as specified (see 6.2.1) as follows:

(a) For RTE type sensors the following ranges and meter scales shall be provided:
    (1) Minus 40 deg. F to 260 deg. F.
    (2) 0 deg. F to 400 deg. F.
    (3) 0 deg. F to 800 deg. F.
    (4) 0 deg. F to 1000 deg. F.
(b) For type TCE sensors the following ranges and meter scales shall be provided:
    (1) Minus 40 deg. F to 260 deg. F.
    (2) 0 deg. F to 400 deg. F.
    (3) 0 deg. F to 800 deg. F.
    (4) 400 deg. F to 1500 deg. F (a range of 1100 deg. F).
    (5) 500 deg. F to 2000 deg. F (a range of 1500 deg. F).

3.6.2 Ambient temperature error. The change in temperature reading (temperature error) of the equipment due to any change in ambient temperature from 40 deg. F to 149 deg. F shall not exceed 0.1 percent of full scale per deg. F change in ambient temperature.

3.6.3 Response time.

3.6.3.1 Alarm circuits (IC/A and IC/I). Alarm relay shall be actuated within 0.1 seconds when a step signal change of 1.5 percent of full scale is applied when the monitoring systems are reading 1.4 percent of full scale below the alarm setting for any alarm setting from 5 to 100 percent of full scale.

3.6.3.2 Alarm circuits (IC/S). The alarm relay shall be actuated on the first scan cycle after the alarm condition appears at the input of the equipment. Alarms shall be programable to actuate either above a set condition or below a set condition.

3.6.3.3 Temperature readout. Equipment shall display the steady state temperature reading plus or minus 2.0 percent in less than 3 seconds when a step signal equivalent to 80 percent (from 10 to 90 percent) of full temperature span is applied to the temperature sensor input terminals of the temperature monitoring equipment console.

3.6.3.4 Compensation for RTE. Equipment shall provide for 3 wire temperature sensor inputs. Means shall be provided to compensate for the resistance of interconnecting wiring associated sensor input terminal configuration shall be so arranged that it can be easily by-passed (removable jumper, alternate terminals or similar means) for use with 2 wire uncompensated resistance temperature sensors.

3.6.3.5 Compensation for TCE. Cold junction compensation shall be self-contained, automatic and shall be referenced to 32 deg. F.

3.6.4 Operation.

3.6.4.1 Temperature monitor equipment. When the equipment is tested as specified in 4.8.3, equipment operation shall comply with the following:

(a) Individual visual alarm indicators light when associated test switch is operated (applicable to IC/A and IC/S equipment).
(b) Test, reset, and audible alarm cut out switches operate as required.

(c) Indicator reads required temperature when test and select (or indicate as applicable) switches are operated. Readout accuracy shall be in accordance with 3.6.1.2.
(d) Alarm indication activated with temperature sensor terminals open or short circuited, except instruments for thermocouple sensors need not detect a short.

3.6.4.2 Selective temperature readout equipment. When tested as specified in 4.8.3, equipment operation shall comply with the following:

(a) Accuracy of readout (see 3.6.1.2).
(b) Selector switch operates in accordance with 3.6.4.1(c).
(c) Indicator scale is driven to either extreme low or high with temperature sensor terminals open or short circuited.

3.6.5 Power supply requirements. Equipments shall operate normally from type I power as defined in DOD-STD-1399, Section 300. Nominal power input voltage and frequency shall be 115 volts, 60 Hertz (Hz), single phase. Power line transients and spikes with magnitudes, duration, repetition rates and decay characteristics as specified in DOD-STD-1399, Section 300 shall not cause equipment damage or affect equipment operation. The maximum difference in indicator reading and alarm setting level at any voltage and frequency condition and nominal (115 volts, 60 Hz) with the same input, shall not exceed 1/2 of 1 percent of full scale on all ranges.

3.6.6 Ripple. Transducer output ripple shall not exceed 0.15 percent of full scale output (see 4.8.4).

3.6.7 Warm-up time. Transducer output shall attain a value within plus or minus 1 percent of the steady-state output with no overshoot in excess of 1 percent. Output shall reach this band in 30 minutes or less and shall remain in this band (see 4.8.5).

3.6.8 Inclination. Maximum deviation of transducer output resulting from inclination shall not exceed 3.0 percent (see 4.8.6).

3.6.9 Insulation resistance. When tested as specified in 4.8.8, the insulation resistance shall be not less than 10 megohms.

3.6.10 Enclosure. There shall be no evidence of water leakage into the equipment enclosures (see 4.8.7).

3.6.11 Shock. When tested as specified in 4.8.9, equipments and assemblies shall show no evidence of mechanical or electrical damage or loosening of parts, and shall comply with the requirements specified in 3.6.11.1.

3.6.11.1 Temperature monitor and readout equipment (IC/A, IC/I, and IC/S). Operating controls shall not change status during, or as a result of, the shock test. There shall be no transfer of switch or relay contacts or change in selector switch position during the shock test (this includes momentary change). After the shock test, without any adjustments, the equipment shall meet the following requirements.

