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(See 6.12)

MILITARY SPECIFICATION

THERMOMETER, GAS ACTUATED, REMOTE READING

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 environmentally hardened thermometers which utilize an elastic element to measure the pressure within a gas filled closed system (thermal system) and convert this pressure to an analog temperature indication on a circular dial. Remote reading is accomplished by connecting the analog temperature indicator to the thermometer bulb by a specified length of capillary tubing. The gas actuated thermometer bulb is configured for either direct immersion or insertion into a thermowell.

1.2 Classification. Gas actuated thermometers shall be classified according to the following variables, as specified (see 6.2):

(a) Sensor configuration (see 1.2.1).
(b) Range (see 1.2.2).
(c) Dial size (see 1.2.3).
(d) Capillary tubing length (see 1.2.4).

1.2.1 Sensor configuration. The sensor configuration shall be designated by two symbols; the first symbol shall designate the class and the second symbol the subclass. The class, designated by the letter A, B, or C, identifies the sensor type and mounting method (see 3.3.2.1.1). The subclass, designated by a number, identifies the physical dimensions of the individual sensors. Class A has only one subclass and shall be designated as A1. Class B has six subclasses as shown on figure 1. Class C has four subclasses as shown on figure 2.

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

AMSC N/A
FSC 6685

- Issue of DODISS to be cited in the solicitation, and if required,

1.2.2 Range. The range shall be designated by the sequence of symbols listed in table IV. The range shall be selected for a particular sensor configuration class only if that range is specified for the particular sensor configuration class in table IV.

1.2.3 Dial size. The dial size shall be designated by one of the following symbols:

Dial size	Symbol
3-1/2	3
4-1/2	4
8-1/2	8

1.2.4 Capillary tubing length. The capillary tubing length selected is designated by its numerical value in units of feet (see 3.3.2.2).

1.3 Part or Identifying Number (PIN). A specification-based PIN to identify sensor configuration, range, dial size, and capillary tubing length is included in section 6 (see 6.10).

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

QQ-N-286 - Nickel-Copper-Aluminum Alloy, Wrought (UNS N05500).
UU-P-268 - Paper, Kraft, Wrapping.
PPP-B-566 - Boxes, Folding, Paperboard.
PPP-B-636 - Boxes, Shipping, Fiberboard.
PPP-B-640 - Boxes, Fiberboard, Corrugated, Triple-Wall.
PPP-B-665 - Boxes: Paperboard, Metal Edged and Components.
PPP-B-676 - Boxes, Setup.
PPP-C-850 - Cushioning Material, Polystyrene, Expanded, Resilient (for Packaging Uses).
PPP-C-1120 - Cushioning Material, Uncompressed Bound Fiber for Packaging.

MILITARY

MIL-P-116 - Preservation, Methods of.
MIL-B-117 - Bags, Sleeves and Tubing.
MIL-S-901 - Shock Tests, H.I. (High-Impact); Shipboard Machinery, Equipment and Systems, Requirements for.
MIL-P-5425 - Plastic Sheet, Acrylic, Heat Resistant.
MIL-C-5541 - Chemical Conversion Coatings on Aluminum and Aluminum Alloys.
MIL-R-6130 - Rubber, Cellular, Chemically Blown.
MIL-B-7883 - Brazing of Steels, Copper, Copper Alloys, Nickel Alloys, Aluminum and Aluminum Alloys.
MIL-A-8625 - Anodic Coatings, For Aluminum and Aluminum Alloys.
MIL-E-15090 - Enamel, Equipment, Light-Gray (Formula No. 111).
MIL-R-20092 - Rubber or Plastic Sheets and Assembled and Molded Shapes, Synthetic, Foam or Sponge, Open Cell.
MIL-S-22473 - Sealing, Locking and Retaining Compounds: (Single Component).
MIL-T-24270 - Thermowells for Thermometers and Electrical Temperature Sensors, General Specification for.
MIL-P-26514 - Polyurethane Foam, Rigid or Flexible, for Packaging.
MIL-R-83248 - Rubber, Fluorocarbon Elastomer, High Temperature, Fluid, and Compression Set Resistant.

STANDARDS

FEDERAL

FED-STD-H28 - Screw-Thread Standards for Federal Services.
FED-STD-313 - Material Safety Data, Transportation Data and Disposal Data for Hazardous Materials Furnished to Government Activities.

MILITARY

MIL-STD-22 - Welded Joint Design.
MIL-STD-108 - Definitions of and Basic Requirements for Enclosures for Electric and Electronic Equipment.
MIL-STD-129 - Marking for Shipment and Storage.
MIL-STD-130 - Identification Marking of U.S. Military Property.
MIL-STD-278 - Welding and Casting Standard.

(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.

NAVAL SEA SYSTEMS COMMAND (NAVSEA)
S8700-841569 - Ring, Steel, for Flush Mounted Plastic Case, Gauges and Thermometers.
S8700-1385799 - Cases, Plastic for Flush Mounted Pressure Gauges and Thermometers.
810-1385917 - Thermometer Selection Guide.

(Application for copies should be addressed to: Commander, Portsmouth Naval Shipyard, Code 202.2, Portsmouth, NH 03801.)

NAVAL SEA SYSTEMS COMMAND (NAVSEA)
0900-LP-001-7000 - Piping Systems, Brazed, Fabrication and Inspection of.

(Application for copies should be addressed to the Naval Publications and Forms Center, (ATTN: NPODS), 5801 Tabor Avenue, Philadelphia, PA 19120-5099.)

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

(The Code of Federal Regulations (CFR) and the Federal Register (FR) are for sale on a subscription basis by the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. When indicated, reprints of certain regulations may be obtained from the Federal agency responsible for issuance thereof.)

(Copies of 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 activity.)

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).

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)
B40.1 - Gauges - Pressure Indicating Dial Type - Elastic Element. (DoD adopted)

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

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

A 216 - Standard Specification for Steel Castings, Suitable for Fusion Welding, for High Temperature Service. (DoD adopted)

A 276 - Standard Specification for Stainless and Heat-Resisting Bars and Shapes. (DoD adopted)

A 473 - Standard Specification for Stainless and Heat-Resisting Steel Forgings. (DoD adopted)

A 480 - Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip. (DoD adopted)

A 564 - Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless and Heat-Resisting Steel Bars and Shapes.

A 581 - Standard Specification for Free-Machining Stainless and Heat-Resisting Steel Wire and Wire Rods. (DoD adopted)

A 582 - Standard Specification for Free-Machining Stainless and Heat-Resisting Steel Bars, Hot-Rolled or Cold-Finished. (DoD adopted)

B 26 - Standard Specification for Aluminum-Alloy Sand Castings. (DoD adopted)

B 85 - Standard Specification for Aluminum-Alloy Die Castings. (DoD adopted)

B 117 - Standard Method of Salt Spray (Fog) Testing. (DoD adopted)

B 209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate. (DoD adopted)

B 443 - Standard Specification for Nickel-Chromium-Molybdenum-Columbium Alloy (UNS N06625) Plate, Sheet, and Strip.

B 570 - Standard Specification for Copper-Beryllium Alloy Forgings and Extrusions.

D 3951 - Standard Practice for Commercial Packaging. (DoD adopted)

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

(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 4.3.

3.2 Materials. Materials for the parts which make up the gas actuated thermometer shall be as specified in 3.2.1 through 3.2.4, and in table I.

TABLE I. Materials.

Part	Designation	Material specification	Remarks
Bulb	UNS S31600	ASTM A 276	CRES 316 1/, 2/
Capillary tubing	UNS S31600	ASTM A 276	CRES 316 1/, 2/
Elastic element	UNS S17400 UNS N0500 UNS N0625 UNS N09902 UNS C17200	ASTM A 564 QQ-N-286 ASTM B 443 ASTM B 570	CRES 17-4ph K-monel Inconel 625 Ni Span C Beryllium Cu
Fill fluid			3/
Spiral armor	UNS S31600	ASTM A 276	CRES 316
Extension tubing	UNS S31600	ASTM A 276	CRES 316 1/, 2/
Flange	UNS S32100 UNS S31603	ASTM A 216 ASTM A 216	CRES 321 CRES 347
Sliding connector assembly	UNS S31600	ASTM A 276	CRES 316
Case		ASTM B 26 ASTM B 85 ASTM A 473	Aluminum 4/, 5/ Aluminum 4/, 5/ CRES 6/
Dial	300 or 400 series	ASTM B 209 ASTM A 276	Aluminum 4/, 5/ CRES
Window		MIL-P-5425	Plastic
Movement	300 or 400 series	ASTM A 276	8/

See footnotes at end of table.

TABLE I. Materials - Continued.

Part	Designation	Material specification	Remarks
Indicating pointer	300 or 400 series	ASTM B 209 ASTM A 276	Aluminum 7/ CRES 7/
Red index	300 or 400 series	ASTM B 209 ASTM A 276	Aluminum 9/ CRES 9/
Threaded fasteners	300 or 400 series	ASTM A 276 ASTM A 581 ASTM A 582	CRES 10/
Washers		ASTM A 276 ASTM A 480	CRES
Gaskets	Flat gaskets	MIL-R-83248	Fluorocarbon Rubber (250°F Max)
O-Rings	O-Rings, type 1	MIL-R-83248	Fluorocarbon Rubber (250°F Max)

1/ For applications having temperatures greater than 800 degrees Fahrenheit (°F), CRES 321 (UNS S32100) or CRES 347 (UNS S31603) in accordance with ASTM A 216 shall be used.
2/ For welding applications, CRES 316L (UNS S31603) in accordance with ASTM A 276 may be used in lieu of CRES 316.
3/ The fill fluid shall be nitrogen or an inert gas as per the periodic table of elements.
4/ Aluminum shall be prepared for protection against corrosion by chromate conversion coatings in accordance with MIL-C-5541 or by anodizing in accordance with type I or II of MIL-A-8625. Aluminum shall then be finished with a flash air-dry primer and a gray enamel finish coat. The finish coat shall be in accordance with type II of MIL-E-15090.
5/ Aluminum alloy shall be selected to meet shock requirements (see 3.6.14).
6/ Corrosion-resisting steel cases shall be prepared for protection against corrosion by providing a 0.001 to 0.002 inch surface profile. Case finish shall then contain a finish which shall include flash air-dry primer and a gray enamel finish coat. The finish coat shall be in accordance with type II of MIL-E-15090.
7/ Indicating pointer shall be non-reflective black.
8/ Bearing may be of special material, when specified (see 6.2).
9/ Red index (see 6.6.7) shall be non-reflective red.
10/ Unless retained by other methods, retaining compound in accordance with grade C of MIL-S-22473 shall be used.

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

3.2.2 Restricted materials. Restrictions for materials incorporated in the parts and products covered by this specification shall be as specified in 3.2.2.1 through 3.2.2.3.

3.2.2.1 General restrictions. Unless otherwise specified for a particular use herein, the following types or kinds of materials shall not be used: cellulose acetate, cellulose nitrate, cellulose asbestos compounds, jute, leather, linen, magnesium and magnesium alloy, organic fiberboard, paper and cardboard, plastic (using cotton, linen, or wood flour as a filler), wood, and fungus nutrients. Equipment, material, and articles incorporated in the parts and products covered by this specification shall neither contain mercury, cadmium, asbestos, glass, radioactive material, nor polychlorinated biphenyl (PCB).

