

MIL-T-6508B**25 JULY 1961****SUPERSEDING****MIL-T-6508A****28 JULY 1952****MILITARY SPECIFICATION****THERMOMETER, SELF INDICATING, BIMETALLIC**

This specification has been approved by the Department of Defense and is mandatory for use by the Departments of the Army, the Navy and the Air Force.

1. SCOPE

Aluminum and Aluminum Alloys.

1.1 This specification covers design requirements and all performance requirements for the procurement of one type of aircraft bimetallic self indicating thermometer.

MIL-S-7742 — Screw Threads, Standard Aeronautical.

2. APPLICABLE DOCUMENTS

MIL-P-7936 — Parts and Equipment, Aeronautical, Preparation for Delivery.

2.1 The following specifications, standards, and publications of the issue in effect on date of invitation for bids, form a part of this specification:

MIL-A-8625 — Anodic Coatings, for Aluminum and Aluminum Alloys.

SPECIFICATIONS

MIL-D-70327 — Drawings, Engineering and Associated Lists.

FEDERAL

HH-G-156 — Gaskets, General Purpose, Rubber (Natural or Synthetic) Molded, Sheet or Strip.

STANDARDS**FEDERAL****MILITARY**

MIL-P-116 — Preservation, Methods of.

FED-STD No. 1 — Standard for Laboratory Atmospheric Conditions for Testing.

MIL-C-5541 * — Chemical Films for

FED-STD No. 595 — Colors.

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MIL-STD-130 — Identification Marking of U.S. Military Property.

MS28028 — Thermometer — Self Indicating, Bimetallic.

MS33558 — Numerals and Letters, Aircraft Instrument Dial, Form of.

MS33586 — Metals, Definition of Dissimilar.

PUBLICATION

**AIR FORCE-NAVY AERONAUTICAL
SPECIFICATION BULLETIN**

No. 143 — Specifications and Standards, Use of.

(When requesting any of the applicable documents refer to both title and number. Copies of this specification and applicable documents may be obtained upon application to the Commanding Officer, Naval Aviation Supply Depot, 5801 Tabor Avenue, Philadelphia 20, Pennsylvania, Attention: Code CDS.)

3. REQUIREMENTS

3.1 Preproduction. The thermometer furnished under this specification shall be a product which has been tested, and passed the preproduction requirements specified herein.

3.2 Selection of government documents. Specifications and standards for necessary commodities and services not specified herein shall be selected in accordance with ANA Bulletin No. 143 except as provided in 3.2.1 and 3.2.2.

3.2.1 Commercial parts. Commercial parts having suitable properties may be used where, on the date of invitation for bids, there are no suitable standard parts available. In any case, commercial utility parts, such as screws, bolts, nuts, cotter pins, hav-

ing suitable properties, may be used provided:

- (a) They can be replaced by the standard parts (MS or AN) without alteration.
- (b) The corresponding standard part numbers are referenced in the parts list and, if practicable, on the contractor's drawings.

3.2.2 Standard parts. With the exception of 3.2.1, MS and AN standard parts shall be used where they suit the purpose. They shall be identified on the drawings by their part numbers.

3.3 Materials. Materials shall conform to applicable specifications and shall be as specified herein. Materials for which there are no applicable specifications or which are not specifically described herein, shall be of the best quality, of the lightest practicable weight, and suitable for the purpose intended.

3.3.1 Critical materials. Noncritical materials shall be used where practicable. Where the use of a critical material is essential to meet specification requirements, the material used shall be the least critical of those which are adequate for the purpose.

3.3.2 Metals. Metals shall be of the corrosion-resistant type, or shall be suitably protected as specified herein to resist corrosion due to salt spray or atmospheric conditions to which the instrument may be subject when in storage or during normal service life.

3.3.2.1 Dissimilar metals. Unless suitably protected against electrolytic corrosion, dissimilar metals as defined in Standard MS-33586 shall not be used in intimate contact with each other.

3.3.3 Nonmagnetic materials. Nonmagnetic materials shall be used for all parts of

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the instrument except where magnetic materials are essential.

3.3.4 Fungus-proof materials. Materials which are nutrients for fungi shall not be used where it is practicable to avoid them. Where used and not hermetically sealed, they shall be treated with a fungicidal agent acceptable to the procuring activity. If used in a hermetically sealed case, fungicidal treatment will not be necessary.