(a) Alarm set point accuracy as specified in 3.6.1.1 (as applicable).
(b) Indicator accuracy in accordance with 3.6.1.2.
(c) Operation shall be in accordance with 3.6.4.

3.6.12 Vibration. Temperature indicating and monitoring equipment shall meet the type I environmental vibration test acceptability requirements of MIL-STD-167-1. Failures affecting the alarm, alarm level accuracy, readout, readout accuracy, sensitivity, and range are major failures as defined in MIL-STD-167-1, basis of acceptability. Equipment range and accuracy requirements shall be demonstrated during and after completion of vibration testing specified in 4.8.10. When tested as specified in 4.8.10, equipments shall show no evidence of mechanical or electrical damage or loosening of parts. Operating controls and relays shall not change status during, or as a result of the vibration test. There shall be no momentary or permanent transfer of switch or relay contacts or change in selector switch position during the vibration test.

3.6.13 Temperature and humidity. Equipment shall comply with the temperature and humidity requirements specified in MIL-I-983, except as follows:

(a) During the temperature and humidity test specified in 4.8.11, equipments shall comply with the operating requirements of 3.6.4.

(b) At the maximum ambient temperature (65 deg. C), equipments shall comply with the calibration, accuracy, and response time requirements specified in 3.6.1 and 3.6.3.

3.7 Detail requirements. Electrical parts, mechanical parts, processes and material shall be selected and applied in accordance with the requirements specified in MIL-I-983, except as specified in 3.7.1 through 3.7.10.

3.7.1 Electron tubes. Electron tubes and vibrators shall not be used.

3.7.2 Batteries. Batteries shall not be used.

3.7.3 Electrical indicating meters. Electrical indicating meters shall be high-impact shock resistant, watertight, or hermetically sealed types, in accordance with one of the following:

(a) 4-1/2 inch 250 degree nominal scale length meter in accordance with MIL-M-16034.
(b) 4-1/2 inch minimum scale length meter in accordance with MIL-M-10304.
(c) Panel mounted, edgewise type meter in accordance with MIL-M-24359.
(d) Resistance reationmeter type meeting the applicable requirements of MIL-M-10304 or MIL-M-16034.

3.7.3.1 Digital readout. Where a digital meter and readout device is utilized in lieu of an electrical indicating meter (analog type readout), the digital readout shall be in accordance with MIL-R-39027. The indicator shall be 3 or 4 digits depending on range (see 6.2.1).

3.7.4 Fuses. Fuses shall be in accordance with MIL-F-15160. Fuses shall be selected so that the overload blowing characteristics and short circuit interrupting capacity specified in MIL-F-15160 matches the overload protection requirements of the equipment and wiring being protected and the short circuit capacity of the supply circuit. Fuse ferrules for normal blowing (characteristic A) fuses and for time lag (characteristic B) fuses in ratings of 30 amperes and above shall be silver plated. High interrupting capacity (characteristic C) fuses shall be silver-plated. Glass tube fuses shall not be used.

3.7.4.1 Fuse mounting. Fuses shall be mounted in panel mounted, indicating type fuse-holders in accordance with MIL-F-19207. Fuseholders FHL10 in accordance with MIL-F-19207/1 or FHL11 in accordance with MIL-F-19207/2 are preferred types.

3.7.4.2 Fuse and fuseholder installation requirements. Fuse and fuseholder installation requirements shall be as follows:

(a) Use of two fuses in parallel in lieu of one larger fuse is prohibited.
(b) Fuses shall be so located as not to be influenced by excessive equipment heat flow or near a high operating temperature part.
(c) Fuseholders shall be mounted for access from the front face of the equipment.
(d) Fuseholders shall be installed so that the test probe hole is located in the downward direction.
(e) Fuseholder shall not be installed for use as disconnects for line circuits.
(f) Information plates. Information plates shall be provided adjacent to the fuseholders for each set of fuses and shall indicate the fuse type designation and the circuit (for example, F09A250V8AS, 115 Vac). In addition "SPARE" shall be marked adjacent to each spare fuseholder. The letters shall be at least 3/64 inch high.

3.7.5 Resistors. Fixed and variable resistors, with power ratings less than 50 watts shall be chosen, specified, and applied in accordance with MIL-STD-199. Fixed and variable resistors with power ratings above 50 watts shall not be used in equipment conforming to this specification. Fixed and variable resistors with power ratings above 10 watts shall not be used in any module except the power supply module.

3.7.6 Capacitors. Capacitors shall be chosen, specified and applied in accordance with MIL-STD-198. Paper, paper-plastic, and metallized paper capacitors in molded cases shall not be used.

3.7.7 Terminal boards. Terminal boards shall be stud types in accordance with MIL-T-55164.

3.7.7.1 Mounting. Terminal boards shall be secured only by bolts (machine screws) and shall be capable of ready removal and replacement. They shall be accessible from the front of the enclosure with the front cover plate removed or access door open.