3.2.2.2 Carcinogens. Certain chemicals have been identified in the Occupational Safety and Health Act (OSHA) as cancer-producing substances (carcinogens). Before using any materials which might contain these chemicals, they should be evaluated in accordance with the Code of Federal Regulations (CFR), Title 29, Chapter XVII, Part 1910.

3.2.2.3 Gases or fumes. Materials and combinations of materials that liberate gases which combine with the atmosphere to form an acid or corrosive alkali shall not be used. Materials and combinations of materials shall not liberate toxic or corrosive fumes which would be detrimental to the performance of the gas actuated thermometer or to the health of the operator. The materials also shall not liberate gases which will produce an explosive atmosphere.

3.2.2.4 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).

3.2.3 Nonmetal materials. Nonmetals, when used for seals, protective finishes, and so forth, shall be moisture and flame resistant, shall not support fungus growth, and shall not be adversely affected by the ambient environments specified in the design and performance requirements of this specification.

3.2.4 Plastic parts. With the exception of the window, the gas actuated thermometer shall not have plastic parts.

3.3 Construction. The gas actuated thermometer's thermal system (see 6.6.9) shall be gas filled. A gas actuated thermometer shall consist of a sensor, capillary tubing, and an indicator (see 6.3 and appendix).

3.3.1 Interchangeability. In no case shall parts be physically interchangeable or reversible unless such parts are also interchangeable or reversible with regard to function, performance, and strength.

3.3.2 Mechanical construction.

3.3.2.1 Sensor configuration. The sensor (see 6.6.8) shall consist of a bulb, an extension tube, and a fitting.

3.3.2.1.1 Sensor configuration classes. The sensor configuration classification (see 1.2.1) identifies the sensor type, mounting method, and dimensions.

3.3.2.1.1.1 Class A sensor configuration. A class A sensor configuration shall be constructed for insertion into a bracket which conforms to NAVSEA 810-1385917. The class A sensor configuration shall meet the dimensional requirements of figure 2, classification designation C2. A bracket which conforms to the requirements of NAVSEA 810-1385917 shall be supplied with each class A sensor configuration. The inner length of the bracket shall be 4 inches.

3.3.2.1.1.2 Class B sensor configuration. The class B sensor configuration shall be constructed for direct immersion into the process fluid. The class B sensor configuration shall conform to the requirements on figure 1.

3.3.2.1.1.3 Class C sensor configuration. The class C sensor configuration shall be constructed for insertion into a thermowell which meets the requirements specified in MIL-T-24270. The class C sensor configuration shall conform to the requirements on figure 2.

3.3.2.1.2 Extension tube. The extension tube shall be heavy walled tubing. For class A and class C sensor configurations the extension tube shall be bendable. Class B sensor configurations shall have a rigid extension tube.

3.3.2.1.2.1 Immersion depth line. The minimum immersion depth (see 6.6.5) for the class B sensor configuration shall be 1 inch beyond the bulb. The immersion depth line (see figure 1) shall be permanently marked on the extension tube external surface for the class B sensor configuration.

3.3.2.1.3 Bulb. The bulb (see 6.6.1) shall meet dimensional requirements as specified on figures 1 and 2. Except for the conditions in 6.5, the class C sensor configuration shall have a bulb diameter of 3/8 inch.

3.3.2.1.4 Fitting.

3.3.2.1.4.1 Sliding connector assembly. The sliding connector assembly (see figure 2, detail A) shall consist of a jam nut (see 6.6.6), ferrule (see 6.6.3), and union connector and shall be adjustable along the length of the extension tube. A sliding connector assembly shall be furnished with each class C and class A sensor configuration.

3.3.2.1.4.1.1 Union connector. The thread of the union connector (see 6.6.10) shall be in accordance with table II.

TABLE II. Union connector thread size.

Nominal diameter bulb (inch)	Union connector thread size
3/8	3/4-28-UN-2A
15/16	1-1/4-18UNEF-2A

3.3.2.1.4.2 Flange. A flange which meets the requirements on figure 3 shall be supplied with each class B sensor configuration. The seal weld between the flange and bulb shall be in accordance with the requirements for weld design P-16 of MIL-STD-22.

3.3.2.2 Capillary tubing. Capillary tubing lengths shall be available in increments of 5 feet. The capillary tubing length shall be as specified (see 6.2).

3.3.2.2.1 Capillary tubing protection. The capillary tubing shall be protected by the extension tube (see 3.3.2.1.2) and spiral armor. The spiral armor shall be the interlocking spiral type or the spring coil type. The strength of the capillary tubing protection shall ensure that neither the weight of the bulb nor the indicator shall subject the capillary tubing to tensile stress.

3.3.2.3 Indicator. The indicator shall include the case, dial, window, elastic element, movement, indicating pointer, and red index.

3.3.2.3.1 Elastic element. The elastic element may be a Bourdon tube, bellows, diaphragm, or other element which reacts to pressure changes in the fill fluid induced by a temperature change in the fill fluid (see 6.6.4).

3.3.2.3.2 Case. Cases shall be interchangeable for mounting purposes with the cases shown in NAVSEA S8700-1385799. Dimensions A, A1, A8, A10, A15, A17, and A29 shall be critical dimensions of the case and shall be in strict accordance with NAVSEA S8700-1385799. Dimension A30 may be greater than indicated in NAVSEA S8700-1385799, but shall be less than 4 inches.

3.3.2.3.2.1 Case connection. Unless otherwise specified (see 6.2), the protrusion of the capillary from the case (the case connection) shall be in a lower back connected orientation. The only other alternative orientation offered shall be the bottom connected configuration. The location of the case connection shall be in accordance with the applicable critical dimensions (see 3.3.2.3.2) in NAVSEA S8700-1385799.

3.3.2.3.3 Pointers. An indicating pointer and a red index shall be furnished with each gas actuated thermometer. The length and tip width shall be in accordance with ANSI B40.1.

3.3.2.3.3.1 Red index. The red index pointer shall be adjustable to any temperature on the scale.

3.3.2.3.4 Dial. Dial configuration, style, pointer rotation and pointer interface shall be in accordance with ANSI B40.1.

3.3.2.3.4.1 Dimensions. Dial numerals and scale dimensions shall be in accordance with table III.

TABLE III. Dial dimensions.

Size (inches)	Numeral height (minimum) (inch)	Diameter scale base line (minimum) (inches)	Dial blank diameter (minimum) (inches)
3-1/2	7/32	3	3-5/16
4-1/2	9/32	4-1/8	4-5/16
8-1/2	1/2	7-3/4	8-1/4

3.3.2.3.4.2 Markings. Dial markings shall include:

(a) Manufacturer's name or trade mark.
(b) Manufacturer's part number.
(c) National stock number.
(d) Elastic element material symbol or name.
(e) Scale graduations, numerals and units of graduations (°F).
(f) Dial color shall be yellow background with black graduations and markings.

3.3.2.3.4.3 Scale. Scales shall cover an arc of not less than 270 degrees central angle. Graduations shall consist of minor, intermediate, and numbered divisions, and shall be in accordance with table IV.

TABLE IV. Range and dial graduations.

Range (°F)	Maximum operating temperature (°F)	Dial minor division	Dial numeral interval	Applicable class (see 1.2.1)	Temperature range classification designation (see 1.2.2)
-40 to 180	180	2	20	A, C	18d
20 to 240	240	2	20	C	24d
50 to 550	500	5	50	C	55d
50 to 750	700	5	50	B, C	75d
400 to 1200	1100	10	100	B, C	12h

3.3.2.3.5 Indicator accessories.

3.3.2.3.5.1 Mounting ring. Unless otherwise specified (see 6.2), gas actuated thermometers shall be supplied with flush mounting rings in accordance with Drawing S8700-841569. Dimensions A2, A3, A4, A5, C12, H1, and H2 shall be critical dimensions of the flush mounting ring, and shall be in strict accordance with Drawing S8700-841569. Round head screws and spacers which ensure secure mounting shall also be provided with each gas actuated thermometer.

3.3.2.3.5.2 Overrange stops. The gas actuated thermometer shall be equipped with an overrange stop which shall meet the requirements of 3.3.2.3.5.2.1, 3.3.2.3.5.2.2, or 3.3.2.3.5.2.3.

3.3.2.3.5.2.1 Elastic element overrange stop. An elastic element overrange stop shall be installed in each gas actuated thermometer. The overrange stop shall be adjustable and shall be set for 105 percent of the full scale value.

3.3.2.3.5.2.2 Pointer overrange stop. If a pointer stop is sufficient to stop the movement of the elastic element without permanent damage occurring to the elastic element, pointer, or both, then a pointer stop may be used in lieu of the elastic element stop. The pointer overrange stop shall be set at 105 percent of the full scale value. A pointer overrange stop shall not be acceptable to meet the overrange stop requirement for gas actuated thermometers containing a C type Bourdon tube elastic element.

3.3.2.3.5.2.3 Pointer catch mechanism. When an elastic element stop or a pointer stop would be insufficient to perform their intended function without permanent damage occurring to the elastic element, a pointer catch mechanism shall be installed on the dial. The pointer catch mechanism shall capture the pointer if the gas actuated thermometer is overranged 105 percent of full scale value. Once captured, the pointer shall slip on the shaft allowing the elastic element to expand. The pointer catch mechanism shall hold the pointer in place after the temperature returns to within the operating range of the gas actuated thermometer. The removal of the window shall be required to release the pointer from the pointer catch mechanism. The dial shall contain the markings: "If pointer in catch position, recalibrate before use".

3.3.3 Methods of attachment.

3.3.3.1 Welding and brazing. Internal pressure containing parts shall be joined by welding or brazing. Welding shall be in accordance with MIL-STD-278 and brazing in accordance with NAVSEA 0900-LP-001-7000 and MIL-B-7883. Internal pressure containing parts shall be joined by welding or brazing. Joints shall be either welded or nicrobrazed.

3.3.3.2 Threads. Threads shall be in accordance with FED-STD-H28. Tapered threads shall not be used.

3.3.3.3 Fastening devices. Screws, pins, bolts, and similar parts shall be installed with means for preventing loss of tightness. These parts, when subjected to removal or adjustment, shall neither be swaged, peened, staked, nor otherwise permanently deformed.

3.3.4 Corners. Corners shall be rounded to preclude injury to personnel and damage to other material. Corners shall be adequately reinforced to protect the gas actuated thermometer.

3.3.5 Lubrication. The gas actuated thermometer shall operate without the need for lubrication of any part after assembly.

3.3.6 Adjustments.

3.3.6.1 Zero adjustment. A zero adjustment shall be performed by the adjustment of pointer or the dial.

3.3.6.2 Movement adjustment. Indicator movement adjustment shall be accomplished through the back of the case.

3.4 Cleaning. The gas actuated thermometer (especially the wetted parts (see 6.6.11)) shall be free of loose scale, rust, grit, filings, mercury, calibration liquids, oil, grease, solvents, and other organic materials. The gas actuated thermometer shall be cleaned in accordance with 5.1.1.1. After cleaning, the gas actuated thermometer shall be preserved in accordance with 5.1.

