GG–T–321c
September 28, 1962

SUPERSEDING
Int. Fed. Spec. GG-T-00321b (NAVY-SHIPS)
August 23, 1960 and
Fed. Spec. GG-T-321
March 31, 1931

FEDERAL SPECIFICATION

THERMOMETERS, SELF-INDICATING, LIQUID-IN GLASS, FOR MACHINERY AND PIPING SYSTEMS

This specification was approved by the Commissioner, Federal Supply Service, General Services Administration, for the use of all Federal agencies.

1. SCOPE AND CLASSIFICATION

1.1 Scope. This specification covers self-indicating, liquid-in-glass thermometers for those applications and temperature ranges specified and other applications within the limits of range and accuracy specified herein.

1.2 Classification. Thermometers shall be of the following types, classes, ranges, styles and forms, as specified (see 6.2).

1.2.1 *Types, classes, and ranges.* **Types, classes, and ranges shall be as follows:**

Type I—Mercury
- Class 2—Bare bulb (flanged)
  - Range f—200° to 1000°F.
- Class 3—Well (threaded and seal welded)
  - Range e—50° to 750°F.
  - Range f—200° to 1000°F.

Type II—Organic liquid
- Class 1—Bare bulb (union)
  - Range a— -40° to 110°F.
- Class 3—Well (threaded and seal welded or seal brazed)
  - Range a— -40° to 110°F.
  - Range b— 20° to 180°F.
  - Range c— 30° to 240°F.
  - Range d— 50° to 400°F.

1.2.2 *Stem styles.* **Styles shall be as follows:**

Style 1—Standard stem
Style 2—Short extension stem
Style 3—Extension neck
Style 4—Extension stem, extension neck
Style 5—Long extension stem

1.2.3 *Forms (see figure 1).* **Forms shall be as follows:**

Form A—Straight stem
Form B—90° Back angle stem
Form C—90° Right side angle
Form D—90° Left side angle
Form E—45° Reclined angle
Form F—45° Inclined angle

2. APPLICABLE SPECIFICATIONS, STANDARDS, AND OTHER PUBLICATIONS

2.1 Specifications and standards. **The following specifications and standards, of the issues in effect on date of invitation for bids, form a part of this specification to the extent specified herein.**

Federal Specifications:

TT-E-529—Enamel, Alkyd, Semi-Gloss.

PPP-B-585 Boxes, Wood, Wirebound.
PPP-B-591 Boxes, Fiberboard, Wood-Cleated.
PPP-B-601 Boxes, Wood, Cleated-Plywood.
PPP-B-621 Boxes, Wood, Nailed and Lock-Corner.
PPP-B-636 Box, Fiberboard.
PPP-T-76 Tape, Pressure-Sensitive Adhesive, Paper, Water Resistant (for Carton Sealing).
PPP-T-97 Tape, Pressure-Sensitive Adhesive, Filament Reinforced.

Federal Standards:

Fed. Std. No. 102—Preservation, Packaging and Packing Levels.
Fed. Std. No. 123—Marking For Domestic Shipment (Civilian Agencies).

(Activities outside the Federal Government may obtain copies of Federal Specifications, Standards, and Handbooks as outlined under General Information in the Index of Federal Specifications, Standards, and Handbooks and at the prices indicated in the Index. The Index, which includes cumulative monthly supplements as issued, is for sale on a subscription basis by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

(Single copies of this specification and other product specifications required by activities outside the Federal Government for bidding purposes are available without charge at the General Services Administration Regional Offices in Boston, New York, Washington, D. C., Atlanta, Chicago, Kansas City, Mo., Dallas, Denver, San Francisco, and Auburn, Wash.

(Federal Government activities may obtain copies of Federal Specifications, Standards, and Handbooks and the Index of Federal Specifications, Standards, and Handbooks from established distribution points in their agencies.)

Military Specifications:

MIL-P-116—Preservation, Methods of.
MIL-M-191—Mercury.
JAN-P-735—Primer, Paint, Zinc-Chromate, Alkyd Type.
MIL-P-5425—Plastic, Sheet, Acrylic, Heat Resistant.
MIL-Q-9858—Quality Control System Requirements.
MIL-B-10377—Box, Wood, Cleated, Veneer, Paper Overlaid.
MIL-L-10547—Liners, Case, Waterproof.

Military Standards:

MIL-STD-105—Sampling Procedures and Tables for Inspection by Attributes.
MIL-STD-129—Marking for Shipment and Storage.
MIL-STD-167—Mechanical Vibrations of Shipboard Equipment.
MIL-STD-278—Welding and Allied Processes for Machinery for Ships of the United States Navy.

(Copies of Military Specifications, Standards, drawings, and publications required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

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

Official Classification Committee:

Uniform Freight Classification Rules

(Application for copies should be addressed to the Official Classification Committee, 1 Park Avenue at 33rd Street, New York 16, New York)

American Standards Association:

B16.5—Steel Pipe Flanges and Flanged Fittings.

(Application for copies should be addressed to the American Standards Association, 10 East 40th Street, New York 16, New York).

National Bureau of Standards Handbook:

H28—Screw-Thread Standards for Federal Services

(Application for copies should be addressed to the Superintendent of Documents, Government Printing Office, Washington 25, D.C.)

American Society for Testing and Materials:

A234—Factory Made Wrought Carbon Steel and Ferritic Alloy Steel Welding Fittings.
A276—Hot-Rolled and Cold-Finished Corrosion—Resisting Steel Bars.
B21—Naval Brass, Rod, Bar, and Shapes.
B139—Phosphor Bronze Alloy Rod and Bar.

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

3. REQUIREMENTS

3.1 **Material.** Material covering the construction of the thermometers under this specification shall be essentially commercial materials except as otherwise specified herein.

3.1.1 *Indicating liquid.* The indicating liquid shall be mercury or organic liquid. The mercury shall appear to be red. The organic liquid shall be red, black, or dark blue. The column shall be continuous and unbroken under all conditions.

3.1.1.1 *Mercury.* Mercury shall conform to grade II of MIL-M-191 and shall be pure, dry and free from air or bubbles.

3.1.1.2 *Organic liquid.* The organic liquid shall be nontoxic and shall not require special protective devices either from inhaling fumes or when handling. Such liquids should be chemically stable and lend themselves to coloring with light fast dies.

3.1.2 *Wells or bare bulbs.* Material for the parts exposed to the fluid, the temperature of which is being measured, shall be in accordance with table I. All wells shall be of one-piece design.

TABLE I—*Materials*

Range and service	Operating temperature, maximum °F.	Pressure, maximum, p.s.i.	Material	Applicable documents
Range a Chilled liquid refrigerants	60	200	Bronze	ASTM B139 (Alloy A)
Range a Refrigerated or cold storage	60	Atmospheric	Corrosion resisting steel	ASTM A-276 (316)
Range b Fresh water	180	200	Bronze	ASTM B139 (Alloy A)
Range b Sea water and brine	180	1000	Nickel-copper alloy	ASTM B-164
Range c Oil and hot water	240	2000	Corrosion-resisting steel	ASTM A-276 (316)
Range d Gases	400	5000	Nickel-copper alloy	ASTM B-164
Range e	[illegible]	[illegible]	[illegible] steel	ASTM [illegible]

3.1.3 *Glass tube and bulb.* Glass tube and bulb for thermometers graduated up to and including 760°F. shall be made of Corning normal glass, or Kimble R-6, or equal. Glass tube and bulb for thermometers graduated above 760°F. shall be made of Corning Borosilicate or Corning 172 glass, or equal.

3.1.3.1 *Bulb chamber for class 3 bulb.* Bulb chambers shall be made of corrosion-resisting steel. The heat transfer medium shall be noncorrosive.

3.1.4 *Case and frame.* Cases and frames shall be made of brass, malleable iron, steel or aluminum alloy. If not polished brass, the case and frame shall be enameled gray in accordance with TT-E-529. One coat of zinc-chromate primer in accordance with JAN-P-735 shall be applied.

3.1.4.1 *Window.* The case shall be provided at the front with a clear window at least 1/16 inch thick, free from cracks, blisters, or defects of any kind. For scale ranges 400°F. and below, the window shall be clear plastic in accordance with MIL-P-5425. For scale ranges above 400°F. a clear safety glass window shall be provided.

3.1.5 *Flanges (class 2).* The material of the flanges shall be corrosion-resisting steel in accordance with ASTM publication A-276. (For corrosion-resisting steel, see figure 2 and for inconel, see figure 3.)

3.1.6 *Elbows.* Elbows, when furnished as a separate part, shall be of commercial brass or corrosion-resisting steel, as applicable.

3.1.7 *Union connections.* The union connections shall be bronze for temperatures up to and including 400°F. and alloy steel for temperatures above 400°F.

3.1.8 *Threaded fasteners.* The material of all threaded fasteners shall be brass or corrosion-resisting steel.

3.2 Design, general.

3.2.1 *Type I, mercury.* The tube and bulb shall contain pure, dry mercury. Bubbles in the mercury column shall be cause for rejection, although the thermometer indicates true temperature within the permissible error. The air shall be entirely removed and the tube filled with an inert gas, such as nitrogen or carbon dioxide. The pressure in the tube shall be sufficient to insure the mercury column in all thermometers to be continuous and unbroken, and to remain so upon violent shaking of the thermometer with head downward or when quickly rotated.

3.2.2 *Type II, organic liquid.* The tube and bulb shall contain red, dark blue, or black organic liquid free from air bubbles. Drainage and color stability characteristics shall be tested as specified (see 4.4.5 and 4.4.6 respectively).

