

INCH-POUND

MIL-DTL-6508C
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SUPERSEDING
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25 July 1961

DETAIL SPECIFICATION

THERMOMETER, SELF-INDICATING, BIMETALLIC, GENERAL SPECIFICATION FOR

Inactive for new design after 26 March 1999.
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This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

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

1.2 Classification. The thermometers are classified by the following part numbers (see 6.2):

- a. MS28028-1 - Luminescent dial markings
- b. MS28028-2 - Lusterless white dial markings

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of the documents cited in sections 3 and 4 of this specification, whether or not they are listed.

Comments, suggestions, or questions on this document should be addressed to Defense Logistics Agency Aviation VEB, 8000 Jefferson Davis Highway, Richmond, VA 23297-5616, or e-mailed to STDZNMGT@dla.mil . Since contact information can change, you may want to verify the currency of this address information using the ASSIST database at https://assist.daps.dla.mil/ .
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2.2 Government documents.

2.2.1 Specifications and standards. The following specifications and standards form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

FEDERAL SPECIFICATION

HH-G-156	- Gasket Material, General Purpose, Rubber Sheets, Strips, and Special Shapes
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FEDERAL STANDARDS

FED-STD-595/37038	- Miscellaneous, Flat or Lusterless
FED-STD-595/37875	- Miscellaneous, Flat or Lusterless

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-DTL-5541	- Chemical Conversion Coatings on Aluminum and Aluminum Alloys
MIL-A-8625	- Anodic Coatings for Aluminum and Aluminum Alloys
MS28028	- Thermometer Self-Indicating, Bimetallic
MS33558	- Numerals and Letters, Aircraft Instrument Dial, Standard Form of

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-130	- Identification Marking of U.S. Military Property
MIL-STD-889	- Dissimilar Metals

(Copies of these documents are available online at <https://assist.daps.dla.mil/> or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.3 Non-government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

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AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME Y14.100 - Engineering Drawing Properties

(Copies of this document are available online at <http://www.asme.org/> or from ASME, Three Park Avenue, New York, NY 10016-5990.)

ASTM INTERNATIONAL

ASTM E171 - Standard Specification for Standard Atmospheres for Conditioning and Testing Flexible Barrier Materials

(Copies of this document are available online at <http://www.astm.org/> or from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959.)

2.4 Order of precedence. Unless otherwise noted herein or in the contract, in the event of a conflict between the text of this document and the references cited herein (except for related specification sheet), 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 Specification sheet. The individual item requirements shall be as specified herein and in accordance with the applicable specification sheet. In the event of any conflict between the requirements of this specification and the specification sheet, the latter shall govern.

3.2 First article. When specified (see 6.2), a sample shall be subjected to first article inspection in accordance with 4.2.

3.3 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, and cotter pins, having 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.

3.4 Standard parts. With the exception of 3.3, MS and AN standard parts shall be used where they suit the purpose. They shall be identified on the drawings by their part numbers.

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3.5 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.

3.5.1 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 that are adequate for the purpose.

3.5.2 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.

3.5.2.1 Dissimilar metals. Unless suitably protected against electrolytic corrosion, dissimilar metals as defined in MIL-STD-889 shall not be used in intimate contact with each other.

3.5.3 Nonmagnetic materials. Nonmagnetic materials shall be used for all parts of the instrument except where magnetic materials are essential.

3.5.4 Fungus-proof materials. Materials that 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.

3.6 Design and construction. The thermometer shall be designed for use on aircraft to indicate the free air temperature and shall conform to 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.

3.6.1 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 that are normally available as commercial standards.

3.6.2 Components. The thermometer shall consist of two mounting grommets, one dished washer, one sunshield, and a thermometer assembly.

3.6.3 Washers and grommets. Washers and grommets shall conform to the dimensions shown on MS28028. The mounting grommet shall be constructed from black molded gasket rubber in accordance with HH-G-156, type II, grade A. The dished washer shall be fabricated of a suitable metal.

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

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

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3.6.6 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 1/3 to 2/3 overlap of the 2-degree graduations.

3.6.7 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 be not less than 310 degrees.