3.5 Performance.

3.5.1 Accuracy. The gas actuated thermometer shall be accurate to plus or minus one minor scale division (see 4.8.1).

3.5.1.1 Accuracy - friction. The difference in the readings taken before and after tapping the window shall be within plus or minus one minor scale division (see 4.8.1.2).

3.5.2 Repeatability. The repeatability of the gas actuated thermometer shall be within plus or minus one-half minor scale division (see 4.8.2).

3.5.3 Inclination. The inclined pointer position shall be within plus or minus one minor scale division of the uninclined pointer position (see 4.8.3).

3.5.4 Compensation. Readings shall be within plus or minus one minor scale division as a result of ambient temperature changes at the indicator and along the capillary tubing (see 4.8.4).

3.5.5 Response time. The response time of the gas actuated thermometer shall be less than the allowed response time specified in table V for each trial (see 4.8.5).

TABLE V. Permissible response time.

Bath fluid	Sensor configuration classification designation (see 1.2.1)	Maximum permissible response time (seconds)
Water	A1, C1, C2 C3, C4	10 12
Salt	C1, C2 C3, C4 B1, B2, B3, B4, B5, B6	12 15 20

3.5.6 Thermal and mechanical stability. After 96 hours, the drift shall be within plus or minus one-half minor scale division (see 4.8.6). The drift shall always be within plus or minus 1 percent of span.

3.5.7 Thermal cycling. After 1500 cycles (see 4.8.7), the gas actuated thermometer shall show no evidence of physical damage.

3.5.8 Storage temperature. The gas actuated thermometer shall not show evidence of any damage (see 4.8.8).

3.5.9 Enclosure. The gas actuated thermometer shall show no signs of leakage into the case between the dial and window (see 4.8.9).

3.5.10 Salt spray. The gas actuated thermometer shall neither show visible corrosion, improper operation, failure, leakage into the case, nor other damage (see 4.8.10).

3.5.11 Over temperature. The gas actuated thermometer shall neither show signs of physical damage nor evidence of improper operation (see 4.8.11). Physical damage includes heat damage to the material, leakage of a fill fluid, or changes in mechanical characteristics.

3.5.12 Vibration. The gas actuated thermometer shall neither show evidence of improper operation, failure, nor damage. Pointer oscillation shall be within plus or minus six minor scale divisions, peak to peak, at any test frequency. The red index shall not shift during the vibration test. There shall be no significant wear on any vital part. Significant wear is defined as wear which causes dimensional changes to the movement visible to the naked eye or which causes increased pointer backlash. Wear to other parts is significant if it adversely affects gas actuated thermometer performance (see 4.8.12).

3.5.13 Shock. The gas actuated thermometer shall neither show evidence of improper operation, failure, nor damage. During the shock test (see 4.8.13), a shift in pointer indication shall be within plus or minus three minor scale divisions for any single blow or a total shift of plus or minus four minor scale divisions for each set of nine blows. The red index shall not shift during the

shock test. The accuracy limits for an accuracy verification test performed after nine blows have been applied to the indicator, but prior to a zero adjustment shall be relaxed to plus or minus four minor scale divisions. After a zero adjustment, the accuracy shall be within plus or minus one minor scale division.

3.6 Identification of product. Gas actuated thermometers and parts shall be marked for identification in accordance with MIL-STD-130.

3.7 Workmanship. Gas actuated thermometers shall be in accordance with the dimensions, design, colors, accuracy, markings and materials specified herein. Gas actuated thermometers shall neither permanently deform nor malfunction, and shall be clean and free of cracks and burrs.

3.7.1 Cleaning and surface finishes. Surfaces of castings, forgings, molded parts, stampings, machined, and welded parts shall be cleaned and free from sand, dirt, sharp edges, scales, flux, and other harmful or extraneous materials. These surfaces shall also be free of defects such as cracks, porosity, undercuts, voids, and gaps. External surfaces shall be smooth and edges shall be either rounded or beveled. There shall be no burn through. There shall be neither warpage nor dimensional change due to heat from welding operations. There shall also be no damage to adjacent parts resulting from the welding.

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 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 this 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.

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

(a) First article inspection (see 4.3).
(b) Quality conformance inspection (see 4.4).

4.3 First article inspection. First article inspection shall be performed on the gas actuated thermometer samples produced with equipment and procedures normally used in production. First article inspection shall consist of the examination and tests specified in table VI (see 6.3).

4.3.1 Sample size. Two gas actuated thermometers of each configuration shall be subject to first article inspection. Each configuration shall include, but not be limited to, the same sensor, elastic element, and case.

4.3.2 Order of inspection. The sample gas actuated thermometers shall be subjected to the inspections specified in table VI in the order listed.

TABLE VI. Examination and tests.

Examination or test	Requirement	Test method	First article inspection	Quality conformance inspection
General examination		4.7.1	X	
General examination		4.7.2		X
Accuracy	3.5.1	4.8.1	X	X
Accuracy - friction	3.5.1.1	4.8.1.2	X	X
Accuracy verification	3.5.1	4.8.1.3	X	
Repeatability	3.5.2	4.8.2	X	
Inclination	3.5.3	4.8.3	X	
Compensation	3.5.4	4.8.4	X	
Response time	3.5.5	4.8.5	X	
Thermal and mechanical stability	3.5.6	4.8.6	X	
Thermal cycling 1/	3.5.7	4.8.7	X	
Storage temperature 1/	3.5.8	4.8.8	X	

TABLE VI. Examination and tests - Continued.

Examination or test	Requirement	Test method	First article inspection	Quality conformance inspection
Enclosure 1/	3.5.9	4.8.9	X	
Salt spray 1/	3.5.10	4.8.10	X	
Over temperature 1/	3.5.11	4.8.11	X	
Vibration 1/	3.5.12	4.8.12	X	
Shock 1/	3.5.13	4.8.13	X	

1/ An accuracy verification test (see 4.8.1.3) shall be performed just prior to and after the completion of this test and the accuracy shall meet the requirements specified in 3.5.1.

4.4 Quality conformance inspection. A quality conformance inspection shall be performed in accordance with the examination and tests specified in table VI (see 6.3).

4.4.1 Inspection lot. An inspection lot shall consist of all gas actuated thermometers of the same classification (see 1.2), produced under the same conditions and offered for delivery at the same time.

4.4.2 Sampling for quality conformance inspection. A random sample of gas actuated thermometers shall be selected from each lot (see 4.4.1) in accordance with table VII for the examination and tests specified in table VI. Any defect shall be cause for rejection.

TABLE VII. Sampling for table VI examination and test. 1/

Lot size	Sample size
2 - 50	5
51 - 90	7
91 - 150	11
151 - 280	13
281 - 500	16
501 - 1,200	19
1,201 - 3,200	23
3,201 - 10,000	29
10,001 - 35,000	35
35,001 - Over	40

1/ Rejected lots may be screened and resubmitted for inspection and test. All defective items must be replaced with acceptable items prior to acceptance.

4.5 Test conditions. Except where the following factors are the variables, the tests specified herein shall be conducted with the equipment and instrumentation operating under the following conditions:

(a) Ambient temperature shall be 75 ± 10°F.
(b) Supply voltage shall be 115 ± 5 volts.
(c) Supply frequency shall be 60 ± 2 hertz (Hz).
(d) The minimum immersion depth into the temperature bath shall be 1 inch beyond the bulb for class A and class C sensor configurations, and the specified minimum immersion depth (see 3.3.2.1.2.1) for class B sensor configuration.

4.6 Methods of inspection.

4.6.1 Temperature equipment and instrumentation.

4.6.1.1 Temperature baths. Temperature baths shall include one or more pots or tanks (containment vessels), a stirrer, means of heating and cooling, and controls. The containment vessel shall have a volume of fluid so that the temperature will not be excessively lowered when a gas actuated thermometer is immersed.

4.6.1.1.1 Stirrer. Any method of stirring may be used provided temperature gradients throughout the working space of the temperature bath are less than plus or minus 1/2°F under steady state temperature conditions.

4.6.1.1.2 Controls. The controls shall be suitable for maintaining the bath fluid temperatures either constant, or uniformly increasing or decreasing while the temperature bath is being stirred.

4.6.1.2 Temperature bath fluids. The temperature bath shall be a stirred liquid bath in which the gas actuated thermometer may be immersed for accuracy comparison. Suggested ranges for temperature baths using the following fluids are:

Temperature bath fluid	Temperature range (°F)
Ethanol or methanol	Minus 140 to 0
Ethylene glycol and water	Minus 40 to 50
Water	40 to 180
Glycerine	150 to 300
Silicone Oil	150 to 350
Salt	350 to 1650

Other temperature bath fluids may be used where the fluid will not damage the gas actuated thermometer being immersed and other conditions herein are met.

4.6.1.2.1 Ethanol, methanol, ethylene glycol and water, glycerine, and silicone oil temperature baths. The temperature bath shall contain heating coils, cooling coils (when required), and a stirrer, none of which shall interfere with the immersion of the gas actuated thermometer. Other designs are equally suitable provided they do not conflict with other requirements of this specification.

4.6.1.2.2 Salt bath. A temperature bath using a heat treating salt as the temperature bath fluid, shall be referred to as a salt bath. Salt baths may be of the type frequently used for heat treating purposes, converted to test work by the addition of a stirrer for uniform temperature distribution and a controller for heat input regulation and temperature control. Heat may be supplied externally, internally, or both, provided the temperature gradient conditions are met.

4.7 General examination.

4.7.1 First article examination. The gas actuated thermometer shall be examined to ascertain that the material, finish, workmanship, construction, assembly, and markings conform to the requirements of this specification. Dimensions, mounting, sensor configuration, scale numerals and graduations, and other interchangeability requirements shall be verified. Examinations shall be limited to the examinations that may be performed without disassembling the gas actuated thermometer in such a manner that its performance, durability or appearance will be affected. Examination shall also include a check of all adjustments, as applicable.

4.7.2 Quality conformance examination. The gas actuated thermometer shall be examined to determine conformance with the requirements of this specification, and the classification of defects specified in table VIII. For critical defects 100 percent inspection is required. Sampling for major defects shall be as specified in table IX. Sampling for minor defects shall be as specified in table X.

TABLE VIII. Classification of defects.