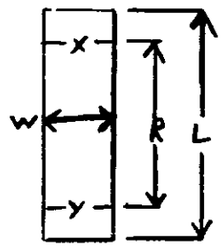
3.2.3 *Case and frame.* The case and frame shall be designed to assure maximum readability. The window shall be securely fitted into the case or into a frame securely attached to the case, so that the thermometer will withstand the tests specified herein.

3.2.4 *Glass tube and bulb.* The thermometer shall be provided with a glass tube and bulb that has been adequately annealed. The tube shall be a magnifying lens tubing with a white enamel strip at the back. The width shall be not less than 1/4 inch. The magnified column shall have a reading angle of not less than 10 degrees in a plane at right angles to the axis of the glass tube. An expansion chamber shall be provided at the top of the tube to prevent breakage when exposed to temperatures exceeding the scale range by not less than 50°F. The glass tube shall be centrally located with respect to the scale and means shall be provided to prevent axial displacement of the tube.

3.2.4.1 *Bulb chamber.* The bulbs for well type thermometers shall be protected and sealed by a metal bulb chamber to prevent breakage. The glass bulb shall extend to not less than 1/8 inch from the bottom of the bulb chamber.

3.3 Scales. The nominal length of the scales shall be 5, 7, and 9 inches as specified (see 6.2) and shall have dimensions in accordance with table II. The scales shall be of sufficient thickness to prevent warping. Each scale shall be so slotted as to permit adjustment equivalent to two scale divisions. All the lines and figures shall be engraved or etched with black on silvered scales. Metal scales with white synthetic enamel baked on at a temperature of not less than 250°F with black figures and lines will be acceptable in lieu of silvered scales for thermometers. The scales shall be held firmly by screws and the screw ends shall be level with the case.

TABLE II—*Scale dimensions (inches)*



L Nominal length	R (Minimum)	W (Minimum)	X to Y (Scale range)
5	3-1/2	1	(see table III)
7	5	1-1/4	
9	6-1/2	1-3/4	

3.3.1 *Graduations.* Scale graduations shall be in accordance with table III.

TABLE III—*Range and graduations*

Range symbol	Smallest division	Numeral interval
a,b,c,	2	10
d,e	5	25
f	10	50

3.3.1.1 *Marking.* The scale as specified, (see 3.3) shall be accurately and correctly graduated up to and including the last subdivision of the scale. The identity of graduation, the units (°F.), a legend "MERCURY" or "ORGANIC LIQUID" and the manufacturers' name and trademark and serial number shall be legibly marked thereon.

3.4 Detail design.

3.4.1 *Class 1, bare bulb (union).* The bulbs for class 1 thermometers shall not exceed 9 inches in length (see figure 4).

3.4.2 *Class 2, bare bulb (flanged).* The bulb shall be a flanged bare bulb in accordance with figure 2 or 3, as applicable. All welds in the bulb shall be ground smooth. The sensitive portion of the bulb shall not exceed 3 inches. The diameter of the insertion length shall not exceed 3/4 inch.

3.4.3 *Class 3, well (threaded and seal welded).* All class 3 thermometers shall be furnished without wells, unless otherwise specified (see 6.2). The wells shall provide for male union threaded 3/4-28 NS-2 for 5 inch scale thermometers and 1-1/4-18 NEF-2 for 7 and 9 inch scale thermometers. Wells for 5 inch scale thermometers shall be as shown on figure 5, as specified (see 6.2). Wells for 7 and 9 inch scale length thermometers shall be as shown on figures 6 through 15. They shall be of such shape, design, and dimensions as to provide for the installation of the bulbs required under wells specified herein. Heat transfer from well to the bulb may be accomplished by use of a heat transfer medium. The heat transfer medium shall not be corrosive to the bulb chamber.

3.4.4 *Threads.* All threads shall be in accordance with National Bureau of Standards Handbook H28.

3.4.5 *Styles.* Styles shall be as specified (see figures 6 through 15). The immersion length shall be at least 1 inch greater than the sensitive portion. (For definition of immersion length, see figure 16).

3.4.6 *Class 3, bulbs.* Each bulb of well

thermometers shall be of such dimension as to fit closely in its well. The sensing bulb dimensions shall be in accordance with applicable figure and shall be provided with a male union nut for fastening securely in the well.

3.4.7 *Flanged dimensions.* The flanges shall be in accordance with ASA Publication B16.5 flanges and shall be used in 600 pounds per square inch (p.s.i.) and 1500 p.s.i. systems, as specified (see 6.2).

3.4.8 *Welding.* Welding shall be in accordance with MIL-STD-278. Where bulbs, sleeves, and flanges are welded together, the material shall be compatible from a welding standpoint (see figure 2).

3.5 Performance. The thermometers shall be designed to meet the performance requirements specified in 3.5.1 through 3.5.6.

3.5.1 *Operating conditions.* Thermometers shall be suitable for operation when the bulb assembly is directly in contact in services of pressure and temperature ratings specified in 3.1.2.

3.5.2 *Accuracy.* Each thermometer shall indicate the correct temperature to within one-half of the smallest scale division.

3.5.3 *Lag (see 4.4.3).*

3.5.3.1 *Classes 1 and 2, bare bulb design (union and flanged).* The time lag for bare bulb thermometers shall not exceed 8 seconds.

3.5.3.2 *Class 3, well design (threaded and seal welded).* The time lag for well thermometers shall not exceed 45 seconds. Graphite or other heat-transfer means may be used to insure acceptable conductance of heat between the well and the bulb.

3.5.4 *Over temperature.* The accuracy shall be within the limit specified in 3.5.2.

3.5.5 *Vibration.* The accuracy of the thermometers, after the vibration test specified in 4.4.7, shall be as specified in 3.5.2.

3.5.6 *Leakage.* Thermometer well shall show no evidence of leakage when tested in accordance with 4.4.2.

4. SAMPLING, INSPECTION, AND TEST PROCEDURES

4.1 Supplier responsibilities for inspection. The supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified, the supplier may utilize his own or any other inspection facilities and services acceptable to the Government. Inspection records of the examination and tests shall be kept complete and available to the Government as specified in the contract or order. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.1.1 *Quality control.* The contractor shall provide and maintain a quality control system acceptable to the Government for the thermometers covered by this specification. The quality control system shall be in accordance with MIL-Q-9858.

4.2 Sampling for acceptance inspection.

4.2.1 *Lot (thermometers).* All thermometers of the same type, class, range, style and form offered for delivery at one time under the same contract or order shall be considered a lot.

4.2.2 *Lot (wells).* All wells of the same composition offered for delivery at one time under the same contract or order shall be considered a lot.

4.2.3 *Sampling for examination and interchangeability.* Sample thermometers and wells shall be selected from each lot in accordance with table IV and MIL-STD-105. Examination and interchangeability shall be as specified in 4.3.

TABLE IV—*Sampling for acceptance inspection*

Number of thermometers and wells in lot	Number of thermometers and wells in sample	Acceptance number (defectives)	Rejection number (defectives)
15 and under	7	0	1
16 to 40	10	0	1
41 to 110	15	0	1
111 to 300	25	1	2
301 to 500	35	1	2
501 to 800	50	2	3
801 to 1300	75	3	4
1301 and over	110	4	5

4.2.4 *Sampling for lot acceptance tests.* A random sample of thermometers and wells shall be selected from each lot in accordance with 4.2.3 and shall be subjected to the tests specified in 4.4.1 through 4.4.7 to determine conformance to the requirements of this specification. Any sample which fails to pass the tests shall be cause for rejection of the entire lot.

4.3 Examination and interchangeability.

4.3.1 *Examination.* Each of the sample thermometers and wells selected in accordance with 4.2.3 shall be examined to determine conformance to all requirements of this specification, not involving tests. Any thermometer or well in the sample containing one or more visual or dimensional defects shall be rejected, and if the number of defective thermometers or wells in any sample exceeds the acceptance number for that sample, the lot represented by the sample shall be rejected.

4.3.2 *Interchangeability.* Samples selected in accordance with 4.2.3 shall be checked for inter-changeability of thermometers to insure correct fitness of the bulb and the well for proper engagement of the bulb within the well. The sample thermometers and wells shall be assembled and disassembled for determination of interchangeability.

4.4 Test procedures.

4.4.1 *Calibration.* The entire insertion length shall be immersed in a suitable fluid. A calibration curve consisting of at least five points nearly equally spaced shall be obtained over the operating range of the instrument with the temperature ascending and descending to determine the extent of the reproducibility of the indication. The bath temperature shall be leveled out in such a manner as to eliminate lag between the thermometer and the standard. A temperature rise or fall of about one or two degrees in five minutes is satisfactory for this purpose. For purposes of meeting the accuracy requirement of 3.5.2, the thermometer shall be considered satisfactory if the calibration curves indicate that adjustment of the scale will bring all the data within 1/2 subdivision.

4.4.2 *Bulb well test.* The thermometer well shall be subjected to a strength and porosity test of 1-1/2 the working pressure specified in table I, externally. In addition, when applicable in bare bulb designs, welded joints in the bulb shall be leak tested to assure soundness.