3.4 Design and construction. The thermometer shall be designed for use on aircraft to indicate the free air temperature and shall conform to Standard MS28028. The thermometer shall be constructed to withstand the normal strains, jars, vibrations, and such other conditions as are incident to shipping, storage, installation and service.

3.4.1 Maintenance. The design shall be such as to facilitate as much as possible disassembly, repair or overhaul, service maintenance, and reassembly by those tools and items of maintenance equipment which are normally available as commercial standards.

3.4.2 Components. The thermometer shall consist of two case washers, one dished washer, one sunshield, and the thermometer assembly.

3.4.3 Washers. Washers shall conform to the dimensions shown on Standard MS-28028. The case and stem washers shall be constructed from black molded gasket rubber in accordance with Federal Specification HH-G-156, type II, grade A. The dished washer shall be fabricated of a suitable metal.

3.4.4 Seal. The seal of the case and stem of the thermometer shall be waterproof.

3.4.5 Stem. The stem and threaded boss of the thermometer shall be constructed from hard-drawn stainless steel.

3.4.6 Pointer. The pointer shall be as light

as practicable, and sufficiently rigid to prevent oscillation under vibration in excess of the requirements specified herein. Pointer stops shall not be used. The pointer shall conform to Figure 1. The length of the pointer shall be sufficient to provide $\frac{1}{3}$ to $\frac{2}{3}$ overlap of the 2-degree graduations.

3.4.7 Dial. The dial shall conform to Figure 1, and shall be securely fastened to the case or frame of the mechanism in such a manner that it will not loosen or turn when the thermometer is vibrated. The scale arc of the dial shall not be less than 310 degrees.

3.4.7.1 Dial markings. Dial markings shall be durable and in accordance with Figure 1. The style and proportions of the letters and numerals placed on the dial shall conform to Standard MS33558. The dimensions of dial markings and the type of paint used shall be as shown in figure 1. The lusterless white shall be Color 37875 of Standard FED-STD-595. The lusterless black shall be Color 37038 of Standard FED-STD-595.

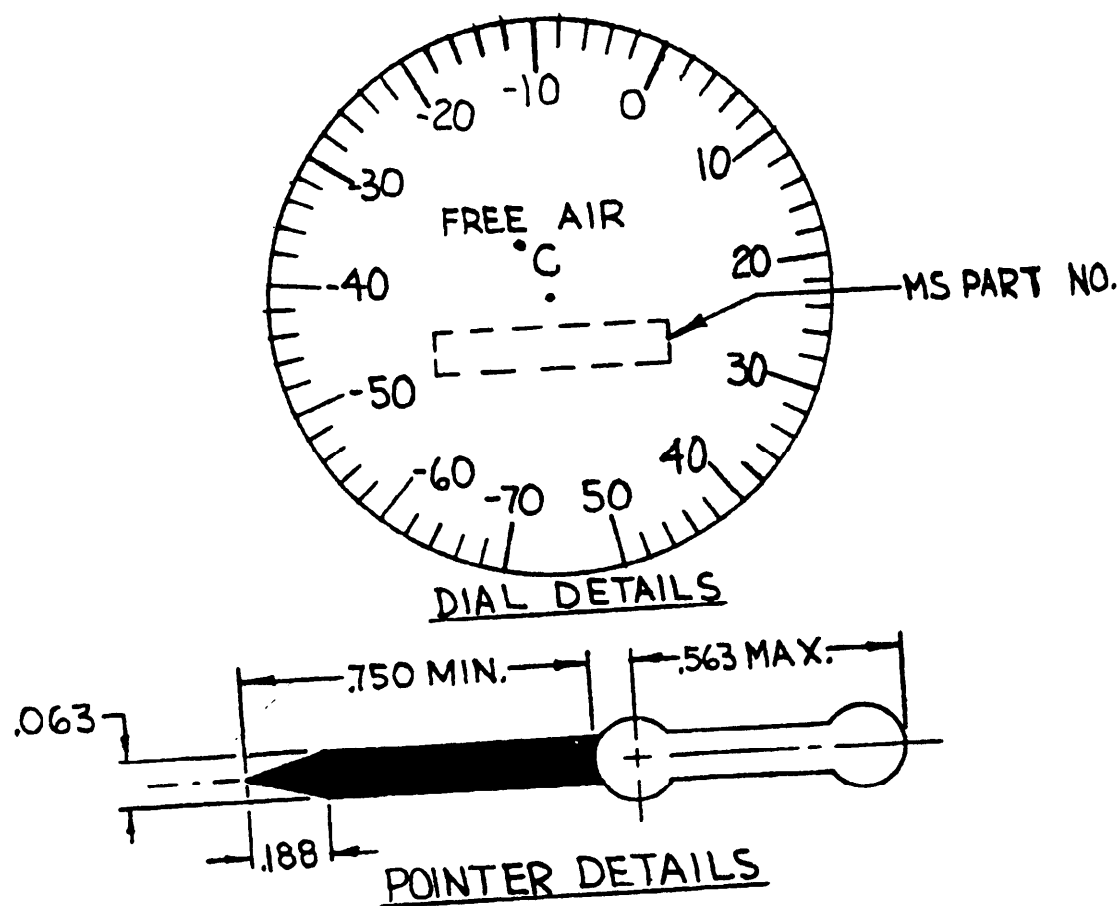
3.4.7.2 Numerals. Numerals shall distinctly indicate the graduation to which each applies. If practicable, each numeral shall be placed so that the center of mass of the numeral is on the radial line joining the appropriate graduations and the center of the dial. Any confusion resulting in doubt as to which graduation the numeral applies shall be cause of rejection. When several numerals are used in one group, the space between the numerals, shall not be less than $\frac{1}{64}$ inch.