Categories	Defects	Requirements
Critical		
1	Welds not acceptable for class B sensor configuration	3.3.2.1.4.2
2	Evidence of unauthorized flange or bulb material for class B sensor configuration	3.2
3	Flange tolerances on class B sensor configuration not maintained	3.3.2.1.4.2
4	Improper flange rating	3.3.2.1.4.2
5	Evidence of unauthorized fill fluid	3.2
Major		
101	Evidence of unauthorized material	3.2 and table I
102	Dimensional tolerances not maintained, mounting dimensions not interchangeable, or dimensions erroneous	3.3.2.1.1 and 3.3.2.1.3
103	Gas actuated thermometer does not meet accuracy test (see 4.8.1)	3.6.1
104	Dial markings not provided or erroneous; part number, national stock number, and so forth, not provided on dial	3.3.2.3.4
Minor		
201	Workmanship unsatisfactory	3.8
202	Evidence that gas actuated thermometer is not cleaned	3.4
203	Packaging non-conforming	Section 5

TABLE IX. Sampling for major defects. 1/

Lot size	Sample size
2 - 90	8
91 - 150	12
151 - 280	19
281 - 500	21
501 - 1,200	27
1,201 - 3,200	35
3,201 - 10,000	38
10,001 - 35,000	46
35,001 - 150,000	56
150,001 - Over	64

1/ Rejected lots may be screened and resubmitted for inspection and test. All defective items must be replaced with acceptable items prior to lot acceptance.

TABLE X. Sampling for minor defects. 1/

Lot size	Sample size
2 - 25	3
26 - 50	5
51 - 90	6
91 - 150	7
151 - 280	10
281 - 500	11
501 - 1,200	15
1,201 - 3,200	18
3,201 - 10,000	22
10,001 - Over	29

1/ Rejected lots may be screened and resubmitted for inspection and test. All defective items must be replaced with acceptable items prior to lot acceptance.

4.8 Test methods.

4.8.1 Accuracy.

4.8.1.1 Precycling. The precycling procedure shall be performed before the start of accuracy test. To remove friction in the movement, the gas actuated thermometer shall be cycled over the entire span by slowly increasing then decreasing the applied temperature 3 times.

4.8.1.2 General procedure. The accuracy test shall consist of a set of readings at five equally spaced points over the entire span for one cycle. This cycle shall consist of reading the five equally spaced points while increasing the temperature throughout the span, then reading the same five equally spaced points in the reverse order while decreasing the temperature throughout the span. These five equally spaced points shall include the high and low limits of the span. Readings shall be taken both before and after the gas actuated thermometer is lightly tapped in the center of the window. The readings taken after tapping shall be used for determining accuracy.

4.8.1.2.1 Friction error. The difference in each reading before and after tapping shall be the friction error.

4.8.1.3 Accuracy verification. The accuracy test procedure, including the friction error, as specified in 4.8.1.1 and 4.8.1.2, shall be referred to as an accuracy verification test when the test is conducted after the conclusion of another test as specified in table VI. Only three equally spaced points read while increasing the temperature shall be required for the accuracy verification test. The readings shall be taken, after tapping, for each of the three equally spaced points read while increasing the temperature.

4.8.2 Repeatability. The accuracy test, including the friction error, as specified in 4.8.1.2, shall be performed two additional times. The difference between any two readings, after tapping, at the same temperature, approached from the same direction, taken during the accuracy and during the repeatability tests, shall be referred to as the repeatability.

4.8.3 Inclination. The gas actuated thermometer shall indicate the midspan temperature so that the pointer is in a vertical position. The gas actuated thermometer shall be positioned such that the dial faces the operator. The gas actuated thermometer shall then be inclined 60 degrees to the right, left, front, and back. The gas actuated thermometer shall remain at each of these inclined positions at least 1 minute before taking each reading.

4.8.4 Compensation. The gas actuated thermometer shall be placed into one of two categories. The first category (category 1) shall consist of gas actuated thermometers whose maximum dial indication is not greater than 240°F. The second category (category 2) shall consist of gas actuated thermometers whose maximum dial indication is greater than 240°F. The gas actuated thermometer shall be tested under the environmental conditions of table XI or XII, whichever is applicable. For each environmental condition, the bulb shall be tested at different temperatures. The three bulb temperatures shall be in the upper, middle and lower 10 percent of the range of the gas actuated thermometer. Readings shall be taken at every bulb temperature within each environmental condition. Both the indicator and capillary shall be held at the required temperatures for not less than 1 hour before taking each reading.

TABLE XI. Compensation conditions, case assembly and capillary temperatures, category 1.

Environmental condition	Capillary temperature (°F)	Indicator temperature (°F)
1	75	75
2	75	50
3	75	100
4	50	75
5	100	75
6	50	50
7	100	100

TABLE XII. Compensation conditions, case assembly and capillary temperatures, category 2.

Environmental condition	Capillary temperature (°F)	Indicator temperature (°F)
1	110	110
2	110	85
3	110	135
4	85	110
5	135	110
6	85	85
7	135	135

4.8.5 Response time. A standard cylinder shall be used for this test. The information needed to construct a standard cylinder is provided on 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 not less than two times faster than the response time of the temperature rise that the standard cylinder will measure (see table XIII). Response time measurement shall be conducted using either a stop watch or any method capable of timing to 0.2 second or better.

TABLE XIII. Response time for standard cylinder.

Bath medium	Response time (seconds)
Water	6 ± 0.2
Salt 1/	8 ± 0.2

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

4.8.5.1 Response time temperature bath. Two temperature baths are used in performing this test. The baths shall be sufficiently large or constructed in such a manner that the temperature bath fluid will not be cooled by greater than 0.5 percent of the span when either the standard cylinder or the gas actuated thermometer is immersed. The "hot" bath shall contain a variable speed stirrer. Two liquid temperature bath fluids are permissible for use with this test. These two fluids are specified in table XIII. The temperature range classification designation of the gas actuated thermometer will determine which of these two fluids shall be used. The temperature at which the fluids in the two temperature baths are set are listed in table XIV. One fluid temperature is referred to as the "cold bath temperature", while the other is referred to as the "hot bath temperature".

TABLE XIV. Test temperatures and bath mediums.

Bath medium	Cold bath temperature (°F)	T_1 start timing (°F)	T_2 stop timing (°F)	Hot bath temperature (°F)	Temperature range classification designation
Water	50	80	143	180	18d, 24d, 55d
Salt	400	500	626	700	75d, 12h

4.8.5.1.1 Setting up temperature bath conditions. The conditions in the hot temperature bath fluid shall be set up such that the standard cylinder response time will be within the limits specified in table XIII. Hot temperature bath fluid conditions and, thus, the standard cylinder response time, will be changed by varying the stirring parameters. The standard cylinder shall be immersed in the temperature bath fluid to the bottom of the standard cylinder collar (see figure 4 for collar location). The standard cylinder shall always be immersed in the hot temperature bath fluid in the same location and in the same orientation.

4.8.5.2 Determining response time. The bulb of the gas actuated thermometer (or standard cylinder) shall be immersed in the hot temperature bath until there is no further indication of a temperature rise. The bulb of the gas actuated thermometer (or standard cylinder) shall then be immersed in the cold temperature bath until there is no further indication of a temperature decrease. The bath of

the gas actuated thermometer (or standard cylinder) shall again be immersed in the hot temperature bath. Timing shall be started when the gas actuated thermometer's (or standard cylinder's) indicator reaches temperature T_1 (see table XIV) and stopped when temperature T_2 is reached. The time it takes the gas actuated thermometer (or standard cylinder) to indicate the difference between temperatures T_1, and T_2 shall be defined as the response time.

4.8.5.3 Conducting response time test. The response test shall be conducted by taking alternate response time measurements between the standard cylinder and the gas actuated thermometer. Each alternation of the standard cylinder's then the gas actuated thermometer's response time measurements shall be defined as a trial. At least trials shall be required in a temperature bath fluid of water and trials in salt. The standard cylinder response time shall be within the limits of table XIII for the trial to be considered valid.

4.8.6 Thermal and mechanical stability. (This test shall not be performed for a gas actuated thermometer with a temperature range classification designation of 18d and 24d.) The insertion length of the bulb shall be subjected to a temperature within the upper 10 percent of the span, for an accumulated total of not less than 96 hours. An initial temperature indication of the gas actuated thermometer shall be measured at the beginning of the test cycle, and used as a reference for the test. Check points on the gas actuated thermometer shall then be made every 24 hours throughout the test. The amount of temperature indication drift between the check points and initial reference reading shall be measured. The test shall be terminated at the end of 96 hours if the drift is less than plus or minus one-half of the smallest scale division or is greater than plus or minus one small scale division. If the drift is between a plus or minus one-half and one small scale division, the test shall be extended for an additional 288 hours. The test shall be terminated if the drift exceeds plus or minus one small scale division any time before the completion of the test (384 hours total).

4.8.7 Thermal cycling. The bulb of the gas actuated thermometer shall be successively exposed to hot and cold temperatures as specified in table XV. The change in temperature required for this test may be obtained by using two liquid baths, induction heating or other means that will reproduce the desired range of temperature. The cycling can be performed by mechanical apparatus or by any suitable method. Where two baths are used, the heat transfer medium should be the same in both baths. (Some high temperature salts are not compatible and the dragging of liquid from one bath to the other can result in an explosion. Similarly, while not explosive, any water carried into a high temperature bath will flash into steam thus throwing hot liquid from the bath and endangering personnel and equipment.) After 1500 cycles, an accuracy verification test shall be performed. The cycle rate shall not exceed 2 cycles per minute.

TABLE XV. Thermal cycling conditions.

Temperature range (°F)	Temperature range classification designation	Cycle temperature (°F ± 10 percent)	
		Lower	Upper
-40 to 180	18d	40	170 water
20 to 240	24d	40	170 water
50 to 550	55d	150	300 glycerine
50 to 750	75d	375	700 salt
400 to 1200	12h	500	1000 salt

4.8.8 Storage temperature. The gas actuated thermometer (sensor capillary system and indicator), shall be placed in a temperature test chamber and shall be exposed to 5 complete temperature cycles, each of which is 48 hours in duration. Each cycle shall consist of the gas actuated thermometer being subjected to the different temperature conditions listed in table XVI. The steps in each cycle shall be performed in the sequence listed in table XVI. After completion of the fifth temperature cycle, the gas actuated thermometer shall be removed from the temperature test chamber and allowed to stabilize at the ambient conditions of the room for not less than 4 hours. An accuracy verification test shall then be performed.

TABLE XVI. Storage temperature cycle.

Step	Temperature condition 1/	Step duration cycle 1	Step duration cycle 2
1	Increasing temperature 2/ from 75 ± 5°F to 145 ± 5°F	3 hour maximum	1 hour maximum
2	Constant temperature of 145 ± 5°F	18 hours minimum	22 hours minimum
3	Decreasing temperature from 145 ± 5°F to TMIN	6 hours maximum	2 hours maximum
4	Constant temperature of TMIN	18 hours minimum	22 hours minimum
5	Increasing temperature from TMIN to 75 ± 5°F	3 hour maximum	1 hour maximum

1/ Cycle 1: TMIN = minus 10 ± 5°F; cycles 2-5: TMIN = 40 ± 5°F.
2/ Ambient temperature for the first cycle.

4.8.9 Enclosure. The gas actuated thermometer shall be subjected to a splashproof enclosure test as specified in MIL-STD-108 using the test criteria specified in MIL-STD-108 for the splashproof degree of enclosure. The test shall be performed with the gas actuated thermometer attached to the mounting surface in a surface mounted configuration. An accuracy verification test shall be performed at the conclusion of the test.