3.6.7.1 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 MS33558. The dimensions of dial markings and the type of paint used shall be as shown in figure 1. The lusterless white shall be in accordance with FED-STD-595/37875. The lusterless black shall be in accordance with FED-STD-595/37038.

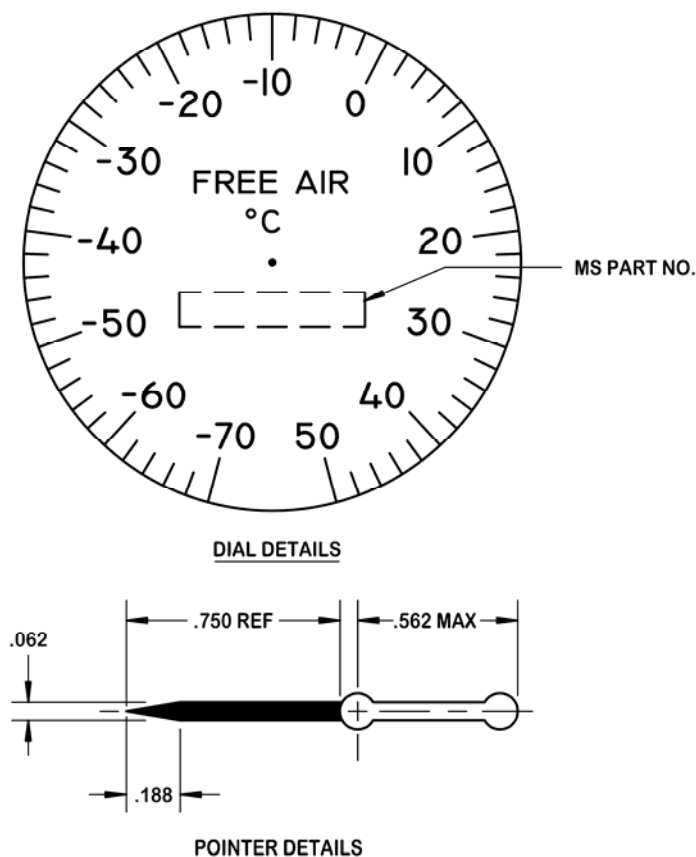
3.6.7.2 Numerals. Numerals shall distinctly indicate the graduation to which each applies. If practicable, each numeral shall be placed so that the center of mass of the numeral is on the radial line joining the appropriate graduations and the center of the dial. Any confusion resulting in doubt as to which graduation the numeral applies shall be cause for rejection. When several numerals are used in one group, the space between the numerals shall not be less than 0.016 inch.

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

3.6.9 Dial to cover glass distance. The distance between the dial and cover glass shall be 0.125 +0.025/-0.015 inch, when measured at the graduations on the dial.

3.6.10 Parallax. To avoid parallax, the pointer shall be reasonably close to the dial without interfering with the action of the thermometer. The distance between the dial and pointer shall be not greater than 0.10 inch.

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Marking	Height or length (± 0.016)	Width or line graduation (± 0.005)	Material or finish
Numerals	0.125	0.020	Lusterless white or fluorescent luminescent material
Graduations at 10-degree divisions	0.156	0.020	
Pointer (shaded part)	As shown	-	
Graduations at 2-degree divisions	0.094	0.015	
Lettering (FREE AIR, °C)	0.094	0.015	Lusterless black
Background of dial	-	-	
MS PART NO.	0.094	-	
Pointer (unshaded part)	As shown	-	

NOTES:

1. Dimensions are in inches.
2. Unless otherwise shown, all tolerances are ± 0.010 .
3. All dial graduations are partial radial lines.
4. Numerals and letters shall be in accordance with MS33558.
5. Pointer dimensional limits are in accordance with 3.6.6.

FIGURE 1. Dial.

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3.7 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.

3.7.1 Aluminum alloy parts. Where practicable, aluminum alloy parts shall be covered with an anodic film conforming to MIL-A-8625. If the dial consists of aluminum alloy, then small holes and case inserts need not be anodized. Aluminum alloys that do not anodize satisfactorily shall be coated with chemical film in accordance with MIL-DTL-5541.