4.4.3 *Lag.* The time required for the thermometer to indicate 63.2 percent of the response to the step change between T_3-T_4 specified in table V shall be as specified in 3.5.3. Dip tests shall be made at that stirring speed and location in the bath at which the standard test cylinder shown on figure 7 and 17 has a lag of 8 seconds plus or minus 0.4 seconds based on an average of 4 trials. The bulb of the thermometer shall be immersed in bath T_1 as shown in table V and allowed to soak until the indicator registers the bath temperature. The thermometer shall be re-

TABLE V—*Test temperatures, °F.*

Range symbol	Scale range °F.	Bath liquid[1]	span Range °F.	T_1 ±5°F.	T_2 Max. value	T_3	T_4
a	-40 to 110	Water	150	95	35	50	78
b	20 to 180	Water	160	164	50	100	140
c	30 to 240	Water	210	200	75	100	163
d	50 to 400	Water	350	200	50	100	163
e	50 to 750	Salt	700	680	425	450	595
f	200 to 1000	Salt	800	940	460	580	808

[1]Salt bath shall be noncorrosive to the metals used in the instrument bulbs tested, usually lavite.

moved from the bath and allowed to cool in air, or in a second bath, until the reading has dropped to T_2 as shown in table V. The bulb shall then be quickly immersed in the bath which has been maintained at T_1. Timing shall start when the temperature reads T_3 on the instrument and stopped when the temperature reads T_4. Elapsed time between T_3 and T_4 readings is the lag time. The lag test shall include the well as applicable.

4.4.4 *Over temperature.* The insertion length shall be subjected to a temperature 50°F. greater than the maximum scale indication for 5 minutes except range f in which case the maximum scale indication shall be held for 5 minutes. The bulb shall then be allowed to cool to ambient temperature in air. The instrument shall then be tested for accuracy in accordance with 4.4.1.

4.4.5 *Drainage test (type II only).* Sample thermometers shall be subjected to a sudden temperature change of approximately 70°F. by quickly transferring from a water bath of approximately 100°F. to a crushed ice and water bath. If bubbles form in the bulb or column at any time during this test or if the indicating column is separated after 2 minutes immersion in the crushed ice bath, the thermometer shall be considered defective.

4.4.6 *Color stability (type II only).* The liquid column shall be free from distillation and shall be easily readable after 10 [illegible] exposure in an Atlas Fade-ometer.

equivalent to 4 months of continuous exposure to noontime June sunlight.

4.4.7 *Vibration test.* The thermometer shall be mounted with its socket screwed into a vibrating platform, as outlined in MIL-STD-167 and subjected for 7 hours to combined vibrations of 1/8 inch total linear movement perpendicular to the face of the instrument and 2-1/2 degrees total angular oscillation parallel to the plane of the face of the instrument without evidence of failure. The center of the oscillatory rotation shall be 3 inches from the thermometer centerline and at the approximate level of the socket threads. The frequency of both vibrations shall be 1,000 cycles per minute. During the vibration test the tube shall not turn in the case, and no parts shall become loose or damaged. After this test, the thermometer shall indicate correctly within one of the smallest scale divisions.

4.4.8 Any thermometer which is damaged during tests shall be repaired, if possible; otherwise, it shall be replaced with a new thermometer.

4.4.9 *Inspection of preparation for delivery.* Sample items and packages shall be selected and inspected in accordance with MIL-P-116 to verify conformance to the requirements of section 5 herein.

4.4.10 *Determination of failures.* In event of failure of the sample thermometers to pass the tests specified in 4.4.1 through 4.4.7, the manufacturer shall supply an additional thermometer, embodying the necessary corrective design.

5. PREPARATION FOR DELIVERY

For civil agency procurement the definitions and applications of the levels of packaging and packing shall be in accordance with Fed. Std. No. 102.

5.1 Preservation and packaging.

5.1.1 *Level A.* Thermometers and wells, or both, shall be preserved and packaged in accordance with method III of MIL-P-116. Threaded areas shall be protected by snug fitting fiberboard sleeves, tubing or similar media. When specified (see 6.2), the unit package shall be water resistant.

5.1.2 *Level C.* Thermometers and wells, or both, shall be preserved and packaged in accordance with the supplier's commercial practice.

5.2 Packing.

5.2.1 *Level A.* Thermometers and wells, or both, packaged as specified shall be packed in overseas type, wood cleated fiberboard, nailed wood, fiber, wirebound wood, wood cleated veneer paper overlaid, or wood cleated plywood boxes conforming to PPP-B-591, PPP-B-621 (class 2), PPP-B-636 (class 2 special requirements), PPP-B-585 (class 3 use), PPP-B-601 or MIL-B-10377, respectively, at the option of the contractor. When specified (see 6.2), shipping containers shall have case liners conforming to MIL-L-10547. Case liners shall be closed and sealed in accordance with the appendix to MIL-L-10547. Case liners for boxes conforming to PPP-B-636 may be omitted provided all joints and corners of the boxes are sealed with minimum 1-1/2 inch wide tape conforming to PPP-T-76. Boxes shall be closed and strapped in accordance with the applicable box specification or appendix thereto, except that fiber boxes shall be banded with tape conforming to type IV of PPP-T-97 and the appendix thereto. The gross weight of wood or wood cleated boxes shall not exceed 200 pounds; fiber boxes shall not exceed the weight limitations of the applicable box specification.

5.2.2 *Level B.* Thermometers and wells, or both, packaged as specified (see 6.2) shall be packed in domestic type wood cleated fiberboard, nailed wood, wirebound wood, cleated plywood or wood cleated veneer paper overlaid boxes or class 2 fiber boxes conforming to PPP-B-591, PPP-B-621 (class 1), PPP-B-585, PPP-B-601, PPP-B-636, or MIL-B-10377, respectively, at the option of the contractor. Box closure shall be as specified in the applicable box specification or appendix thereto. The gross weight of wood or wood cleated boxes shall not exceed 200 pounds; fiber boxes shall not exceed the weight limitations of the applicable box specification.

5.2.3 *Level C.* Thermometers and wells, or both, packaged as specified (see 6.2) shall be packed in containers which will insure acceptance by common carrier and safe delivery at destination. Shipping containers shall comply to the Uniform Freight Classification Rules or other carrier regulations as applicable to the mode of transportation.

5.3 Marking.

5.3.1 *Military agencies.* In addition to any special marking required by the contract or order or herein, interior packages and exterior shipping containers shall be marked in accordance with MIL-STD-129.

5.3.2 *Civil agencies.* In addition to any special marking required by the contract or order or herein, interior packages and exterior shipping containers shall be marked in accordance with Fed. Std. No. 123.

6. NOTES

6.1 Intended use.

6.1.1 The selection of the bulb with respect to its application shall be as shown in table VI.

TABLE VI—*Selection of bulb*

Range symbol	Bulb design and material	Figure	Application
a	Bare, union connected, corrosion-resisting steel	4	Refrigerated or cold storage room
a	Threaded well, bronze	5 or 11 through 15	Chilled liquid refrigerants
b	Threaded well, bronze or nickel-copper	5 or 11 through 15	Sea water, brine and fresh water
c	Threaded well, bronze or nickel-copper	5 or 11 through 15	Oil and hot water
d	Threaded well, bronze or nickel-copper	5 or 11 through 15	Gases
e	Threaded and seal welded well, carbon steel	6 through 10	Saturated steam
f	Bare, flanged, Inconel	3	Flue gas
f	Bare, flanged[1] Corrosion-resisting steel	2	Superheated steam

[1]Flanged bare bulb to be used where high speed response is mandatory.

6.1.2 *Selection of wells.* Extension neck wells are intended for applications where the pressure vessel is insulated.

6.1.3 The selection of the scale size with respect to its application shall be as shown in table VII.

TABLE VII—*Selection of scale size*

Scale size, inches	Maximum operating temperature, °F.	Service	Bulb design
5	400	Oil, water, gas	Type I or II, class 3
7	650	Saturated steam, oil, water, gas	Type I, class 3
9	850	Superheated steam	Type I, class 2 or 3
7 to 9	60	Cold storage and refrigeration	Type I or II, class 1 cold storage and class 3 refrigeration

6.2 **Ordering data.** Purchasers should exercise any desired options offered herein and procurement documents should specify the following:

(*a*) Title, number, and date of this specification.

(*b*) Type, class, range, style, and form required (see 1.2).

(*c*) Length of scale (see 3.3).

(*d*) When wells are required, the applicable figure and the material should be specified (see table I and 3.4.3).

(*e*) Whether 600 p.s.i or 1500 p.s.i. should be ordered for flanged assemblies (see 3.4.7).

(*f*) Selection of applicable levels of preservation, packaging, and packing (see 5.1 and 5.2).

(*g*) When package should be water resistant (see 5.1.1).

(*h*) When case liners are required (see 5.2.1).