4.8.10 Salt spray. The gas actuated thermometer shall be subjected to the salt-spray test in accordance with ASTM B 117. The salt spray test shall run for the duration of 96 hours. The salt solution shall be 5 ± 1 percent concentration (5 parts by weight of salt in 95 parts by weight of water). At the conclusion of this test an accuracy verification test shall be performed.

4.8.11 Over temperature. The bulb of the gas actuated thermometer shall be placed in a hot temperature bath which is maintained at a temperature specified in table XVII for 5 minutes. The bulb shall then be allowed to cool to ambient temperature in air. After the cooling period, an accuracy verification test shall be performed.

TABLE XVII. Over temperature bath temperature.

Range (°F)	Temperature range classification designation	Required bath temperature (°F)
-40 to 180	18d	202 ± 2
20 to 240	24d	308 ± 3
50 to 550	55d	650 ± 5
50 to 750	75d	870 ± 7
400 to 1200	12h	1280 ± 10

4.8.12 Vibration. The vibration test consists of the exploratory test, the variable frequency test, and the endurance test. These tests shall be conducted in the sequence listed. Each of the three tests shall be conducted in each of the three mutually perpendicular axes. All three tests shall be completed in one axis before performing the tests in another axis. For each gas actuated thermometer sensor classification submitted (see 4.3.1), one gas actuated thermometer indicator shall be secured to the panel in a flush mounting configuration, and the other indicator in a surface mounted configuration. The panel shall be rigid to ensure that its motion will be essentially the same as the motion of the platform of the vibration machine. The sensor configuration for each gas actuated thermometer sensor configuration class shall be mounted in a manner which will simulate its intended application (see table XVIII). For all the tests, the capillary tubing shall be arranged in such a manner as not to exercise restraint or otherwise hinder the movement of the sensor or indicator during the test.

TABLE XVIII. Sensor vibration mounting.

Sensor configuration class designation	Sensor mounting
A	Bracket bolted to platform, sensor attached to bracket.
B	Flange bolted directly to platform.
C	Fitting screwed into platform and sliding connector assembly affixed to fitting.

The exploratory test, variable frequency test, and the endurance test shall be as follows:

(a) Exploratory test.

(1) Maintain each discrete frequency from 5 to 60 Hz at 1 Hz intervals for not less than 15 seconds, or a sweep rate that shall be not greater than 4 Hz per minute.
(2) Displacements shall be as specified in table XIX.
(3) Frequencies and locations where resonance occurs during this test shall be determined.

(b) Variable frequency test.

(1) Maintain each discrete frequency from 5 to 60 Hz, at 1 Hz intervals for not less than 5 minutes.
(2) Displacements shall be as specified in table XIX.
(3) Frequencies and locations where resonance occurs during this test shall be determined.

(c) Endurance test.

(1) The gas actuated thermometer shall be subjected to a 2-hour endurance run at each resonance.
(2) Displacements shall be the variable frequency test values that are specified in table XIX.
(3) If no resonance is found, a 2-hour endurance run shall be performed at 50 Hz.

An accuracy verification test shall be performed after the conclusion of the vibration test. The gas actuated thermometer shall be visually examined for wear after the vibration test.

TABLE XIX. Vibratory displacement criteria.

Frequency range (Hz) (inclusive)	Table displacement (inches, peak to peak)	
	Exploratory test	Variable frequency test
5 to 15	0.020 ± 0.004	0.060 ± 0.012
16 to 25	.020 ± .004	.040 ± .008
26 to 33	.020 ± .004	.020 ± .004
34 to 40	.005 ± .001	.010 ± .002
41 to 60	.005 ± .001	.005 ± .001

4.8.13 Shock. A shock test shall be conducted in accordance with the grade A, class I, type C requirements for lightweight equipment specified in MIL-S-901. Two sets of nine blows shall be applied. In both parts of the test, the capillary tubing shall be arranged in such a manner as neither to exercise restraint nor otherwise hinder the movement of the sensor or indicator during each blow. For the first set of nine blows the sensor shall be mounted not less than 3 inches from the side and 3 inches from the rear of a 4C fixture in a manner which will simulate the intended application. The indicator shall not be mounted on the shock machine. A total of nine blows shall be applied in accordance with MIL-S-901. After the required nine blows are applied, the sensor shall be removed from the fixture and an accuracy verification test shall be performed. The indicator shall then be mounted to a 6D fixture. For each gas actuated thermometer sensor configuration tested (see 4.3.1), one indicator shall be attached in the surface mounted configuration, the other indicator shall be attached in the flush mounting configuration. The gas actuated thermometer shall indicate the median temperature. A total of nine blows in accordance with MIL-S-901 shall be applied. A reading shall be taken after each blow. The indicator shall be removed from the fixture and an accuracy verification test shall be performed. A zero adjustment (see 3.3.6.1) shall be performed, and another accuracy verification test shall then be conducted.

4.9 Inspection of packaging. Sample packages and packs, and the inspection of the preservation, packing and marking for shipment 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 6.9.)

5.1 Preservation. Preservation shall be level A, C, or commercial, as specified (see 6.2).

5.1.1 Level A.

5.1.1.1 Cleaning and drying. In addition to the general cleaning requirements of MIL-P-116, solvent cleaning process C-3 of MIL-P-116 shall be applied. Drying procedures shall conform to procedures D-1 or D-2, prepared compressed air or oven drying in accordance with MIL-P-116 with selection of the procedure at the option of the contractor.

5.1.1.2 Unit protection. Preservatives shall not be used.

5.1.1.2.1 Bagging. Gas actuated thermometers shall be individually placed in a plastic bag conforming to MIL-B-117 type I, class B, style 2, having a minimum thickness of 0.004 inch. Any sharp edges and protrusions of the gas actuated thermometer shall be cushioned before placing in the plastic bag.

5.1.1.2.2 Boxing. Each bagged gas actuated thermometer shall be individually unit packed in a box conforming to PPP-B-566 variety 2, process II, PPP-B-636 class weather-resistant, PPP-B-665 class 2, or PPP-B-676 with box selection and style at the contractor's option. Box closure and sealing shall conform to the requirements for waterproofing or weather-resistant as specified in the applicable box specification or appendix thereto.

5.1.1.2.2.1 Flush mounting ring and associated hardware. When applicable (see 3.3.2.3.5.1), the flush mounting ring and associated hardware shall be placed in either a cloth bag having a draw string or a plastic "zip-loc" bag. The bag shall be placed in the same box as the gas thermometer.

5.1.1.3 Intermediate packing. Gas actuated thermometers, unit packed as specified in 5.1.1.2.1, shall be intermediate packed in close-fitting fiberboard boxes conforming to PPP-B-636, type CF, class weather-resistant, style optional. Intermediate packs shall contain uniform quantities. Boxes shall be closed method V in accordance with the appendix to the box specification.

5.1.2 Level C. Cleaning and drying, unit protection, and boxing shall be as specified for level A (see 5.1.1) except that boxes may be of the nonwaterproof domestic class or variety.

5.1.3 Commercial. Gas actuated thermometers shall be cleaned, dried, and bagged as specified for level A (see 5.1.1) with boxing in accordance with ASTM D 3951.

5.2 Packing. Packing shall be level B, C, or commercial, as specified (see 6.2).

5.2.1 Level B. Gas actuated thermometers preserved as specified in 5.1 shall be packed in fiberboard containers conforming to PPP-B-636, class weather-resistant, or PPP-B-640, class 2, with container selection at the option of the contractor. Containers shall be closed, sealed, and reinforced, with reinforcement utilizing nonmetallic banding or pressure sensitive reinforced tape. Box closure for PPP-B-636 containers shall conform to method V of the appendix to the box specification. Intermediate containers conforming to 5.1.1.3 require no further overpacking.

5.2.2 Level C. Gas actuated thermometers preserved as specified in 5.1 shall be packed as specified for level B (see 5.2.1) except that containers shall be of the nonweather-resistant class. Containers shall be closed as specified in the appendix to the container specification with method I closure applicable to PPP-B-636 containers.

5.2.3 Commercial. Gas actuated thermometers, preserved as specified in 5.1, shall be packed in accordance with ASTM D 3951.

5.3 Cushioning, filler dunnage and wrapping material.

5.3.1 Levels A, B, and C. Use of excelsior, newspaper, shredded paper (all types, including wax paper), and similar hygroscopic or nonneutral materials and all types of loose-fill materials for applications such as cushioning, filler, stuffing, and dunnage for materials destined for shipboard stowage and use, is prohibited. Cushioning and wrapping materials selected shall have properties and characteristics for resistance to fire; examples are:

(a) Paper, kraft wrapping type II, grade C or D as specified in UU-P-268.
(b) Polystyrene, expanded grade SE, type I or II only as specified in PPP-C-850.
(c) Bound fiber, uncompressed type III or IV, class A as specified in PPP-C-1120.
(d) Cellular rubber grade A as specified in MIL-R-6130.
(e) Cellular rubber class 5 as specified in MIL-R-20092.
(f) Polyurethane foam (rigid or flexible) as specified in MIL-P-26514.

5.3.2 Commercial preservation and packing. When specified (see 6.2), loose fill type materials may be used for preservation and packing applications such as cushioning, filler, and dunnage; and all containers (unit, intermediate, and shipping) shall be marked or labelled with the following information:

"CAUTION

Contents cushioned with loose-fill material shall not be taken onboard ship. Remove and discard loose-fill material. If required, recushion with cellulosic material, bound fiber, fiberboard, or transparent flexible cellular material".

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

5.4 Marking. In addition to any special marking required (see 6.2), interior packs and exterior shipping containers for levels A, B, and C shall be marked in accordance with MIL-STD-129 including the bar-code markings specified therein. Packaging and packing shall also be marked as follows:

"CONTAINS FRAGILE INSTRUMENT HANDLE WITH CARE".

"SHIPPING AND STORAGE TEMPERATURE LIMITS: -10° TO 150°F".

6. NOTES

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

6.1 Intended use.

6.1.1 Class A sensor configuration. This sensor configuration is intended for the application in which the sensor is installed in a mounting bracket. The mounting bracket is constructed in accordance with NAVSEA 810-1385917. This sensor configuration is intended to be used in applications where the air temperature is being measured at pressures of or near 1 atmosphere.

6.1.2 Class B sensor configuration. This sensor configuration is intended to retrofit mercury actuated thermometers with the same sensor configuration in saturated and superheated steam applications. This sensor configuration is intended for retrofit and replacement applications only and should not be used for new construction.

6.1.3 Class C sensor configuration. This sensor configuration is intended for application in which the sensor is inserted into a thermowell. The sensor configuration is compatible with thermowells constructed in accordance with MIL-T-24270. The sensor configuration is not intended for applications requiring direct immersion into the process fluid or for applications where the sensor becomes part of the process system pressure boundary.

6.1.4 Temperature range. Each temperature range is intended for use in the application or process fluid listed below:

(a) -40 to 180°F range for cold storage (air).
(b) 20 to 240°F range for water and oil.
(c) 50 to 550°F range for hot water and compressed air.
(d) 50 to 750°F range for saturated steam.
(e) 400 to 1200°F range for superheated steam.