3.7.2 Case front. The front of the thermometer case shall be finished in a durable lusterless black.

3.7.3 Stem. The thermometer stem shall have a bright natural metal finish.

3.7.4 Sunshield. The outer surface of the sunshield shall be a highly polished metal finish.

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

3.9 Performance. The thermometer shall perform satisfactorily when subjected to the tests specified in Section 4.

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

3.11 Identification of product. A nameplate or self-adhesive metallic label shall be securely attached to the exterior of the case and shall be legibly and durably marked in accordance with MIL-STD-130.

3.11.1 Manufacture's part number. The manufacture'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.

3.11.2 Interchangeability. All parts having the same manufacturer's part number shall be functionally and dimensionally interchangeable. The drawing number requirements of ASME Y14.100, numbering, coding, and identification section, shall govern changes in the manufacturer's part numbers.

3.12 Installation instruction. 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 8.5 by 11 or 11 by 17-inch paper.

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

IMPORTANT

THIS ENVELOPE CONTAINS
INSTALLATION INSTRUCTIONS

3.13 Recycled, recovered, or environmentally preferable materials. Recycled, recovered, or environmentally preferable materials should be used to the maximum extent possible, provided that the material meets or exceeds the operational and maintenance requirements, and promotes economically advantageous life cycle costs.

4. VERIFICATION

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

- a. First article inspection (see 4.2).
- b. Conformance inspection (see 4.3).

4.2 First article inspection. First article inspection shall consist of all the inspections and tests of this specification performed in the order specified in table I.

TABLE I. First article and conformance inspections.

Inspections and tests	First article inspection	Conformance inspection	Paragraph
Inspection	X	Individual test	4.5.1
Scale error	X	Individual test	4.5.2
Position error	X	Individual test	4.5.3
Drift	X	Sampling test	4.5.4
Durability	X	Sampling test	4.5.5
Response time (lag)	X	Sampling test	4.5.6
Sealing	X	Sampling test	4.5.7
Vibration	X	Sampling test	4.5.8
Altitude	X	-	4.5.9
Thermal conductivity	X	-	4.5.10
Vibration endurance	X	-	4.5.11
Detail examination	X	-	4.5.12

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4.2.1 First article inspection sampling instructions. First article inspection shall consist of three thermometers of each manufacturer's part number which have not been previously tested. 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 First Article Tests

Submitted by (name, date) for first article testing in
accordance with contract (contract number)
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INDICATING, BIMETALLIC, GENERAL
SPECIFICATION FOR

Manufacturer's Part Number

4.3 Conformance inspection. The conformance inspection 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 inspections 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 the specification, that have been 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 acceptance of the finished product.

4.3.1 Individual tests. The individual tests shall consist of the tests indicated in table I and shall be conducted on each thermometer.

4.3.2 Sampling tests. The sampling tests shall consist of the tests indicated in table I and shall be conducted on each sampling test sample.

4.3.2.1 Sampling test instructions. Samples shall consist of three thermometers selected at random by the inspector from a lot 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 that have been subjected to the sampling tests shall not be delivered on contract until they have been rebuilt and successfully completed to all individual tests.

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4.4 Test conditions.

4.4.1 Atmospheric conditions. Unless otherwise specified, all tests required by this specification shall be in accordance with the requirements of ASTM E171.

4.4.2 Vibration stand. When-specified, a vibration stand shall be used that shall vibrate at any desired frequency between 5 and 50 Hertz (Hz) 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 in 4.5.8.(a).

4.5 Test methods.

4.5.1 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.

4.5.2 Scale error. Each thermometer shall be tested for scale errors at the points of the scale indicated in table II, 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 so that the bimetallic junction 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 (-94 °F) for 15 minutes. The errors at the test points shall not exceed the tolerances specified in table II. If so specified by the inspector, the thermometer shall be tested for scale errors at any additional points on the scale.

TABLE II. Thermometer scale error.