3.4.8 Cover glass. The cover glass shall be clear and free from flaws.

3.4.9 Dial to cover glass distance. The distance between the dial and cover glass shall be 0.125 ± 0.025 inch when measured at the -0.015 graduations on the dial.

3.4.10 Parallax. To avoid parallax, the pointer shall be reasonably close to the dial without interfering with the action of the

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DECIMALS: .010

MARKINGS	HEIGHT OR LENGTH INCH $\pm 1/64$	WIDTH OF LINE OR GRADUATION INCH $\pm .005$	FINISH
NUMERALS	$1/8$.020	LUSTERLESS WHITE
GRADUATIONS AT 10-DEGREE DIVISIONS	$5/32$.020	
POINTER (SHADED PART)	$3/32$.015	
2 DEGREE GRADUATIONS	$3/32$.015	LUSTERLESS BLACK
LETTERINGS "FREE AIR C"			
BACKGROUND OF DIAL (MS PART NO.)	==	==	

Figure 1. Dial

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thermometer. In no case shall the distance between the dial and pointer be more than 0.10 inch.

3.5 Finish. Protective coatings and finishes which will crack, chip or scale during normal service life or due to extremes of atmospheric conditions shall not be used.

3.5.1 Aluminum alloy parts. Where practicable, aluminum alloy parts shall be covered with an anodic film conforming to Specification MIL-A-8625 except that the dial, if of aluminum alloy, small holes, and case inserts need not be anodized. Aluminum alloys which do not anodize satisfactorily shall be coated with chemical film in accordance with Specification MIL-C-5541.

3.5.2 The front of the thermometer case shall be finished in lusterless black paint conforming to Color 37088 of Standard FED-STD-595.

3.5.3 The thermometer stem shall be a bright natural metal finish.

3.5.4 The outer surface of the sun shield shall be a highly polished metal finish.

3.6 Weight. The weight of the complete instrument shall not exceed 0.18 pound.

3.7 Performance The indicator shall perform satisfactorily when subjected to the tests specified in Section 4.

3.8 Workmanship. The thermometer including all parts, and accessories, shall be constructed and finished to produce an instrument free from all defects which would affect proper functioning in service. Particular attention shall be given to freedom from blemishes, defects, burrs and sharp edges, accuracy of dimensions, and marking of parts and assemblies.

3.9 Identification of product. A nameplate shall be securely attached to the exterior of

the case and shall be legibly and durably marked in accordance with Standard MIL-STD-130.

3.9.1 Manufacturer's part number. The manufacturer's part number marked in the space provided on the nameplate shall be identical with the manufacturer's engineering production drawing number, including applicable dash numbers if the drawing is tabulated and covers more than one part.