6.2 Acquisition requirements. Acquisition documents must specify the following:

(a) Title, number, and date of this specification.
(b) Classification (see 1.2).
(c) Issue of DODISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.1.1 and 2.2).
(d) When first article inspection is required (see 3.1).
(e) When special bearing material may be used (see 3.2).
(f) Capillary tubing length required (see 3.3.2.2).
(g) When the case connection configuration to be provided is bottom connected rather than the preferred back connection (see 3.3.2.3.2.1).
(h) When a flush mounting ring is not to be provided (see 3.3.2.3.5.1).

(i) Level of cleaning, drying, unit protection and intermediate packing required (see 5.1).
(j) When substitute cleaning agents may be used (see 5.1.1.1.3).
(k) Level of packing required (see 5.2).
(l) When special wrapping is specified (see 5.3).
(m) When loose fill material is allowed for cushioning, packaging, or packing, and special marking required for loose fill material (see 5.3.2).
(n) Special marking required (see 5.4).

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.

Reference Paragraph	DID Number	DID Title	Suggested Tailoring
3.1 and appendix	DI-DRPS-80651	Engineering drawings	----
4.3	DI-T-4902	First article inspection report	----
4.4	DI-T-5329	Inspection and test reports	----

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, and the number of items to be tested as specified in 4.3.1. 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 Preferred bulb diameter. For a class C sensor configuration, the preferred bulb diameter is 3/8 inch. A resistance thermometer or thermocouple sensor built to the requirements of MIL-T-24388 should be used for remote monitoring over distances which exceed the maximum capillary tubing length supplied for class C sensor configuration with a 3/8 inch bulb diameter. A gas actuated thermometer containing a class C sensor configuration with a 15/16 inch bulb diameter should only be used in a unique application where a mechanical thermometer is required for remote temperature monitoring but the distance from the sensor to the indicator exceeds the effective capillary length of a 3/8 inch bulb diameter class C sensor configuration.

6.6 Definitions. Terminology for the indicator in this specification is consistent with ANSI/ASME B40.1.

6.6.1 Bulb. The fill fluid reservoir portion of the thermal system which contains the majority of the fill fluid, and senses process temperature (see figures 1 and 2).

6.6.2 Compression profile surface. The interior machined surface of the union connector which contacts the ferrule (see figure 2, detail A).

6.6.3 Ferrule. A fitting which when compressed between the jam nut and union connector secures the sliding connection assembly to the extension tube (see figure 2, detail A).

6.6.4 Fill fluid. The gas confined within the thermal system which senses temperature changes in the bulb and exerts pressure on the elastic element.

6.6.5 Immersion depth, minimum. The depth to which the sensor portion must be immersed so that a lesser immersion results in a change in indicated temperature beyond the accuracy limits.

6.6.6 Jam nut. A threaded fitting which compresses the ferrule against the compression profile surface of the union connector (see figure 2, detail A).

6.6.7 Red index. An adjustable marker (painted red) which is set at a significant temperature value, usually the maximum expected operating temperature.

6.6.8 Sensor. The portion of the gas actuated thermometer which includes the bulb, extension tube, and fitting (flange or sliding connection assembly).

6.6.9 Thermal system. A thermal system is a closed system containing a fill fluid and includes the bulb, capillary tubing, and elastic element as the closed system boundary.

6.6.10 Union connector. A threaded fitting which affixes to a thermowell, bracket, or boss bushing; supplies a compression profile surface for contact with the ferrule; and also provides threads for the jam nut (see figure 2, detail A).

6.6.11 Wetted parts. The portions of the gas actuated thermometer which are exposed to the process fluid contained in a pipe or vessel. The sensor portion of a gas actuated thermometer with a class B sensor configuration is considered a wetted part for purposes of this specification.

6.7 Material safety data sheet (MSDS). 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 Provisioning. Provisioning Technical Documentation (PTD), spare parts, and repair parts should be furnished as specified in the contract. 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.

6.9 Sub-contracted material and parts. The packaging requirements of reference 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.

6.10 Part or Identifying Number (PIN). The PINs to be used for items acquired to this specification are created as follows:

Example: M19646 - A118d310

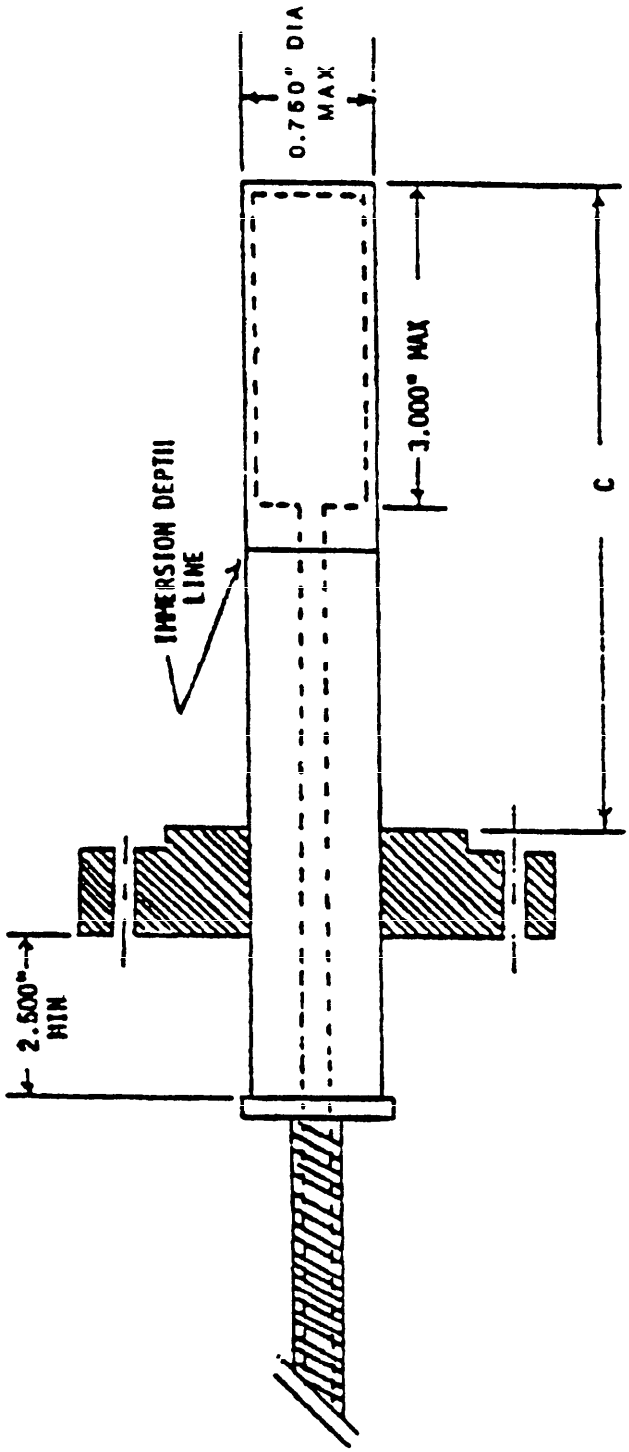
M	19646	-	A1	18d	3	10
Prefix indicating measurement system used	Specification number		Sensor configuration (see 1.2.1)	Range (see 1.2.2)	Dial size (see 1.2.3)	Capillary tubing length (see 1.2.4)

6.11 Subject term (key word) listing

Sensor
System, filled
System, thermal

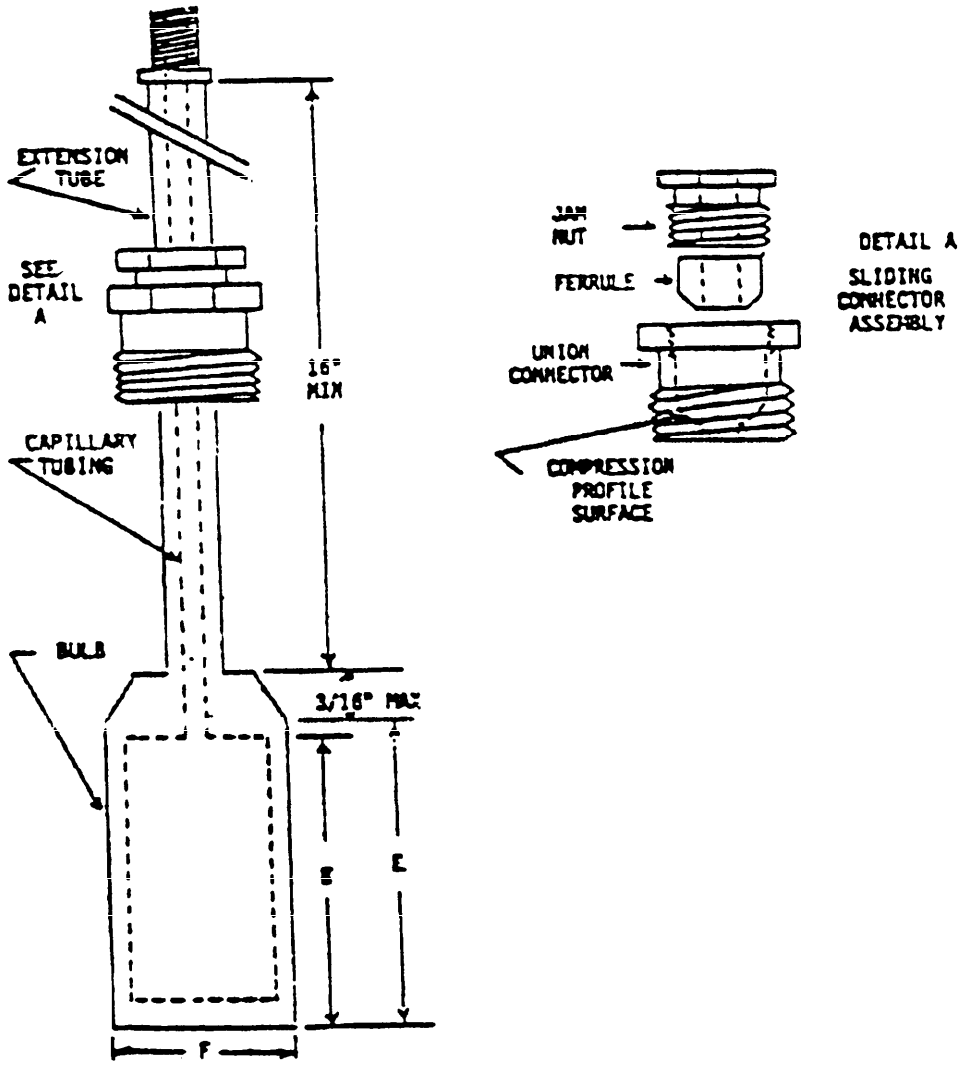
6.12 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

Preparing activity:
Navy - SH
(Project 6685-N812)



Sensor configuration classification designation	Flange rating (lb/in^2)	G ± 0.1 (inches)
B1	600	4.5
B2	1500	4.5
B3	600	8.0
B4	1500	8.0
B5	600	10.0
B6	1500	10.0