3.7.8 Terminal lugs. Terminal lugs shall be in accordance with MIL-T-7928, MIL-E-16366, or MIL-T-55156. Where uninsulated terminal lugs are used, the barrel shall be covered with an insulating sleeve. Where the conductor temperature may exceed 100 deg. C, an uninsulating terminal lug shall be used with an insulating sleeve which is suitable for the maximum temperature of the conductor.

3.7.8.1 Crimp limitations. Only one wire shall be crimped to a terminal lug.

3.7.9 Wire and wiring methods. Wire and wiring methods shall be in accordance with MIL-I-983.

3.7.10 Switches. Switches shall be selected so that rated currents and voltages (make, break, carry) are not exceeded in the intended application, as well as for their ability to withstand the shipboard environments. Rotary switches are preferred for power circuit interruption. Readout channel selector switch shall be a "push to turn" type so that momentary contact is not made with intermediate channels while turning the switch. Switches selected shall conform to one of the following specifications:

Switch type	Specification	Application
Rotary, snap action	MIL-S-15291	Power circuits 10A, 30A, 60A, and 200A
Rotary, snap action, enclosed	MIL-S-15743	Power circuits 10A, 30A, 60A, and 200A
Rotary (detent action)	MIL-S-18396	Meter and control up to 20A
Rotary (detent action)	MIL-S-21604	Meter, control, circuit selection up to 10A
Rotary, circuit selector (low current capacity)	MIL-S-3786	Low current circuits (2 amp or less)
Sensitive, limit pushbutton (snap action)	MIL-S-8805	Power and control circuits up to 40A
Toggle (snap action)	MIL-S-3950	Power and control circuits up to 20A
Lighted pushbutton (snap action)	MIL-S-22885	Power and control circuits up to 10A
Printed circuit and thumbwheel (detent action)	MIL-S-22710	Circuit selection low current
Thermal	MIL-S-24236	Temperature control various currents
Reed switches (snap action)	MIL-S-55433	Control circuit low currents

Where moisture seals are required for switches, boots in accordance with MIL-B-5423 shall be used.

3.8 Technical data. The contractor shall prepare the following technical data in accordance with the data ordering documents included in the contract or order (see 6.2.2) and as specified in 3.8.1 through 3.8.3.1.

3.8.1 Purpose. Drawings and technical manuals are required, as specified herein, to satisfy the following:

(a) To provide data and information to assure conformance to the specification or contract requirements including compatibility with ships and ship systems and suitability of the design for its intended end use.
(b) Assist in the evaluation of the safety, accessibility, interchangeability and maintainability features of the equipment.
(c) Enable the user to install and operate the equipment without assistance from the contractor.
(d) Permit the ship’s force or shore activities to operate, repair, obtain required modules and parts and maintain the equipment without assistance from the contractor.

3.8.2 Drawings. The contractor shall prepare drawings in accordance with the data ordering document (see 6.2.2). Unless otherwise specified (see 6.2.1), two copies of the drawings shall be submitted for initial review to NAVSEC. The number of copies submitted with contract or order shall be as specified (see 6.2.1). Where drawing acceptance has previously been obtained, it shall be necessary only to submit copies of the accepted drawing

to meet drawing requirements on subsequent contracts. No changes shall be made without review approval of NAVSEC.

3.8.2.1 Drawing data. Drawings shall be prepared in accordance with the data ordering document (see 6.2.2), and the type of information to be detailed as a minimum shall be:

(a) Type of equipment (see 1.2).
(b) Manufacturer's name and identification number of equipment.
(c) List of descriptive data including:
    (1) Applicable specification and exceptions.
    (2) Complete rating showing input voltage, frequency, outputs, etc.
    (3) Number of channels provided.
    (4) Enclosure - degree, size, and mounting details.
    (5) Temperature range.
    (6) Weight.
    (7) Notation of the corrosion-resistant treatment of hardware.
    (8) Special features.