6.3 **Supersession data.** This specification includes the requirements of the following Military Specifications:

Military Specifications	*Date*
MIL-T-656	23 April 1953
MIL-T-2868	23 August 1956
MIL-T-15164	10 June 1953
MIL-T-19474	25 April 1956
MIL-T-19475	19 November 1956

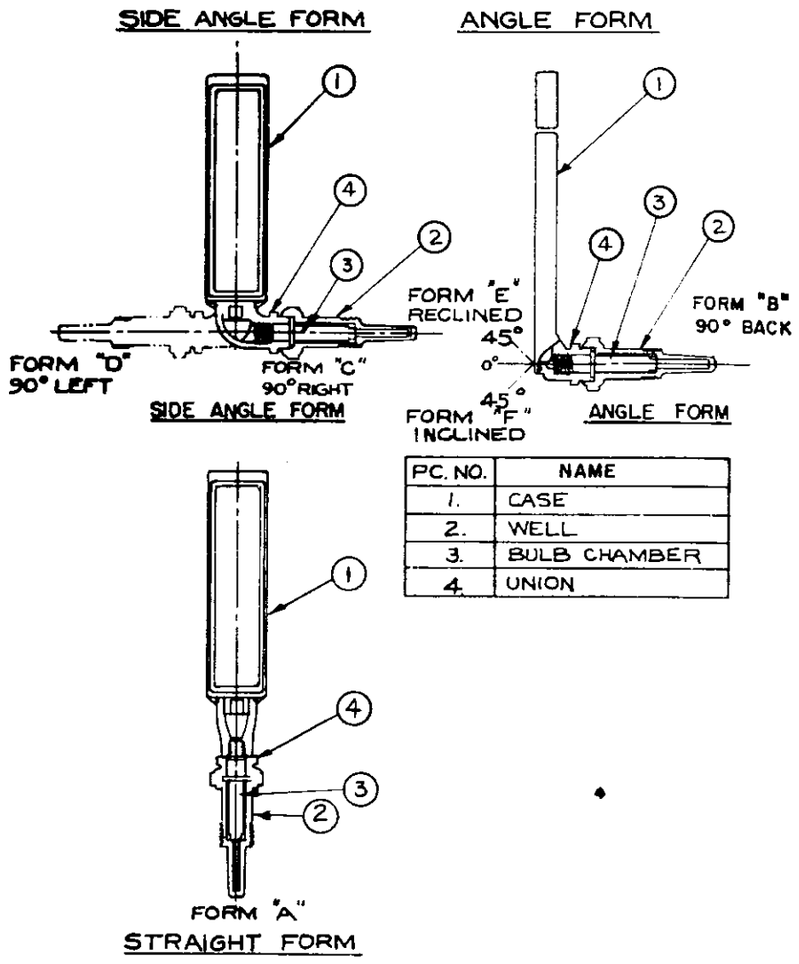
Notice. When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the Government may 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.

MILITARY CUSTODIANS:

Army—O

Navy—Sh

Air Force—ASD



PC. NO.	NAME
1.	CASE
2.	WELL
3.	BULB CHAMBER
4.	UNION

FIGURE 1—Forms of thermometers and separable wells (forms A through F))