3.9.2 Interchangeability. All parts having the same manufacturer's part number shall be directly and completely interchangeable with each other with respect to installation and performance. Changes in manufacturer's part number shall be governed by the drawing number requirements of Specification MIL-D-70327.

3.10 Installation instructions. The contractor shall furnish with each thermometer one copy of the installation instructions with illustrations and diagrams. Prior to printing, two copies shall be furnished to the procuring activity for approval. The instructions shall be printed on 8½ by 11 or 11 by 17 inch paper.

3.10.1 Envelope. An envelope furnished by the contractor containing installation instructions shall be packaged with each thermometer and shall be marked with the following information:

IMPORTANT

**THIS ENVELOPE CONTAINS
INSTALLATION INSTRUCTIONS**

4. QUALITY ASSURANCE PROVISIONS

4.1 Classification of tests. The inspection and testing of the thermometer shall be classified as follows:

- (a) Preproduction tests are those tests accomplished on samples which are representative of the production of the item after the award

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of contract, to determine that the production item meets the requirements of this specification.

- (b) Acceptance tests are those tests performed on thermometers manufactured and submitted for acceptance under contract

4.2 Preproduction tests. The preproduction test shall consist of all the tests of this specification as listed under Test Methods. The tests may be performed in any sequence except that tests considered to be destructive shall be conducted last.

4.2.1 Preproduction sampling instructions. Preproduction test samples shall consist of three thermometers of each manufacturer's part number which have not been previously tested, and upon which preproduction testing is requested. The samples shall be forwarded to the testing laboratory designated by the procuring activity. The manufacturer shall submit certified test results showing conformance with all the requirements of this specification. The test samples shall be plainly identified by securely attached durable tags marked with the following information:

Samples for Preproduction Tests.
Submitted by (name, date) for preproduction testing
in accordance with contract (contract number) MIL-T-
THERMOMETER, SELF INDICATING, BIMETALLIC
Manufacturer's Part Number

4.2.2 Rejection and retest of preproduction samples. Thermometers failing to meet the requirements of the preproduction tests shall be rejected and returned at the contractor's expense. Thermometers which have been rejected may be replaced or repaired to correct the defects and resubmitted for all specified tests. A report, certified by the Government Inspector and the unit(s) shall be submitted to the testing activity. The re-

port shall give full particulars concerning previous rejections and the action taken to correct all defects. Units rejected after this retest shall not be resubmitted without specific approval of the procuring activity.

4.3 Acceptance tests. The acceptance tests of the thermometers shall consist of the individual tests and the sampling tests of this specification. The contractor shall furnish all samples and shall be responsible for accomplishing the required tests. When inspection and testing are conducted at the contractor's plant, all inspection and testing shall be under the supervision of the Government Inspector. Contractors not having laboratory facilities satisfactory to the Inspector shall engage the services of a commercial testing laboratory acceptable to the procuring activity. The contractor shall furnish test reports, in duplicate, showing quantitative results for all tests required by this specification, and signed by an authorized representative of the contractor or laboratory as applicable. Acceptance or approval of material during the course of manufacture shall in no case be construed as a guarantee of the acceptance of the finished product.

4.3.1 Individual tests. The individual tests shall consist of the following test conducted on each thermometer:

Inspection
Scale Error
Position Error

4.3.2 Sampling tests. The sampling tests shall consist of the following tests conducted on each sampling test sample:

Drift
Durability
Response Time (Lag)
Sealing
Vibration

4.3.2.1 Sampling test instructions. Samples shall consist of three thermometers selected at random by the inspector from a lot

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of 100 or less, which have passed the individual tests. A lot shall consist of identical thermometers with the same manufacturer's part number, manufactured under substantially the same conditions and submitted at substantially the same time. Thermometers which have been subjected to the sampling tests shall not be delivered on contract until they have been rebuilt and submitted to all individual tests.

4.4 Rejection and retest of acceptance items. When any thermometers fail to meet the requirements of the sampling tests, the lot represented shall be rejected and returned at the contractor's expense. Any thermometer failing to meet the requirements of the individual tests shall be rejected and returned at the contractor's expense. Thermometers which have been rejected may be replaced or repaired to correct the defects and resubmitted for all specified tests. Before resubmissions, full particulars concerning previous rejection and the action taken to correct the original defects shall be furnished the Inspector. Units rejected after retest shall not be resubmitted without specific approval of the procuring activity.