(d) A complete external wiring connection diagram, a complete wiring diagram, and a complete schematic circuit.
(e) Finish, including method of treatment of enclosure for paintings, color, and applicable paint specification.
(f) List of material including items of hardware, with original source and source part number - generic name and parameters, also include part symbol number.
(g) List of on board repair parts and tools in table form with original source and source part number - generic name and parameters, also include part symbol number.
(h) Installation drawings - Data to be shown on these drawings shall be as follows:
    (1) Dimensional outline of all major assemblies (detector, module, etc.), showing overall and principle dimensions in sufficient detail to establish the limits of space in all directions required for installation, operation and servicing, exclusive of the space required for personnel. Include the amount of clearances required for withdrawal of parts and subassemblies, clearances for cable and piping access, and clearances for ventilation. Also indicate the location of operating controls and test points.
    (2) A table of reference drawings to include drawing number of each major assembly, weight of each enclosure and separately furnished assembly and heat dissipation of major assemblies.
    (3) A block diagram of all major assemblies showing interconnection between these assemblies. Terminal identification, as well as maximum current rating for each cable should be shown.
    (4) Location, type and dimensions of cable entrance plates, connectors, with optional entrances indicated.
    (5) Any special instructions for preservation, painting, installation or assembly as necessary.
    (6) Heat dissipation.
(i) A table or list of component units as transformers, diodes, resistors, capacitors, and similar items giving piece number, type, and rating of each. This data is a supplement to the list of material where space normally does not permit complete listing of component rating. Ratings shall include both manufacturer's rating and the specific application rating. The source shall be designated, with source part numbers and contractor symbol number. The military specification that applies shall be given if applicable.
(j) Assembly drawings showing clearly the details of design, construction, and assembly of the unit and individual circuit boards and their location. Identification of parts shall correspond to the list of materials.
(k) Schematic - A single electrical schematic diagram for each unit to represent clearly the operation of the equipment. The following features shall be incorporated in the diagram:
    (1) In preparation of the schematic, emphasis shall be placed on simplicity and ease of understanding of circuit operation. Physical placement of components and connecting wiring may be ignored in the interest of simplicity and clarity of this diagram.
    (2) A thin, broken line shall be used to represent the boundaries of each unit of subassembly. Terminals to which external connections are made shall be shown within these boundaries, with the numbers, markings, type of a

signal, power and ground, as appropriate.

(3) Each part, such as resistors, capacitors, relays shall be given a unique reference designation consisting of a letter denoting the type of part (as required by ANSI Y32.16) and a number assigned consecutively. The numbers shall be assigned in a logical sequence of electrical current or signal flow through the circuit.

(4) In addition to the reference designation, the following information shall be noted to designate the unites used:

a. Resistors - Resistance, power rating, and tolerances. If variable, an arrow to indicate clockwise rotation of the control shaft.

b. Capacitors - Capacitance, voltage rating, and tolerance.

c. Reactors - Inductance and voltage rating.

d. Semi-conductors - type number.

e. Integrated circuits - Operational symbol diagram of input-output relationship, terminal numbering corresponding to a representative schematic and type number.

f. Controls, adjustments and test points - the assigned name.

(5) Supply voltages, phases, and frequencies and transformer terminal voltage shall be indicated and labeled as to purpose.

(6) Winding polarities shall be indicated for transformers and saturable reactors. The same system shall be used throughout. The method of marking polarity shall be shown and explained in a note.
(7) Schematic diagrams, size D and larger, shall be zoned. Zone widths shall be between 6 and 8 inches. Smaller size drawings may be zones for clarity.
(8) Description of operation - A brief description of operation of the circuit elements to enable operators to understand circuity.

3.8.2.2 Qualification data. In addition to the information specified in 3.8.2.1, drawings shall include data regarding extension of qualification as specified in 4.4.2.1. These data shall indicate the design and construction details of the item actually qualified and a comparison, with comparable details, for items to which extension of is requested. Justification, based on similarity of design, construction and material shall be included with the data.

3.8.3 Technical manuals. Technical manuals shall be prepared in accordance with the data ordering document (see 6.2.2), and shall be supplied in the quantity specified (see 6.2.1). The writing level shall be to a high school graduate having no previous experience with similar equipment. Content and arrangement shall be as follows:

(a) Front matter.
(b) General information, such as:
  (1) Power requirements.
  (2) Size and weight.
  (3) Photographs.
  (4) Designator codes.
(c) Installation.
  (1) This section is to include complete installation calibration and alinement and adjustment procedures.
  (2) Resistance-temperature characteristic of the temperature detector element.
  (3) Cable connection requirements, mounting and power requirements.
(d) Operation.
  (1) Operating procedures.
  (2) Operating calibration checks.
  (3) Theory of operation of the system.
(e) Maintenance, repair and troubleshooting.
(f) Parts identification - from symbol number to system producer and part source, include military specification to conforming parts.
(g) Drawings - installation, schematic, block, outline, test arrangement, special maintenance tools, outline, part location.
(h) Appendix - inserts on special components include calibration charts obtained from qualification testing.

NAVSEC manual acceptance is required.

3.8.3.1 Technical manual validation. NAVSEC shall receive 20 days prior notice of validation requirement of MIL-M-15071 so that this activity may have the opportunity to witness this validation demonstration if desired. This validation shall be done continuously without interruption during regular working hours until complete. Operation, maintenance, installation, refurbishing, and calibration procedure validity and completeness shall be

demonstrated. Omissions and error shall be corrected by the vendor before final manual acceptance.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract, 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 assure supplies and services conform to prescribed requirements.

4.1.1 Quality program. The contractor shall provide and maintain a quality program acceptable to the Government for supplies and services covered by this specification. The quality program shall be in accordance with MIL-Q-9858 (see 6.2.1).

4.2 Classification of inspections. The methods of examination and testing shall be classified as follows:

(a) Qualification inspection (see 4.4).
(b) Quality conformance inspection (see 4.6).

4.3 Inspection conditions. Except for those tests where the following factors are the variables, tests shall be conducted with the equipment operating under the following conditions:

(a) The ambient temperature shall be 25 deg. C +/- 3 deg. C, and the relative humidity shall be between 25 and 50 percent.
(b) The supply voltage shall be 115 volts nominal.
(c) The supply frequency shall be 60 Hz nominal.