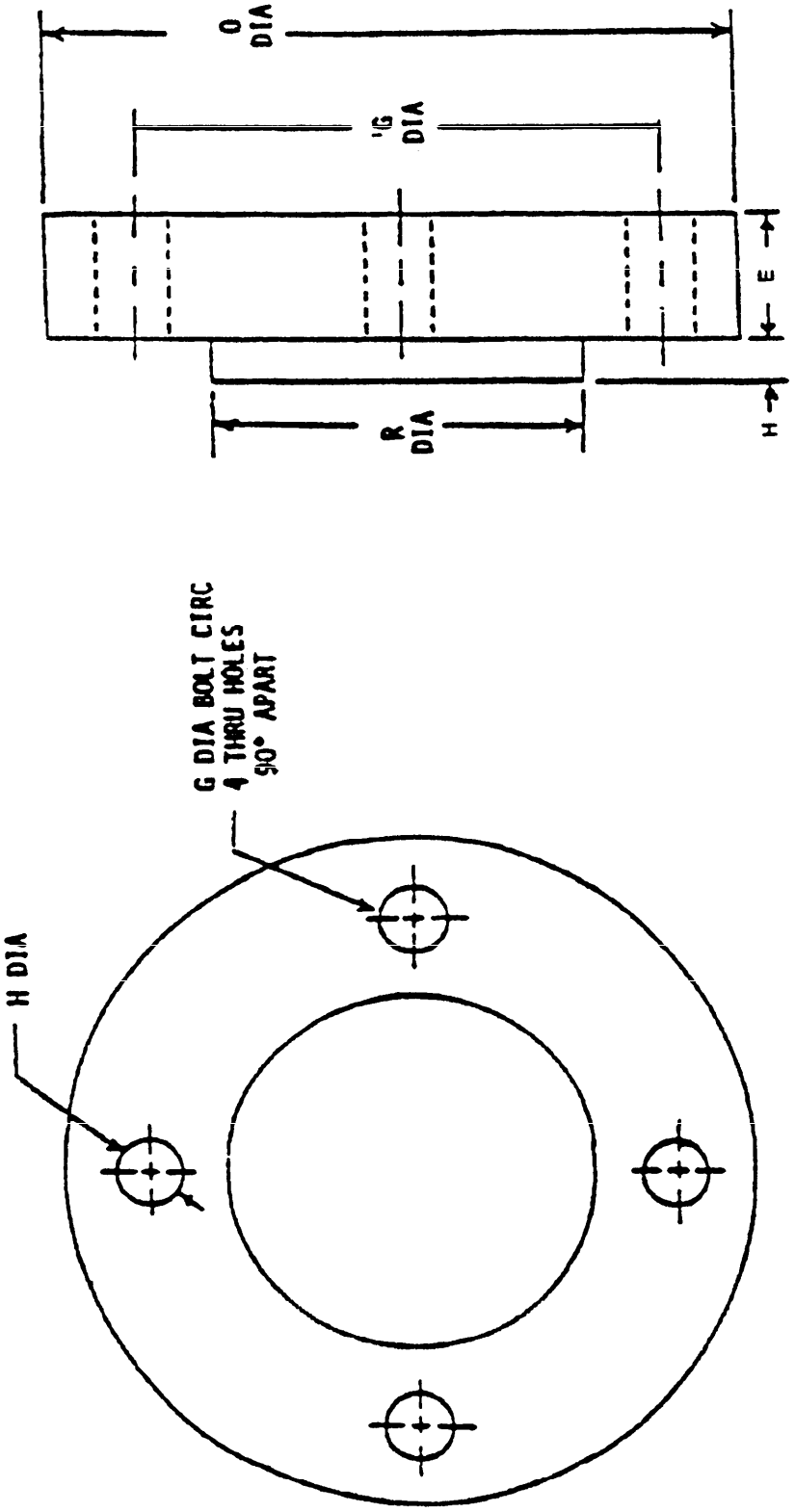
FIGURE 1. Class B sensor configuration.



Sensor configuration classification designation	F ± 0.002 (inches)	B Maximum (inches)	E Maximum (inches)	Notes
C1	0.375	1.500	2.000	
C2	0.375	3.000	3.500	1
C3	0.933	1.000	1.000	2
C4	0.933	3.500	3.500	2

NOTES:
1. Equivalent to sensor configuration classification designation A1.
2. Restricted use, see 6.5.

FIGURE 2. Class C sensor configuration.



Sensor configuration classification designation	O ± .02 (inches)	F ± .12 (inches)	F ± .00 (inches)	G ± .06 (inches)	H ± .12 -.00 (inches)
B1, B3, B5 B2, B4, B6	4-7/8 5-7/8	11/16 1-1/8	2-11/16 2-15/16	3-1/2 4	11/16 15/16

FIGURE 3. Class B sensor configuration flange.

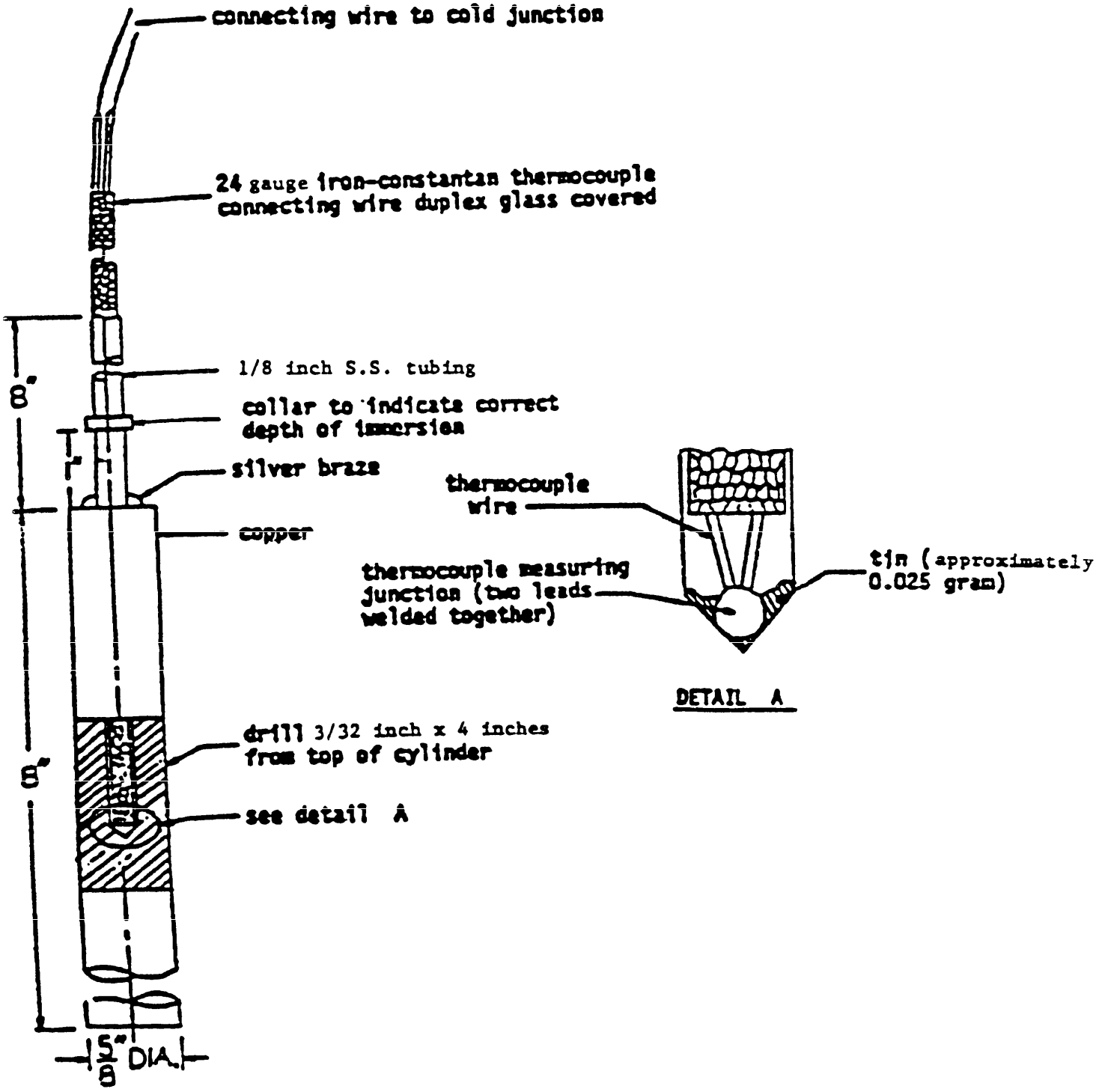


FIGURE 4. Standard cylinder.

APPENDIX

ENGINEERING DRAWINGS TECHNICAL CONTENT REQUIREMENTS

10. SCOPE

10.1 Scope. This appendix contains the format and content preparation instructions for the development of and revision to a conformance verification drawing. It is not intended that each requirement contained herein should be applied to every type of instrumentation. Portions of this appendix are subject to deletion tailoring depending upon the material, construction, and principle of operating requirements that are specified in the individual instrumentation specification or acquisition document. This appendix is applicable only when data item description DI-DRPR-80651 is cited on the DD Form 1423.

20. APPLICABLE DOCUMENTS

20.1 Government documents.

20.1.1 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).

SPECIFICATION

MILITARY
MIL-I-45208 - Inspection System Requirements.

STANDARD

MILITARY
MIL-STD-17-1 - Mechanical Symbols (Other Than Aeronautical, Aerospacecraft and Spacecraft Use) Part-1.

(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.)

20.2 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).

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)
Y14.1 - Drawing Sheet Size and Format. (DoD adopted)
200 - Standard Reference Designations for Electrical and Electronics Parts and Equipments. (DoD adopted)

(Application for copies should be addressed to the American National Standards Institute, 1430 Broadway, New York, NY 10018.)

(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.)

30. CONFORMANCE VERIFICATION DRAWING FOR INSTRUMENTATION

30.1 Purpose. The conformance verification drawing contains the information necessary to verify that the instrumentation meets the requirements specified in the applicable instrumentation specification and acquisition document.

30.2 Content and format. One conformance verification drawing shall be developed for each specific type of instrumentation. It shall include all ranges, sizes, connections and other variations. The conformance verification drawing shall include the following minimum information (except as specified in 10.1) and shall be developed to the format in 30.3 through 30.9.

30.3 Descriptive data.

(a) Instrument identification numbering system for instrumentation. This numbering system shall include, but may not be restricted to, the classification variables.
(b) Instrumentation identification number system for replaceable parts.
(c) Size, operating data, ranges, scale markings, and other data for proper selection.
(d) Test approval data, presenting the following information in tabular form:

(1) Specification classification (unique alphanumeric variables to designate instruments).
(2) Test report number and date.
(3) Facility where test was conducted.
(4) Authorized Government activity (NAVSEA) approval letter and date.

(e) A statement that instrumentation is in accordance with the requirements of the applicable instrumentation specification or acquisition document and to referenced specifications.
(f) Conformance verification drawing acceptance data, presenting the following information in tabular form:

(1) Authorized Government activity (NAVSEA) acceptance letter and date.
(2) Revision number.