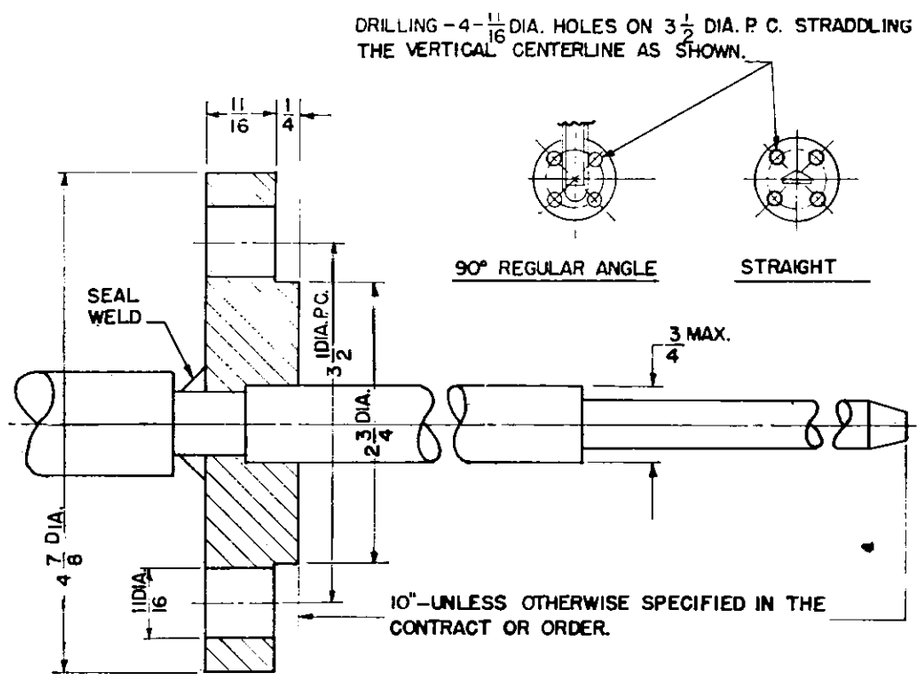


FIGURE 2—Class 2, range f, 9 inch scale thermometers for superheated steam

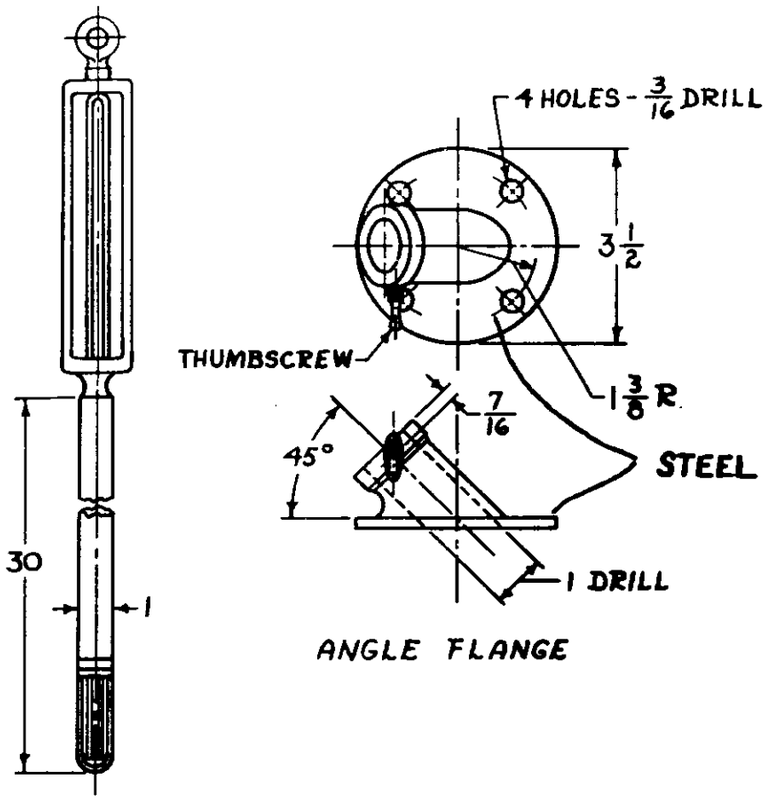


FIGURE 3—Class 2, range f, 7 and 9 inch scale thermometers for flue gases

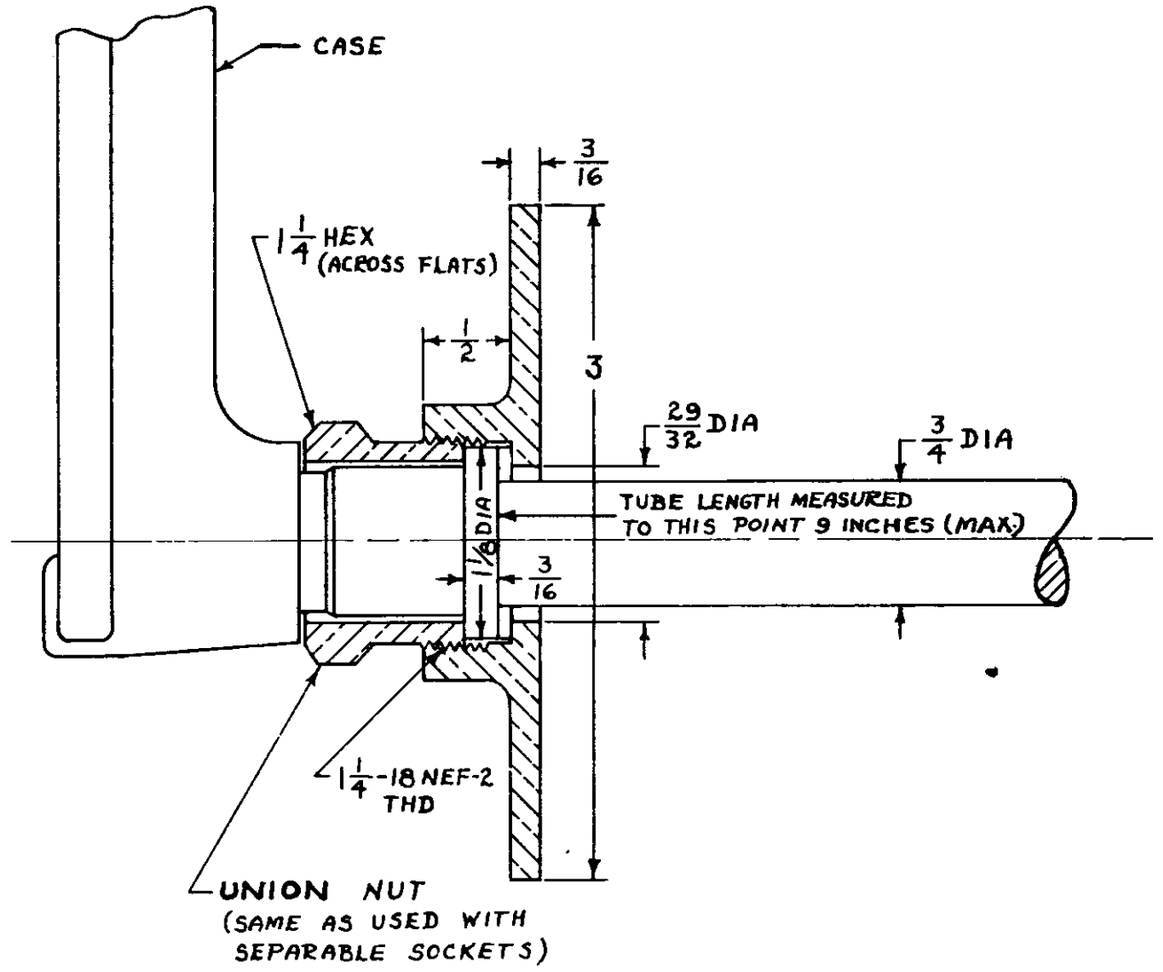
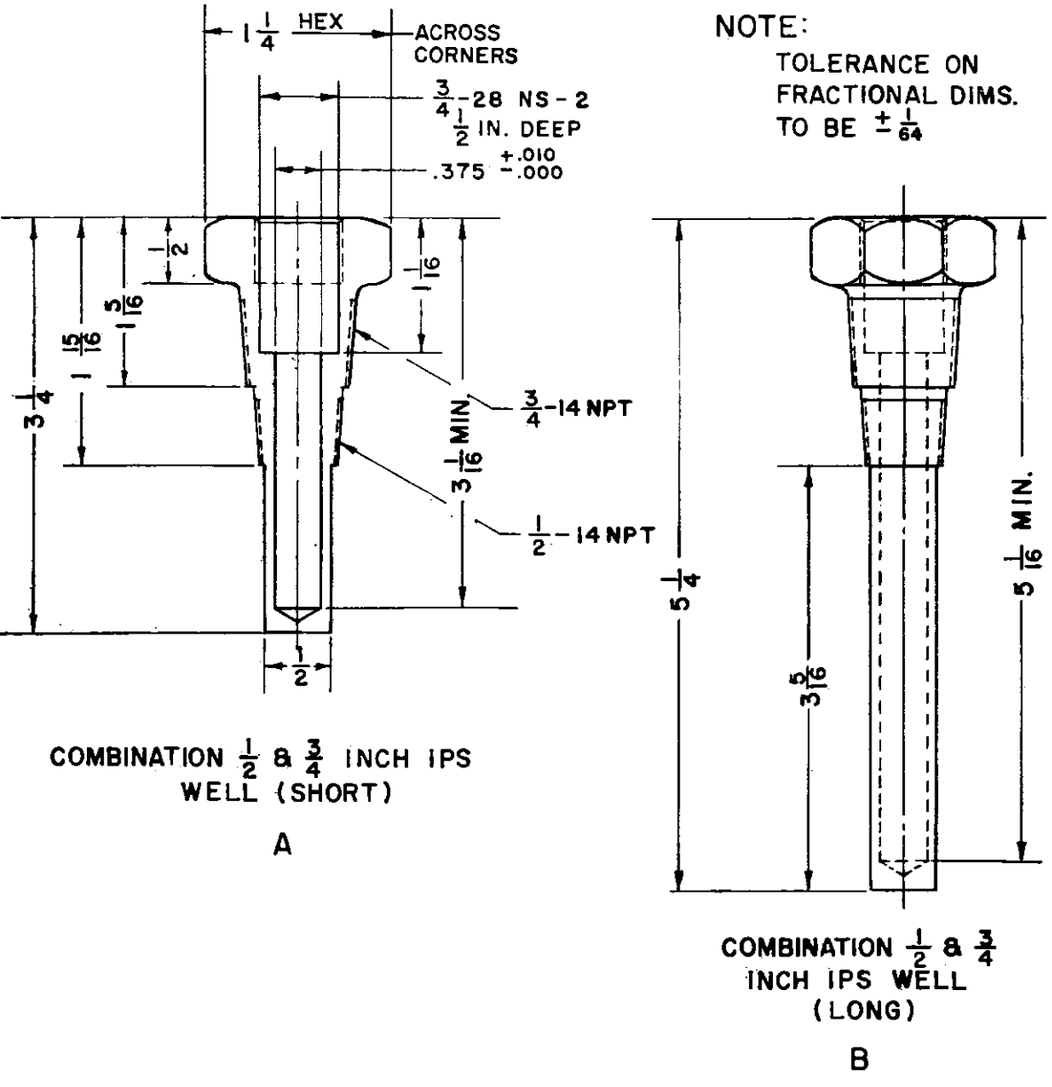


FIGURE 4—Class 1, range a, 7 and 9 inch scale thermometers for cold storage room



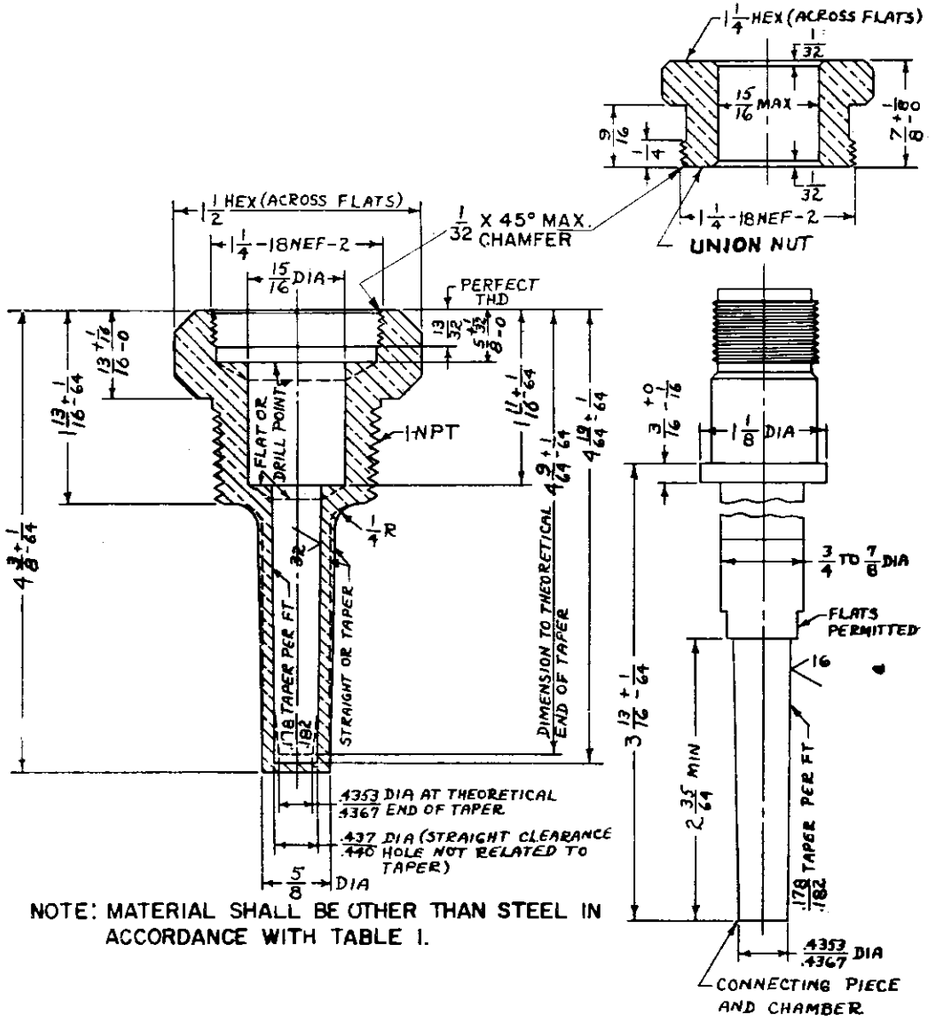
COMBINATION $\frac{1}{2}$ & $\frac{3}{4}$ INCH IPS WELL (SHORT)

A

COMBINATION $\frac{1}{2}$ & $\frac{3}{4}$ INCH IPS WELL (LONG)