4.4 Qualification. Qualification tests shall be conducted at a laboratory satisfactory to NAVSEC. Qualification tests shall consist of the examination of 4.7 and the tests specified in table I and shall be conducted on equipments produced with techniques and procedures normally used in production.

4.4.1 Data submission. Prior to test authorization (preferably together with application for qualification), the manufacturer shall submit detail drawings and test data (see 3.8) to show substantiating evidence that the equipments have been designed so that they can comply with the requirements of this specification.

4.4.2 Qualification sample - monitor and readout equipments. One sample of each type and temperature sensing technique (see 1.2.1) with the maximum number of channels for which qualification is sought shall be submitted for examination and test.

4.4.2.1 Extent of qualification. Qualification of an equipment type will also grant qualification to equipments of the same design, type and sensing technique, with lesser number of channels.

4.4.2.2 Test routine. Equipments submitted for qualification inspection shall be subjected to the tests shown in table I in the order listed. Failure of an equipment to comply with any of the requirements listed shall cause refusal to grant qualification.

TABLE I. Qualification inspection (monitor and selective temperature readout equipment).

Examination and tests	Requirement paragraph	Examination and test paragraph
General examination	3.4, 3.5	4.7
Operation	3.6.4, 3.6.5	4.8.3
Calibration and accuracy:	3.6.1	4.8.1
Accuracy of alarm setpoint	3.6.1.1	4.8.1.1
Accuracy of readout	3.6.1.2	4.8.1.2
Response time	3.6.3	4.8.2
Warm-up time	3.6.7	4.8.5
Ripple	3.6.6	4.8.4
Inclination	3.6.8	4.8.6
Enclosure	3.6.10	4.8.7
Temperature and humidity:	3.6.13	4.8.11

Temperature error	3.6.2	- - - -
Vibration	3.6.12	4.8.10
Shock:	3.6.11	4.8.9
Accuracy of alarm setpoint	3.6.1.1	4.8.1.1
Accuracy of readout	3.6.1.2	4.8.1.2
Operation	3.6.4	4.8.3
Insulation resistance	3.6.9	4.8.8

4.5 Sampling for quality conformance inspection.

4.5.1 Lot. Equipment of the same type presented for quality conformance inspection at one time shall be considered a lot. The lot may include the entire contract quality or it my be the production of any convenient time period.

4.5.2 Sampling for group A examination and tests. A sample of equipment shall be selected from each lot in accordance with table II and subjected to the group A examinations and tests specified in table IV, in the order listed.

TABLE II. Sampling for group A examination and tests.

Number of equipments in lot	Number of equipments in sample	Number of equipments nonconforming on any group A examination and test
		Rejection number
7 and under	All	-
8 to 15	7	1
16 to 40	10	1
41 to 110	15	1
111 to 300	25	2
301 to 500	35	2
501 and over	50	3

4.5.3 Sampling for group B inspection. A sample of equipment shall be selected from each lot in accordance with table III and subjected to the examinations and tests specified in table IV, in the order shown. Group B tests shall be performed on units that have passed the group A tests.

TABLE III. Sampling for group B tests.

Number of equipments in lot	Number of equipments in sample	Number of equipments nonconforming on any group B test
		Rejection number
3 and under	All	-
4 to 15	3	1
16 to 40	5	1
41 to 110	7	1
111 to 300	10	1
301 to 500	15	2
501 and over	25	3

4.5.4 Acceptance of group A and B examination and tests. The results of each examination and test shall be compared with the requirement of this specification. Failure to conform to the requirements of this specification for any group A or B test shall be counted as a defect and the equipment shall be rejected. If the number of such nonconforming equipments in any sample exceeds the acceptance number for that sample, the lot represented by the sample shall be rejected.

4.5.5 Sampling for group C inspection.

4.5.5.1 Temperature monitor and selective temperature readout equipments. One equipment of each type and temperature sensing technique

with the maximum number of channels produced during the period shall be selected every four years. The equipment selected shall be a sample unit that has passed the group A and group B tests of table IV. Group C tests will also be required when the basic design of the equipment or the process or material has been changed.

4.5.5.2 Acceptance of group C tests. The results of each group C test shall be compared with the requirements of this specification. In the event of failure to conform to the requirements of this specification for any group C test, the manufacturer shall take corrective action on the materials or processes, or both, as warranted, and on all units of product which can be corrected and which were manufactured under essentially the same conditions, with essentially the same materials, processes, etc., and which are considered subject to the same failure. Acceptance of the product shall be discontinued until corrective action, acceptable to the Government, has been taken. After the corrective action has been taken, group C inspection shall be repeated on additional sample units (all inspection, or the inspection which

the original sample failed, at the option of the Government). Groups A and B inspection may be reinstituted; however, final acceptance shall be withheld until the group C reinspection has shown that the corrective action was successful. In the event of failure after reinspection, complete information concerning the failure and the corrective action taken shall be furnished to the contracting officer. If group C tests have not been successfully completed one year after first group C failure the manufacturer shall be deleted from the Qualified Products listing for equipment conforming to this specification excluding parts and temperature sensors that sill test satisfactorily.