4.5 Test conditions.

4.5.1 Atmospheric conditions. Unless otherwise specified, all tests required by this specification shall be made in accordance with the requirements of Standard FED-STD-1.

4.5.2 Vibration stand. Whenever a vibration stand is specified, it shall be a device which will vibrate at any desired frequency between 5 and 50 cycles per second and shall subject the thermometer to such vibration that a point on the vibration stand shall describe, in a plane inclined 45 degrees to the horizontal plane, a circle of the diameter specified herein.

4.6 Test methods.

4.6.1 Inspection. Each thermometer shall be examined externally to determine conformance with the applicable drawings and with all the requirements of this specification not covered by tests.

4.6.2 Scale error. The thermometer shall be tested for scale errors at the points of the scale indicated in Table I starting at the lowest temperature. Tests shall be accomplished by placing the thermometer dial in a horizontal position and immersing the thermometer stem to the attaching thread in a temperature controlled bath. The thermometer stem shall be gradually subjected to the lowest temperature in order that the bi-metal will not be subject to unnecessarily severe conditions. No readings shall be taken until the thermometer has been immersed in the bath at a temperature of -70°C for 15 minutes. The errors at the test points shall not exceed the tolerances specified in Table I. When desired by the Inspector, the thermometer shall be tested for scale errors at any additional points on the scale.

TABLE I

True Indication $^{\circ}\text{C}$	Tolerance $\pm^{\circ}\text{C}$	True Indication $^{\circ}\text{C}$	Tolerance $\pm^{\circ}\text{C}$
-70	1.5	0	0.5
-60	1.0	+10	0.5
-50	1.0	+20	0.5
-40	0.5	+30	0.5
-30	0.5	+40	0.5
-20	0.5	+50	1.0

4.6.3 Position error. The thermometer shall be held in the level position and a reading taken. It shall then (in level position) be

tapped and a reading taken. The instrument shall then be held in the following positions:

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- (a) Rotated from level position through 45 degrees to the rear (dial tilted 45 degrees backward from vertical position).
- (b) Rotated from level position through 45 degrees to the front (dial tilted 45 degrees forward from vertical position).
- (c) Rotated from level position through 45 degrees to the right (dial vertical).
- (d) Rotated from level position through 45 degrees to the left (dial vertical).
- (e) Rotated from level position through 180 degrees (dial vertical).

The maximum deviation of the five latter readings from the original reading shall not exceed 200 feet.

4.6.4 Drift. The thermometer shall be subjected to a temperature of $+70^{\circ}\text{C}$ for a period of one hour, after which the stem of the thermometer shall be immersed in a temperature controlled bath at $+20^{\circ}\text{C}$ and the scale error observed. There shall be no change in the scale error over that obtained in the scale error tests as a result of this test. In addition, no failures of any kind shall occur.

4.6.5 Durability. The stem of the thermometer shall be alternately immersed in a bath containing liquid at $+40^{\circ} \pm 2^{\circ}\text{C}$ and a bath containing liquid at $-40^{\circ} \pm 2^{\circ}\text{C}$ one hundred times, after which the scale error test shall be repeated. The change in indication at the conclusion of the test shall not be increased over indications obtained as a result of the scale error test specified in the individual tests, by more than 0.5°C .

4.6.6 Response time (lag). The stem of the thermometer shall be quenched from a bath at $+40^{\circ}\text{C}$ to an agitated liquid bath at -40°C . The time required for the indicated temperature to fall from $+40^{\circ}$ to -30°C

shall not exceed 14 seconds. The test shall be accomplished by immersing the thermometer stem to the attaching thread in a temperature controlled bath.

4.6.7 Sealing. The thermometer shall be immersed to a depth of 2 feet in water at room temperature for a period of 2 hours, after which it shall be removed, dried, and inspected for moisture leakage. Any appearance of moisture on the dial or inner surface of the cover glass shall be cause for rejection.

4.6.8 Vibration. The thermometer reading shall be obtained at any temperature specified in Table I. The thermometer shall then be mounted on a suitably designed vibration stand and subjected to vibration for a 2-hour period.