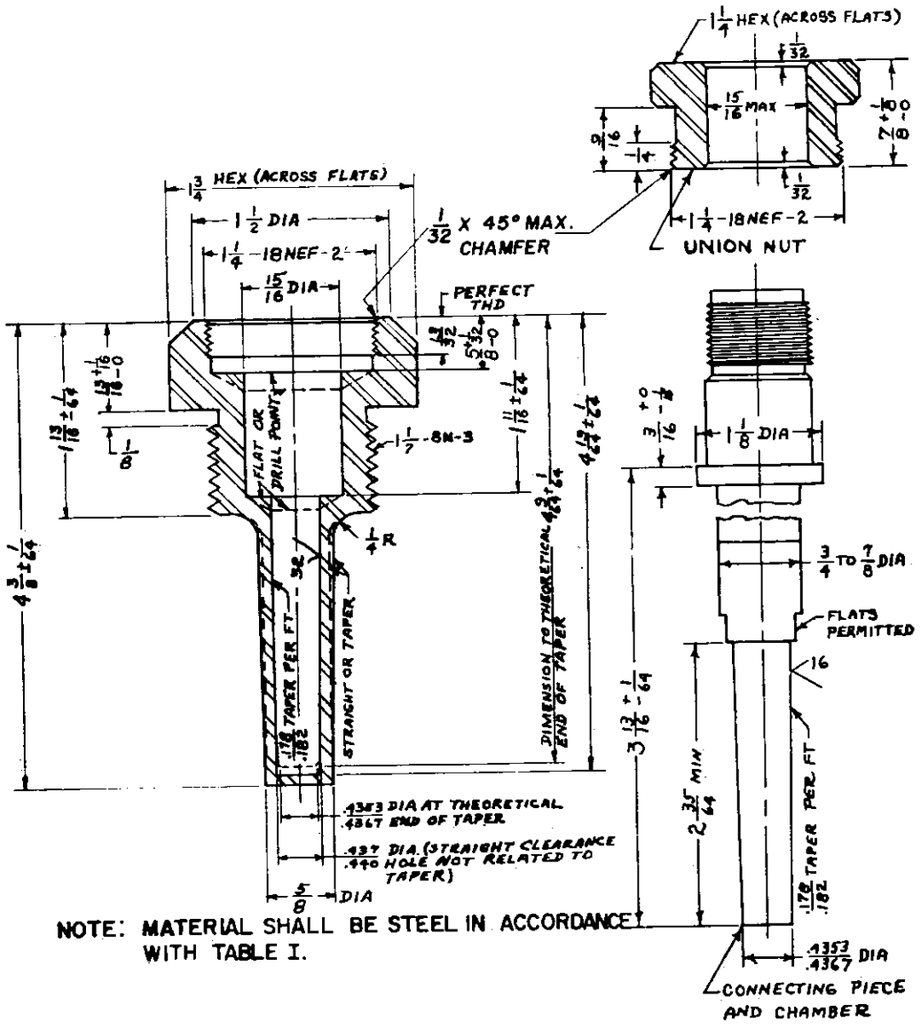
B

FIGURE 5—Type II, class 3, 5-inch scale thermometers.



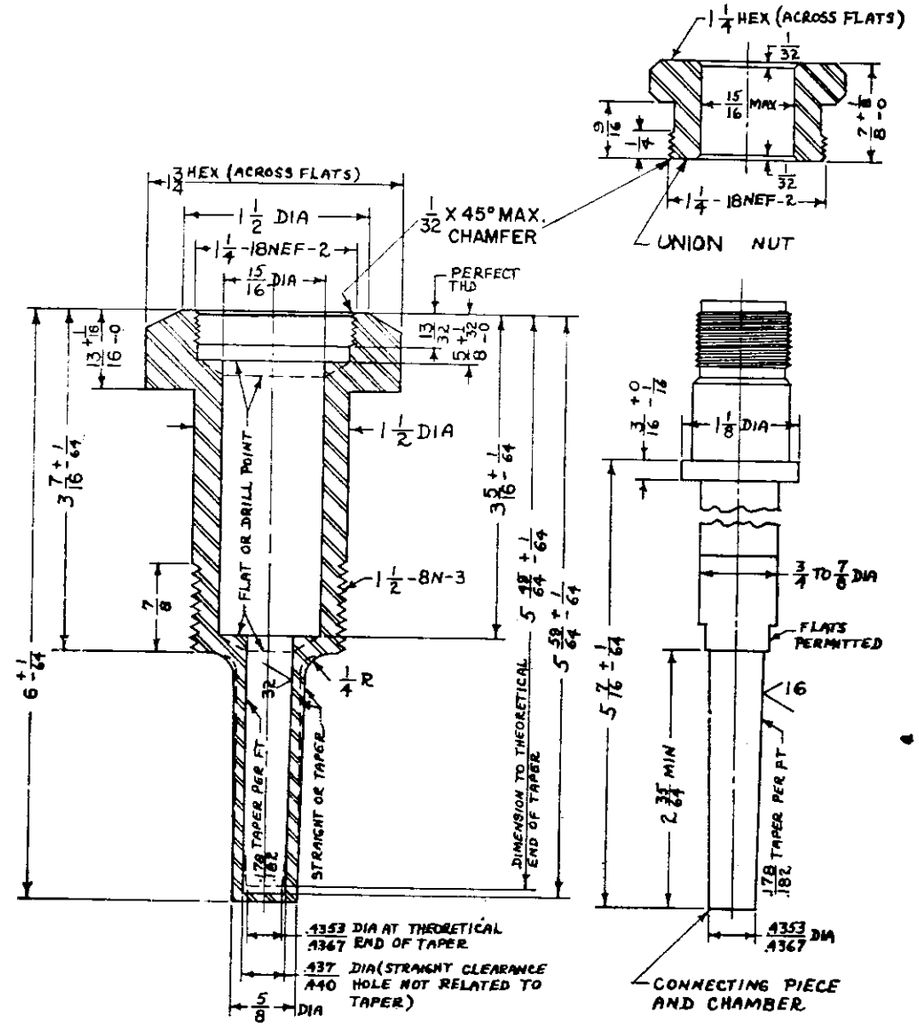
NOTE: MATERIAL SHALL BE OTHER THAN STEEL IN ACCORDANCE WITH TABLE I.

FIGURE 6—One- and one-half inch threaded well for style 1, standard 7 or 9 inch scale thermometers



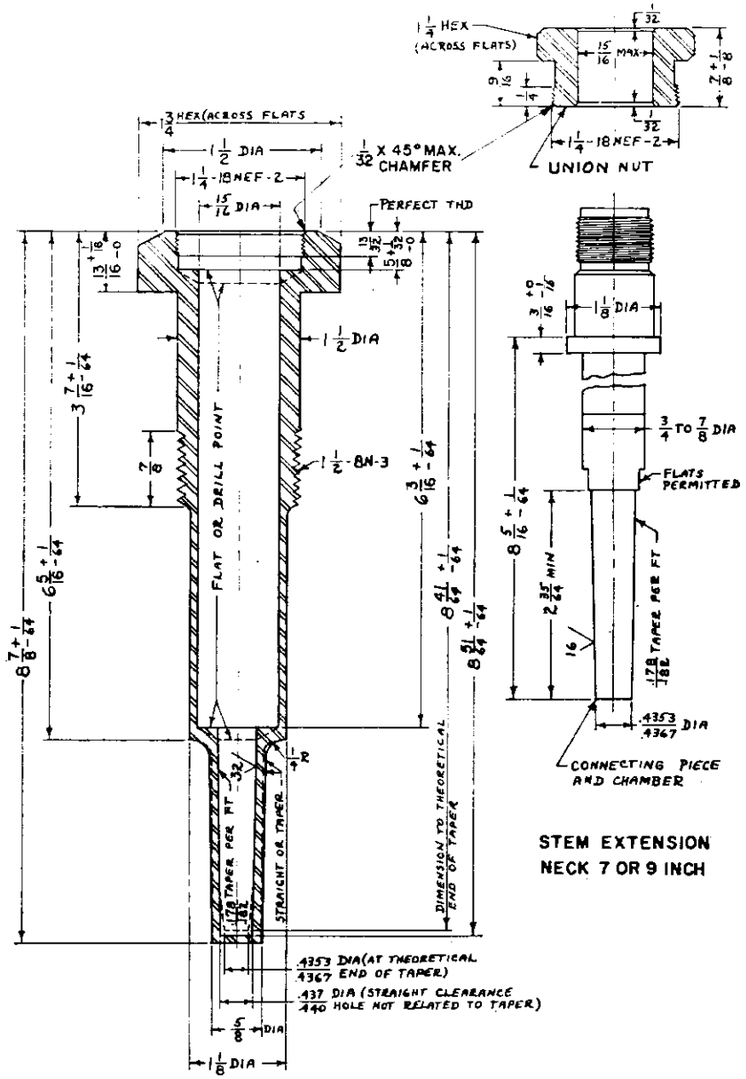
NOTE: MATERIAL SHALL BE STEEL IN ACCORDANCE WITH TABLE I.

FIGURE 7—One-and one-half inch threaded well for style 2, short extension stem 7 or 9 inch scale thermometers.



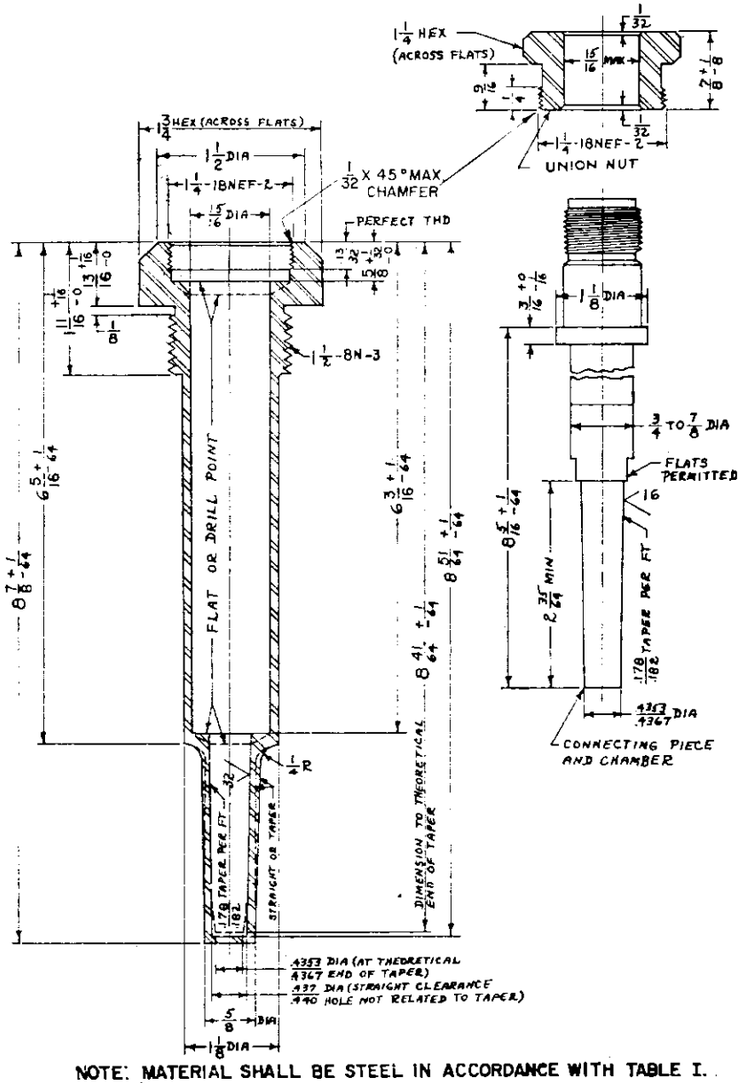
NOTE: MATERIAL SHALL BE STEEL IN ACCORDANCE WITH TABLE I.