30.4 Details of construction.

(a) Two or more representative assembly views, as required, to show clearly the details of the design, construction, and assembly of the instrumentation and to identify each part and its location. Identification of parts shall correspond to the list of materials. Assembly shall show how all mechanical parts are joined or attached.
(b) Sectional views or notes as necessary to show internal details.
(c) Details such as entrance provisions, gaskets, fastening techniques, welding symbols, mounting requirements, and other details as applicable.
(d) Module enclosure requirements for separately mounted modules.
(e) Dimensions required to ensure interchangeability.
(f) Schematic of indicating system.
(g) Description of the nature and purpose of any adjustments.
(h) Welding procedures with acceptance data, including acceptance letter, report numbers and dates.
(i) Any special features.
(j) Complete weight.
(k) Location, size, and type of connections.
(l) Identification of quality control documents which show conformance with MIL-I-45208 or the quality control specification that is listed in the applicable instrumentation specification or acquisition document. The acceptance letter shall be referenced.

30.5 Parts list. The following information shall be presented in tabular form:

(a) Item number (corresponding to flag number identifying the part on the conformance verification drawing).
(b) Quantity of each part required per assembly.
(c) Name of part with sufficient information to readily identify the part (for example, screws: thread size, length and type of head, shall be specified).
(d) Material of part.
(e) Material specification (military, federal, or non-Government document number or Government activity (NAVSEA) drawing number).

NOTE: When substitution of a material specification is made, it is the responsibility of the contractor to provide written documentation to substantiate that the substituted material is equivalent to the specified material.

(f) Type, class, grade, size, military designation, or other classification of any referenced specification.
(g) Part number or identification assigned by assembly supplier.
(h) Name of actual manufacturer of part (when applicable).
(i) Part number or identification assigned by part supplier (when applicable).

(j) Onboard repair parts. Parts that are appropriate for, or are supplied as, onboard repair parts shall be indicated by a symbol in this column.
(k) Remarks column. Finishes, platings, or coatings along with the applicable specification or other requirements should be specified in this column.

30.6 Table for special tools. Special tools required for the instrumentation shall be presented in the following tabular form:

(a) Item number (corresponding to flag number identifying the tool on the conformance verification drawing).
(b) Quantity of each tool required per instrument.
(c) Name (description) of tool (include generic name).
(d) Tool specification (military, federal, or non-Government document number or Government activity (NAVSEA) drawing number).
(e) Tool number or identification assigned by assembly supplier.
(f) Name of actual manufacturer of tool (when applicable).
(g) Tool number or identification assigned by tool supplier (when applicable).
(h) Description of tool's application.
(i) Remarks column. Special techniques or other usage requirements shall be explained in this column.

30.7 Fluid and electrical system schematics. Fluid (piping) and electrical schematics shall be included in the verification conformance drawing when applicable. A complete schematic shall contain all the parts in the fluid or electrical systems. When confusion over its function could result, a simplified schematic containing only the major components shall also be provided. This simplified schematic may be presented in block diagram format.

(a) Complete fluid system schematic. A single schematic shall present clearly the operation and functions of the fluid system within the instrumentation. This schematic shall contain all parts (including valves, fittings, hoses, and tubing) which make up the piping or fluid system. The following features shall be incorporated into the schematic:

(1) A simplified, clear schematic in preference to one showing the physical placement or parts.
(2) A thin, broken line shall be used to represent the boundaries of each subassembly.
(3) Arrows adjacent to the parts shall indicate direction of flow.
(4) Each part shall be identified by the schematic part designation. The numbers shall be assigned in a logical sequence observing flow paths through the system.
(5) All inlet and outlet ports shall be identified.
(6) The methods of attachment for each part shall be designated by an appropriate label or symbol.

(7) The symbol used to designate a part shall be in accordance with MIL-STD-17-1 when applicable.
(8) A brief description of the fluid system operation shall be provided.
(9) Maximum operating pressure of the system and maximum pressure drop through the system (when operating at maximum pressure) shall be specified.
(10) Table for pressure rating and connection of fluid system parts. Supplementary information on parts found in the fluid (piping) system schematic shall be contained in tabular form. One column shall contain the schematic part designation for each fluid system part; for example, valve V-1 and other similar designations. The other columns shall contain the following information:

a. Item number.
b. Description.
c. Type (size).
d. Pressure ratings (including operating, proof, and burst).
e. Method of attachment, including, as applicable, brazing or welding procedure, bonding agent, and seal (gasket, O-ring, etc.).
f. End connections, fittings, and adapters.
g. Relief valve ratings (include cracking and set pressure).

(b) Complete electrical system schematic. A single schematic shall represent clearly the operation and the function of the electrical circuitry within the instrumentation. The schematic shall contain all parts (including components, connectors, alarms, etc.) which make up the electrical system. The following features shall be incorporated into the schematic.

(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 or subassembly. Terminals, to which external connections are made, shall be shown within these boundaries, with the numbers, markings, type of signal, power and ground, as appropriate.
(3) Each part (such as resistors, capacitors, relays, etc.) shall be given a unique reference designation consisting of a letter denoting the type of part (as required by ANSI 200) 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 where the reference designation, parts not conforming to a military specification, where permitted, shall have the following information noted adjacent to the part. Where numerical values are given, a code shall be noted to designate the units 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 (JEDDC number is adequate).
e. Integrated circuits - operational symbol diagram of input-output relationship, terminal numbering corresponding to a representative schematic, and type number.

(5) Supply voltages, phases, and frequencies and transformer terminal voltage shall be indicated and labeled as to purpose.
(6) Table for troubleshooting of electrical system. The content table shall include each test point, as identified on the electrical system schematic, with voltage, waveform or other electrical parameter that should be measured at each test point.

30.8 Selection and installation considerations.

(a) Performance data.

(1) Accuracy (in percent of span).
(2) Shock and vibration classification.
(3) Degree of water tightness of the enclosure.
(4) Electromagnetic interference and pulse susceptibility.

(b) Dimensional outline of the instrumentation showing overall and principle dimensions in sufficient detail to establish space requirements in all directions necessary for installation, servicing, exclusive of space required for operator observation of the indication.
(c) Special considerations which may affect selection or installation.

(1) Ambient temperature range.
(2) Calibration points and adjustments.
(3) Orientation.
(4) Location of instrumentation relative to vibrating equipment.
(5) Protection of the instrumentation from pulsations and spikes in the parameter being measured.
(6) Selection of the instrumentation range relative to the operating range of the system.
(7) Application for each type connection.

(8) Cleaning procedure or reference to the cleaning procedure used.
(9) Selection of the instrumentation for compatibility (materials, temperature, pressure, etc.) with the ambient environment and with the parameter being measured.

30.9 Drawing format.

(a) Unless otherwise approved by the authorized Government activity, a maximum of three sheets shall be allotted for single functioned system instrumentation and a maximum of ten sheets for instrumentation containing a multiple functioned system. A single functioned system is one that performs only one operation such as: expands/contracts a pressure elastic element, steps up/steps down the voltage, conditions one electrical signal, or winds/unwinds a bimetallic element. A multiple functioned system is one that contains two or more single functioned systems.
(b) Each sheet shall be zoned.
(c) Title block shall be included on each drawing sheet and shall include the following information:

(1) Title, drawing number, and revision letter. Each sheet shall contain the same title, drawing number, and revision letter.

a. Title - the title shall consist of the name by which the instrumentation is known.
b. Drawing number - the drawing number shall consist of alphanumeric characters which may be separated by dashes or slashes. The total number of characters in the drawing number (including dashes and/or slashes) shall not exceed 15. Blank spaces are not permitted within the drawing number.
c. Revision letter - the revision letter shall denote the latest approved version of the drawing. The revision letter of conformance verification drawing shall not be changed until all the changes under that revision have been accepted in writing by the authorized Government activity (NAVSEA). No changes made to the conformance verification drawing shall be considered a revision until after the initial version of the conformance verification drawing has been accepted in writing by the authorized Government activity. After initial submittal of the conformance verification drawing, no changes shall be made during the initial drawing review process unless the change is either requested by the authorized Government activity or the change is documented in written correspondence by the contractor.

(2) Sheet _____ of _____.
(3) Tolerance on dimensions for fractions, decimals, and angles. Units of the dimensions specified on the conformance verification drawing.

(4) Contractor acceptance block (appropriate signatures and dates).
(5) Commercial and Government entity (CAGE) code for manufacturer.
(6) Scale.
(7) Reference drawings.
(8) Manufacturer's name and address.
(9) Drawing size.

(d) A revision block shall be included on each sheet of the conformance verification drawing and shall contain the following information in tabular form:

(1) Revision letter.
(2) Description of revision.
(3) Acceptance letter serial number and originator identification.
(4) Acceptance data.

(e) Sheet size and format not specified herein shall be in accordance with ANSI Y14.1.
(f) No Government security classification designation such as confidential or secret shall appear on the conformance verification drawing unless a particular classification is specified by the Government.

40. CONFORMANCE VERIFICATION DRAWING ACCEPTANCE

40.1 Acceptance. Acceptance shall be granted by the authorized Government activity only after the conformance verification drawing is found to meet all the requirements specified in 30 through 30.9.

50. Acquisition document instructions. The acquisition document should contain provisions that address submission, review, extension, disapproval, default, acceptance, and waiver of conformance verification drawings in addition to the effects on the delivery schedule due to delays in conformance verification drawing acceptance. NAVSEA shall be designated as the activity that accepts or disapproves the conformance verification drawing.

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions – Reverse Side)

1. DOCUMENT NUMBER	2. DOCUMENT TITLE
MIL-T-19646A(SH)	THERMOMETER, GAS ACTUATED, REMOTE READING

3a. NAME OF SUBMITTING ORGANIZATION	4. TYPE OF ORGANIZATION *(Mark one)*
	☐ VENDOR
b. ADDRESS *(Street, City, State, ZIP Code)*	☐ USER
	☐ MANUFACTURER
	☐ OTHER *(Specify)*: _____

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	b. WORK TELEPHONE NUMBER *(Include Area Code)* – Optional
c. MAILING ADDRESS *(Street, City, State, ZIP Code)* – Optional	8. DATE OF SUBMISSION *(YYMMDD)*

DD FORM 82 MAR 1426

PREVIOUS EDITION IS OBSOLETE.

(TO DETACH THIS FORM, CUT ALONG THIS LINE.)

INSTRUCTIONS: In a continuing effort to make our standardization documents better, the DoD provides this form for use in submitting comments and suggestions for improvements. All users of military standardization documents are invited to provide suggestions. This form may be detached, folded along the lines indicated, taped along the loose edge *(DO NOT STAPLE)*, and mailed. In block 5, be as specific as possible about particular problem areas such as wording which required interpretation, was too rigid, restrictive, loose, ambiguous, or was incompatible, and give proposed wording changes which would alleviate the problems. Enter in block 6 any remarks not related to a specific paragraph of the document. If block 7 is filled out, an acknowledgement will be mailed to you within 30 days to let you know that your comments were received and are being considered.

NOTE: This form may not be used to request copies of documents, nor to request waivers, deviations, or clarification of specification requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document*(s)* or to amend contractual requirements.

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