4.6 Quality conformance inspection. The sample equipments or sensor assemblies selected in accordance with 4.5 shall be subjected to the examination and tests listed in table IV. Examinations and tests shall be performed in the order listed.

TABLE IV. Quality conformance inspection.

Examination and tests	Requirement paragraph	Test paragraph
Group A		
General examination	3.4, 3.5	4.7
Insulation resistance	3.6.9	4.8.8
Operation	3.6.4	4.8.3
Group B		
Calibration and accuracy:	3.6.1	4.8.1
Accuracy of alarm set point	3.6.1.1	4.8.1.1
Accuracy of readout	3.6.1.2	4.8.1.2
Response time	3.6.3	4.8.2
Group C		
Shock:	3.6.11	4.8.9
Accuracy of alarm set point	3.6.1.1	4.8.1.1
Accuracy of readout	3.6.1.2	4.8.1.2
Operation	3.6.4	4.8.3
Temperature and humidity:	3.6.13	4.8.11
Temperature error	3.6.2	- - - -

4.7 Examination. Each equipment shall be subjected to an examination as specified in MIL-I-983. The examination shall verify compliance with the enclosure and system requirements specified in 3.4 and 3.5.

4.8 Methods of examination and test.

4.8.1 Calibration and accuracy. Monitor and readout equipment calibration and accuracy measurements shall be accomplished by simulating temperature sensor signal output over the designated temperature span. Simulated signal for equipments using the resistance sensing technique shall be resistances as specified in MIL-T-24388 and shall be simulated by a resistance decade (or similar device) having an accuracy of plus or minus 0.055 ohm. The simulated signal for equipments using the thermocouple sensing technique shall be millivolts (mV) as specified in ANSI C96.1 and shall be simulated by a stable direct current (d.c.) voltage source having an

accuracy of plus or minus 0.025 mV.

4.8.1.1 Accuracy of alarm set point. Alarm set points shall be calibrated and adjusted in accordance with the instructions contained in the technical manual furnished with the equipment. The accuracy of the alarm set point shall be checked at 5 different temperatures approximately equally spaced over the temperature span for each alarm channel. A signal simulating the temperature sensor output shall then be applied to the equipment input terminals. The accuracy of the alarm set point shall be checked with both increasing and decreasing signals. The signal required to actuate the alarm shall be within the limits specified in 3.6.1.1.

4.8.1.2 Accuracy of readout. The accuracy of the readout portion of equipment types shall be determined at 5 approximately equally spaced intervals over each readout temperature span. The reading, at each simulated temperature input, shall be as specified in 3.6.1.2.

4.8.1.3 Lead resistance compensation. For equipments which operate with RTE sensors, one of the measurements specified in 4.8.1.1 and 4.8.1.2 shall be repeated by inserting a resistance in series with each lead of the resistor simulating the RTE to simulate lead resistance. The resistance in each lead shall be any value between 20 and 30 ohms, but the resistances for each lead shall be equal to each other within 0.1 ohm.

4.8.2 Response time.

4.8.2.1 Alarm circuits. Compliance with 3.6.3.1 shall be demonstrated by testing at 10, 20, 50, 90 and 100 percent of the full alarm setting range.

4.8.2.2 Temperature readout. A step input signal, equal to 80 percent of the temperature span (from 10 to 90 percent of the span) for each temperature range setting shall be applied to the temperature sensor input terminals. Indicator reading shall be as specified in 3.6.3.2.

4.8.3 Operation (monitor and readout equipment). Equipment shall be energized with nominal voltage and frequency (115 volts, 60 Hz) and allowed to stabilize for at least 30 minutes. Input signals, simulating temperature sensor outputs equivalent to approximately mid-range of the temperature span shall be connected to all equipment input terminals. Equipment controls shall then be actuated in turn to verify compliance with 3.6.4.1 and 3.6.4.2. Indicator readings shall be noted and recorded. The supply voltage and frequency shall then be adjusted to the lower limit of permissible variation (see 3.6.5). Equipments shall then be adjusted to the lower limit of permissible variation (see 3.6.5). Equipments shall be stabilized at this input power for at least 15 minutes and indicator reading shall be noted and recorded. Supply voltage and frequency shall then be adjusted to the higher limit, stabilized for at least 15 minutes and the indicator reading noted and recorded. Temperature sensor inputs during these tests shall remain constant. The change in indicator reading, due to variations in input power shall be within the limits specified in 3.6.5.

4.8.4 Ripple. Ripple shall be determined at an input temperature of 80 +/- 5 percent of transducer span. Performance shall conform to the requirements of 3.6.6.

4.8.5 Determination of warm-up time. Test shall be conducted to determine the elapsed time between the application of line power to the transducer and the point at which the transducer output reaches the conditions specified in 3.6.7.