FIGURE 8—One- and one-half inch threaded well for style 3, extension neck, 7 or 9 inch scale thermometers



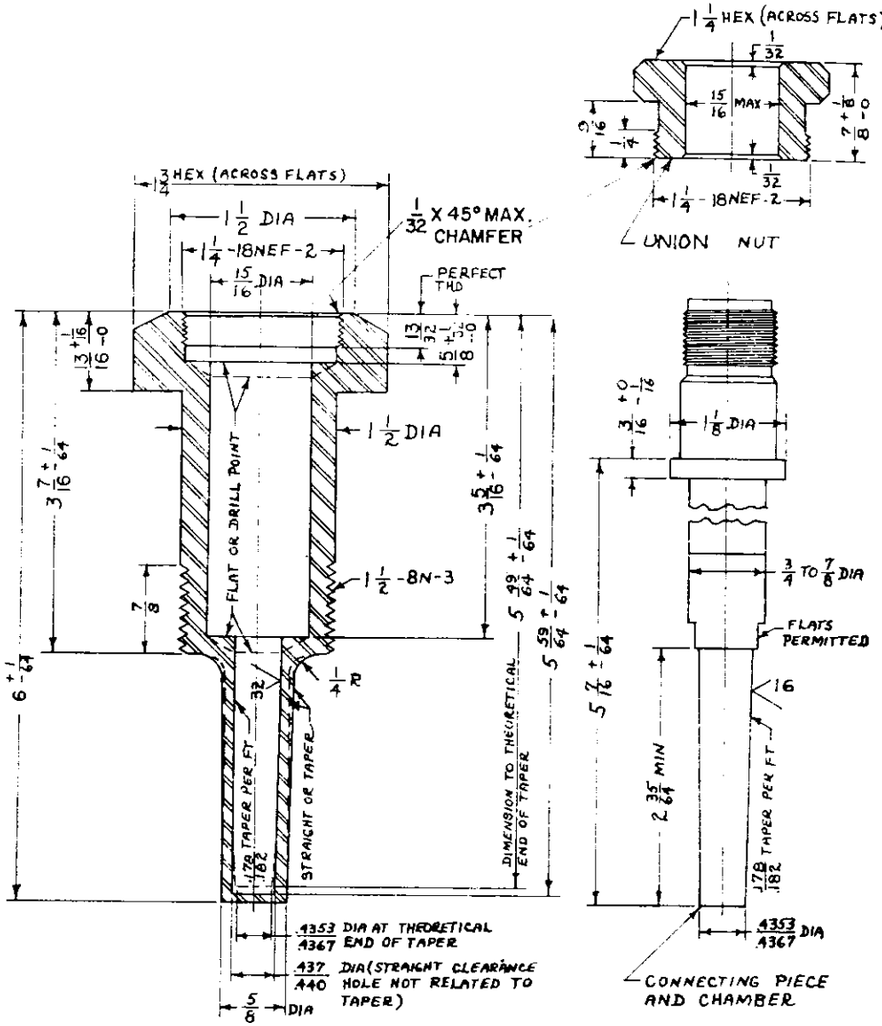
NOTE MATERIAL SHALL BE STEEL IN ACCORDANCE WITH TABLE I.

FIGURE 9—One- and one-half inch threaded well for style 4, extension stem; extension neck, 7 or 9 inch scale thermometers



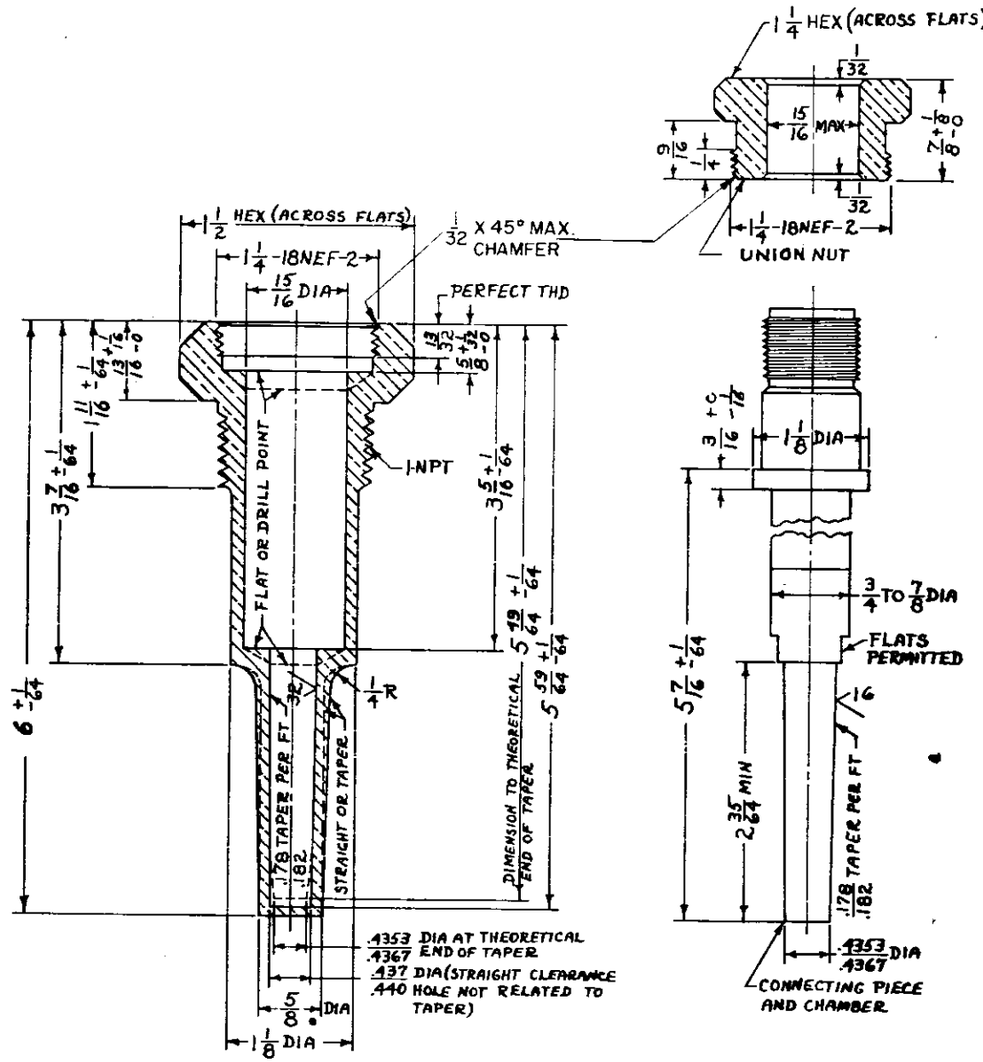
NOTE: MATERIAL SHALL BE STEEL IN ACCORDANCE WITH TABLE I.

FIGURE 10—One- and one-half inch threaded well for style 5, long extension stem, 7 or 9 inch scale thermometers



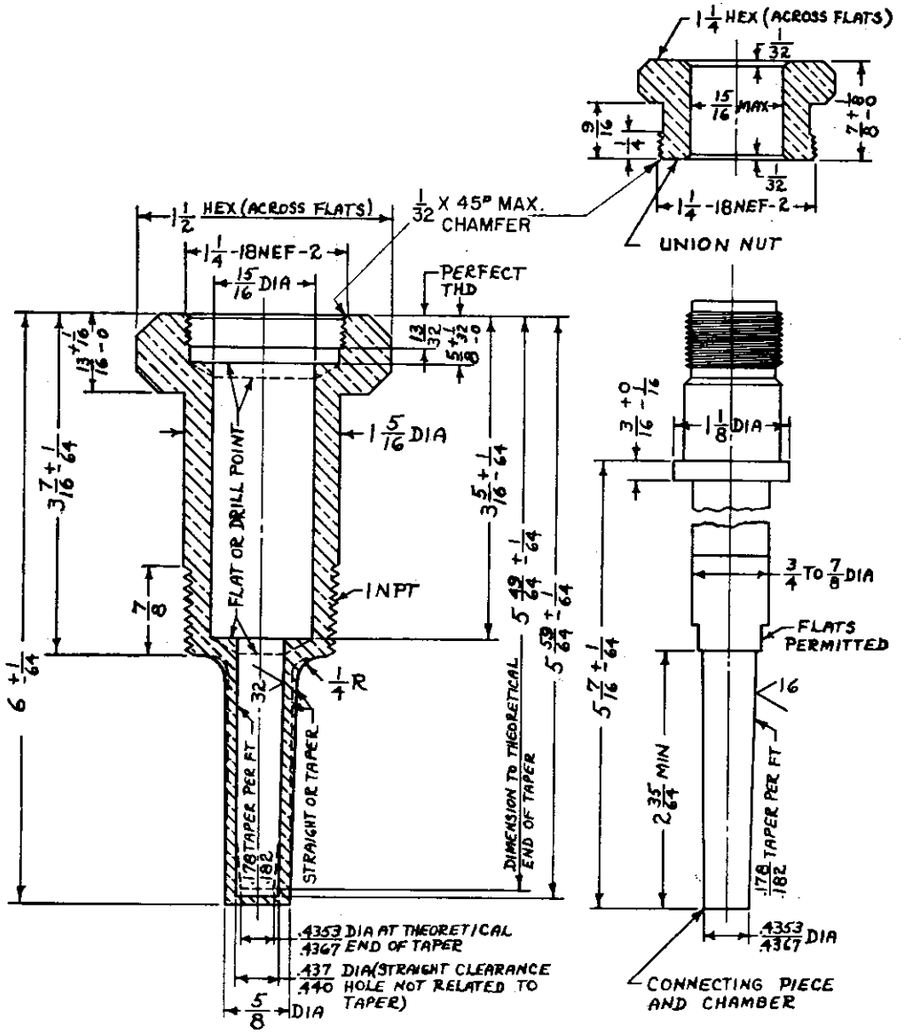
NOTE: MATERIAL SHALL BE STEEL IN ACCORDANCE WITH TABLE I

FIGURE 11—One inch threaded well for style 1, standard stem, 7 or 9 inch scale thermometers