True indication °C	Tolerance ±°C
-70	2.0
-60	1.0
-50	1.0
-40	1.0
-30	1.0
-20	1.0
-10	1.0
0	1.0
10	1.0
20	1.0
30	1.0
40	1.0
50	1.0

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4.5.3 Position error. Each thermometer shall be held in the level position and a reading taken. It shall then (in level position) be lightly tapped and a reading taken. The instrument shall then be held in the following positions:

- a. Rotated from level position through 45 degrees to the rear (dial tilted 45 degrees backwards 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 readings taken in the positions above shall deviate from the original reading by not more than 1.0 °C.

4.5.4 Drift. The thermometer shall be subject to a temperature of 70 °C (158 °F) for a period of one hour, after which the stem of the thermometer shall be immersed in a temperature-controlled bath at 20 °C (68 °F) and the scale error observed. There shall be no change in the scale error, over that obtained in the scale error tests (see 4.5.2) as a result of this test. In addition, no failure of any kind shall occur.

4.5.5 Durability. The stem of the thermometer shall be alternately immersed in a bath containing liquid at 40 ± 2 °C (104 ± 3.6 °F) and a bath containing liquid at -40 ± 2 °C (-40 ± 3.6 °F) one hundred times, after which the scale error test shall be repeated. The change in indication at the conclusion of the test shall not have increased by more than 1.0 °C over the indications obtained as a result of the scale error test specified in the individual tests.

4.5.6 Response time (lag). The stem of the thermometer shall be quenched from a bath at 40 °C (104 °F) to an agitated liquid bath at -40 °C (-40 °F). The time required for the indicated temperature to fall from 40 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.

4.5.7 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.

4.5.8 Vibration. The thermometer reading shall be recorded at any temperature specified in table II. The thermometer shall then be mounted on a suitably designed vibration stand and subjected to vibration for a 2-hour period.

- a. 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 with a 0.018 to 0.020 inch diameter. The vibration frequency shall be varied from 8 to 50 Hz and back for each hour of the test.

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

c. Following the 2-hour vibration period, the thermometer reading shall be recorded at the same temperature as taken at the beginning of the test. The change in reading obtained from the test conducted before and the test after vibration shall not exceed 1.0 °C. No damage shall result from this test.

4.5.9 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 mercury absolute pressure) and a temperature of -65 ± 2 °C (-85 ± 3.6 °F). Before the chamber is evacuated, it 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 in 4.5.7 shall be repeated. There shall be no moisture leakage evident on the dial or inner surface of the cover glass.

4.5.10 Thermal conductivity. The dial indicator head of the thermometer shall be subject to agitated air at a temperature of 70 °C (158 °F). The thermometer stem shall then be immersed to the attaching threads, in an agitated ice bath maintained at the temperature of 0 °C (32 °F). There shall be no change in indication over the tolerances specified in table II as a result of the temperature differential.

4.5.11 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 tolerances specified in table II by more than 1.0 °C.

4.5.12 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. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the military service's system commands. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

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6. NOTES

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

6.1 Intended use. The thermometers covered by this specification are intended for use in aircraft for the measurement of free air temperature.

6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number, and date of this specification.
- b. MS part number (see 1.2).
- c. Quantity desired.
- d. First article, if required (see 3.1).
- e. Packaging requirements (see 5.1).

6.3 Provisions for first article tests. Manufacture of any further thermometer on the particular contract will be suspended until the samples submitted are pronounced satisfactory by the procuring activity. When a contractor is in continuous production of these thermometers from contract to contract, submission of further first article samples on the subsequent contracts may be waived at the discretion of the procuring activity. Approval of first article samples or the waiving of first article tests does not preclude the requirements of acceptance testing. It will be understood that the product supplied under contract or order will be identical to the corresponding first article sample in design, construction, quality, material, workmanship, and method of manufacture. Deviation from the standards of the first article sample will be made only by the procuring activity. Evidence of unauthorized change will constitute cause for rejection.

6.4 Subject term (key word) listing.

Altitude
Atmosphere
Drift
Durability
Position error
Response time
Scale error
Sealing
Temperature
Thermal conductivity
Vibration endurance

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

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Custodians:

Army - AR
Navy - AS
Air Force - 99
DLA - GS

Preparing Activity:

DLA - GS1

(Project 6685-2011-010)

Review Activity:

Air Force - 71

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