4.8.5.1 The transducer shall be placed in a ambient temperature of 25 deg. C +/- 2 deg. C for not less than 2 hours de-energized. Recording equipment and other auxiliary equipment shall be energized to assure complete warm-up. An input differential pressure of 80 +/- 5 percent of the transducer span is to be applied to the transducer and maintained constant during this test. Performance shall conform to 3.6.7.

4.8.6 Inclination. The equipment shall be inclined for a period of at least 1 minute in each of the following positions:

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

In each position a referenced measurement (see 4.8.1) shall be made. Performance shall conform to 3.6.8.

4.8.7 Enclosure. The enclosure shall be subjected to the splashproof test specified in MIL-STD-108. Performance shall conform to 3.6.10.

4.8.8 Insulation resistance. Equipment shall be tested in accordance with method 302 of MIL-STD-202. The following details and exceptions shall apply:

(a) Test condition B (500 volts) for equipments.
(b) Points of measurement between circuits and ground.

4.8.9 Shock. Equipments and sensor assemblies shall be tested in accordance with the class HI shock test specified in MIL-S-901 for grade A, class I, type C equipment.

4.8.9.1 Monitor and readout equipment. The equipment shall be energized during the test with nominal voltage and frequency (115 volts, 60 Hz) and sensor input signals shall be 80 percent of span. During the test all operating controls shall be observed for change in status. After the shock

test, equipments shall be subjected to the following examinations and tests:

(a) Alarm set point accuracy - see 4.8.1.1.
(b) Readout accuracy - see 4.8.1.2.
(c) Operation at nominal voltage and frequency - see 4.8.3.
(d) Examination for evidence of mechanical damage or loosening of parts.

4.8.10 Vibration. Equipments and sensor assemblies shall be tested in accordance with type I vibration of MIL-STD-167-1. Energization, input signals, observations during test and examinations after vibration shall be as specified in 4.8.9 for the shock test. IC/A systems shall have the alarm point set within 4 percent of full scale of the incoming temperature level. The temperature level shall be at 90 percent of full scale. If an alarm occurs during vibration, any vibration test is a failure and corrective action is required. Frequency variation tests of MIL-STD-167-1 are required with the same settings. It shall be demonstrated that vibration from 1 to 50 Hz in accordance with MIL-STD-167-1 shall not cause alarm.

4.8.11 Temperature and humidity. Equipments shall be tested in accordance with the temperature and humidity test of MIL-I-983. Performance during and after test shall be as specified in 3.6.13.

4.9 Inspection of preparation for delivery. Sample packages and packs and the inspection of the preservation-packaging, packing, and marking for shipment and storage shall be in accordance with the requirements of section 5 and the documents specified therein.

5. PREPARATION FOR DELIVERY

(The preparation for delivery requirements specified herein apply only for direct Government acquisitions. For the extent of applicability of the preparation for delivery requirements of referenced documents listed in section 2, (see 6.5.)

5.1 Preservation-packaging, packing and marking. Each equipment with associated parts and technical manuals shall be preserved-packaged level A or C, packed levels A, B, or C as specified (see 6.2.1) and marked in accordance with MIL-E-17555.

5.2 Repair parts. Repair parts shall be preserved-packaged, packed and marked in accordance with MIL-E-17555, as applicable for the intended use and destination as follows:

	Levels	
Destination	Preservation-packaging	Packing
Onboard (accompanying equipment)	A	C
Stock	A	B
Immediate use	C	C

Unless otherwise specified (see 6.2.1), repair parts shall be packaged one part to a unit package, except when used in quantities greater than one or parts comprising a single set or assembly. Parts, sets or assemblies shall be individually protected to prevent direct surface contact with surfaces of adjacent parts and shall be packaged together as a single unit.

5.2.1 Repairables. Repair parts subject for return to a repair facility

for restoration and reissue shall be packaged and packed in materials and containers capable of reuse. Unless otherwise specified (see 6.2.1), packaging shall be in accordance with MS90363. Repairables requiring reusable containers, such containers shall be in accordance with the guidelines of MIL-E-17555. Containers shall be marked - "REUSABLE DO NOT DESTROY." Packaging and transportation support data shall be furnished for items falling in this category (see 6.2.2).

5.3 Semi-conductors or solid state devices: Semi-conductors such as diodes, transistors, integrated circuits as well as circuit boards or chassis in which they are incorporated, shall be individually packaged in a barrier bag conforming to class I, type 1; type I or II, or class F, type 1, type I or MIL-B-117. MIL-B-117 bag material shall employ aluminum foil as a laminate of the bag barrier material. Bag closure shall be effected by heat sealing. Leads and terminals shall be protected from damage by means of the container (carrier) design, die cut inserts, or by the use of non-corrosive cushioning material. Leads and other projecting parts may be used for positioning, but shall not be subjected to loads or other stresses such as bending or twisting that can damage the entry seals. For level C preservation-packing, semi-conductors or solid state devices subject to electro magnetic degradation shall be protected with a warp of aluminum foil or a barrier bag employing aluminum foil as a laminate of the bag material.