4.6.8.1 The vibration shall be such that a point on the thermometer case will describe, in a plane inclined 45 degrees to the horizontal plane, a circle of not less than 0.018 nor more than 0.020 inch in diameter. The vibration frequency shall be varied from 500 to 3,000 cpm and back each hour of the test.

4.6.8.2 While the thermometer is being vibrated, the pointer shall not oscillate over an indicated range greater than 1°C at any frequency.

4.6.8.3 Following the 2-hour vibration period, the thermometer reading shall be obtained from the same temperature as at the beginning of the test. The change in reading obtained from the test conducted before and the test after vibration shall not exceed 0.5°C . No damage shall result from this test.

4.6.9 Altitude. The thermometer shall be placed in an altitude chamber and the pressure reduced to simulate an altitude condition of 50,000 feet (3.436 inches Hg absolute pressure) and a temperature $-65^{\circ} \pm 2^{\circ}\text{C}$. Before the chamber is evacuated, it

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shall be ascertained that the thermometer assembly is at the same temperature as the interior of the chamber. No change in accuracy shall occur as a result of the reduction in pressure, nor shall there be any damage to the thermometer. After completion of the altitude test, the sealing test specified herein shall be repeated. There shall be no moisture leakage evident on the dial or inner surface of the cover glass.

4.6.10 Thermal conductivity. The indicator head of the thermometer shall be subjected to agitated air at a temperature of $+70^{\circ}\text{C}$. The thermometer stem shall then be immersed to the attaching threads, in an agitated ice bath maintained at a temperature of 0°C . There shall be no change in indication over the tolerances specified in Table I as a result of the temperature differential.

4.6.11 Vibration endurance. The vibration test shall be repeated, except that the vibration time shall be 30 hours. After completion of 30 hours vibration, the scale error test shall be repeated. The scale errors at the conclusion of the vibration endurance test shall not exceed the tolerance specified in Table I by more than 0.5°C .

4.6.12 Detail examination. The thermometer shall be critically examined to determine full compliance with regard to weight, physical dimensions, dial composition, markings, and similar detail requirements.

5. PREPARATION FOR DELIVERY

5.1 Packaging.

5.1.1 Level A. The thermometer shall be packaged in accordance with Specification MIL-P-7936. The method of preservation shall be in accordance with Specification MIL-P-116, Method IIId, omitting preservation compound/using metal reusable containers (see 6.2).

5.1.2 Level C. When this level is required,

packaging shall be in accordance with standard commercial practice.

5.2 Packing.

5.2.1 Levels A and B. The thermometer shall be packed in accordance with Specification MIL-P-7936. The level or levels required shall be as specified in the invitation for bid or contract.

5.2.2 Level C. The thermometer shall be packed to insure that the shipment arrives in a satisfactory condition at destination. The shipment shall conform to the applicable carriers' rules and regulations in effect at the time of shipment.

5.3 Marking. The interior and exterior containers shall be marked as specified in Specification MIL-P-7936.

5.3.1 Precautionary marking. The following precautionary marking shall appear on two opposite sides of each interior package and shipping container whenever practicable depending on the size of the carton:

FRAGILE

DELICATE INSTRUMENTS
HANDLE WITH CARE

6. NOTES

6.1 Intended use. The thermometer covered by this specification is intended for use in aircraft to indicate the free air temperature.

6.2 Ordering data. Requisitions, contracts and orders should state the quantity and MS part number of the thermometer and the levels of packaging (see 5.1) and packing (see 5.2) to be furnished.

6.3 Provisions for preproduction tests. Manufacture of any further thermometer on the particular contract shall be suspended until the samples submitted are pronounced satisfactory by the procuring ac-

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tivity. When a contractor is in continuous production of these thermometers from contract to contract, submission of further preproduction samples on the subsequent contracts may be waived at the discretion of the procuring activity. Approval of preproduction samples or the waiving of preproduction tests does not preclude the requirements of acceptance testing. It shall be understood that the product supplied under contract or order shall be identical to the corresponding preproduction sample in design, construction, quality, material, workmanship, and method of manufacture. Deviation from the standards of the preproduction sample shall be made only by the procuring activity. Evidence of unauthorized change shall constitute cause for rejection.

Notice. When Government drawings, specifications or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the Government may have formulated, furnished or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

Custodians:

Army—TC

Navy—Wep

Air Force—MAAMA

Preparing Activity:

Air Force—Middletown Air Materiel Area