Leads and terminals shall be protected as specified herein.

5.4 Cushioning, dunnage and wrapping materials.

5.4.1 Level A preservation-packaging and levels A and B packing. Use of all types of loose-fill materials for packaging and packing applications such as cushioning, filler or dunnage is prohibited for materials destined for shipboard installation/stowage.

5.4.2 Level C preservation-packaging and packing. When loose fill type materials are used for packaging and packing applications such as cushioning, filler and dunnage, all containers (unit, intermediate and shipping) shall be marked or labelled with the following information:

"CAUTION

Contents cushioned etc., with loose-fill material. Not to be taken aboard ship. Remove and discard loose-fill material before ship board stowage. If required, recushion with cellulosic material, bound fiber, fiberboard or transparent flexible cellusar material."

5.4.3 Cushioning, filler, dunnage and wrapping materials selected, whenever available, shall exhibit improved performance for resistance to fire.

6. NOTES

6.1 Intended use. The temperature monitoring equipment is intended for use on all Naval ships to continuously monitor and selectively indicate at a central location, a number of temperatures at remote, shipboard equipment locations.

6.2 Ordering data.

6.2.1 Acquisition requirements. Acquisition documents should specify the following:

(a) Title, number and date of this specification.
(b) Classification required (see 1.2.1).
(c) Number of temperature sensors to be monitored (see 3.5.1 and 3.5.3).
(d) Setting of alarm channels, if other than 200 deg. F (see 3.5.1).
(e) Height and weight of equipment assembly (see 3.5.1.10).
(f) Number of remote resistance temperature sensors or remote thermocouple temperature sensors monitored by equipment (see 3.5.4 and 3.5.5).
(g) Equipment alarm and readout temperature range (see 3.6.1.2.1).
(h) Whether 3 or 4 digits are required (see 3.7.3.1).
(i) Quantity of drawings required (see 3.8.2).
(j) Quantity of technical manuals required (see 3.8.3).
(k) Quality assurance requirements (see 4.1.1).
(l) Levels of preservation-packaging and packing required (see 5.1).
(m) Quantity of repair parts per package (see 5.2).
(n) Packaging other than MS 90363 required (see 5.2.1).
(o) Quantity of items required.

6.2.2 Data requirements. When this specification is used in a contract which invokes the provision of the "Requirements for Data" of the Defense

Acquisition Regulation (DAR), the data identified below, which are required to be developed by the contractor, as specified on an approved Data Item Description (DD Form 1664), and which are required to be delivered to the Government, should be selected and specified on the approved Contract Data Requirement List (DD Form 1423) and incorporated in the contract. When the provisions of the "Requirements for Data" of the DAR are not invoked in a contract, the data required to be developed by the contractor and required to be delivered to the Government should be selected from the list below and specified in the contract.

Paragraph	Data requirements	Applicable DID	Option
3.8.2 and 3.8.2.1	Drawings, engineering and associated lists	DI-E-7031	Level 3 (production) Design activity designation - contractor Design number - contractor
3.8.2	Manual, technical standard	DI-M-2044	Type I of MIL-M-15071
5.2.1	Packaging and transportation support data	UDI-P-23508	- - - - -

(Copies of data item descriptions required by the contractors in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.)

6.2.2.1 The data requirements of 6.2.2 and any task in section 3, 4, or 5 of the specification required to be performed to meet a data requirement may be waived by the contracting/acquisition activity upon certification by the offeror that identical data were submitted by the offeror and accepted by the Government under a previous contract for identical item acquired to this specification. This does not apply to specific data which may be required for each contract regardless of whether an identical item has been supplied previously (for example, test reports).

6.3 With respect to products requiring qualification, awards will be made only for products which are at the time set for opening of bids, qualified for inclusion in applicable Qualified Products List QPL-15377 whether or not such products have actually been so listed by that date. The attention of the contractors is called ot this requirement, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. The activity responsible for the Qualified Products List is the Naval Ship Engineering Center, SEC 6124, Department of the Navy, Washington, DC 20362, and information pertaining to qualification of products may be obtained from the activity. Application for Qualification tests shall be made in accordance with "Provisions Governing Qualification SD-6" (see 6.3.1).

6.3.1 Copies of "Provisions Governing Qualification SD-6" may be obtained upon application to Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, Pennsylvania 19120.

6.4 Cross-reference of classifications. Temperature sensor assemblies previously covered by MIL-T-15377E(SHIPS) are not specified in MIL-T-24388B(SH). Temperature sensing technique classification has been changed as follows:

MIL-T-15377E(SHIPS)	MIL-T-15377F(SH)
RTD	RTE
TCD	TCE

6.5 Sub-contracted material and parts. The preparation for delivery 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.

6.6 Changes from previous issue. The symbol "#" is not used in this revision to identify changes with respect to the previous issue, due to the extensiveness of the changes.

Preparing activity:
Navy - SH
(Project 6685-N606)