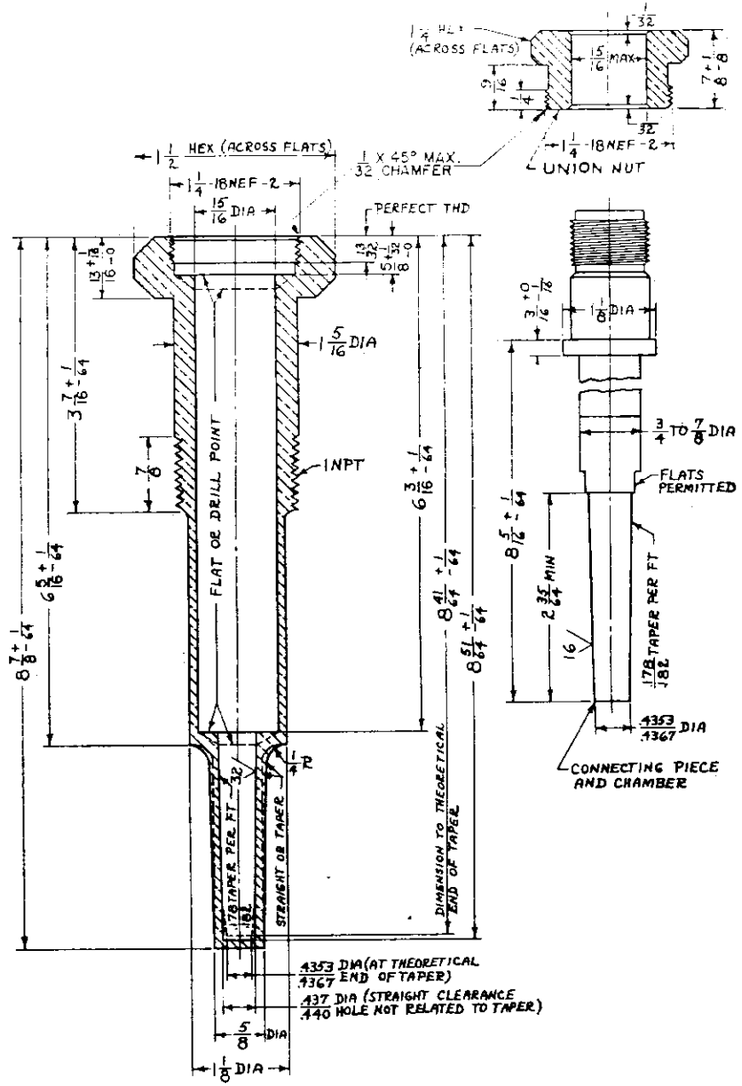
NOTE: MATERIAL SHALL BE OTHER THAN STEEL IN ACCORDANCE WITH TABLE I.

FIGURE 12—One inch threaded well for style 2, short extension stem, 7 or 9 inch scale thermometers



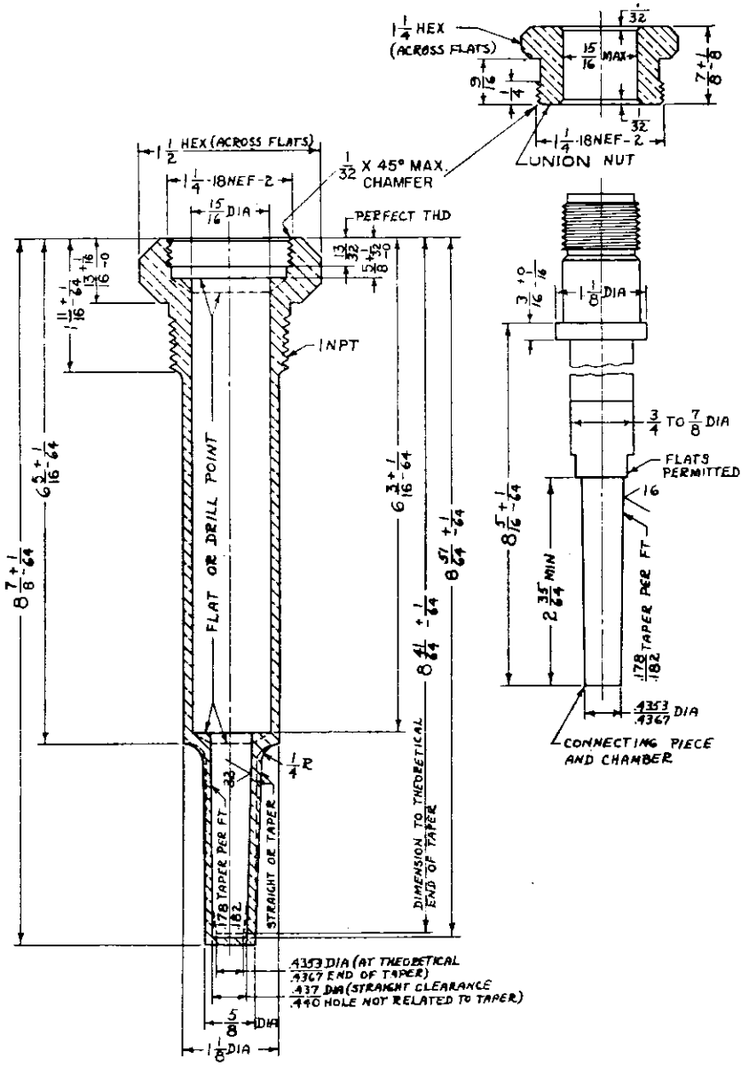
NOTE: MATERIAL SHALL BE OTHER THAN STEEL IN ACCORDANCE WITH TABLE I.

FIGURE 13—One inch threaded well for style 3, extension neck, 7 or 9 inch scale thermometers



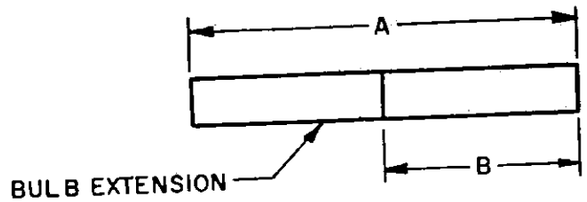
NOTE: MATERIAL SHALL BE OTHER THAN STEEL IN ACCORDANCE WITH TABLE I.

FIGURE 14—One inch threaded well for style 4, extension stem; extension neck, 7 or 9 inch scale thermometers

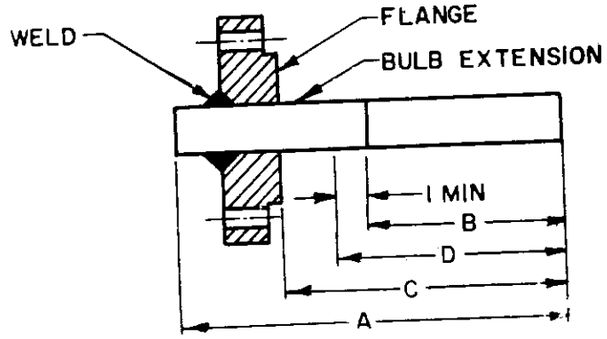


NOTE: MATERIAL SHALL BE OTHER THAN STEEL IN ACCORDANCE WITH TABLE I.

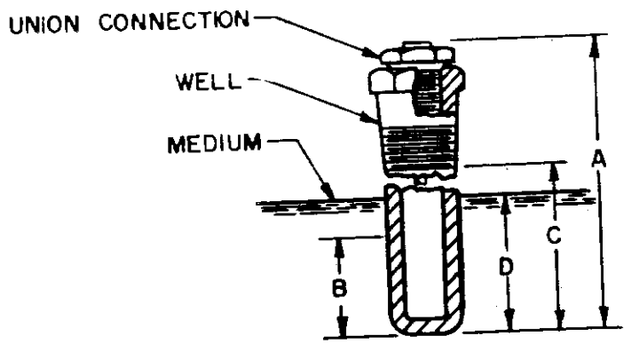
FIGURE 15—One inch threaded well for style 5, long extension stem, 7 or 9 inch scale thermometers



a. UNION BULB



b. FLANGED BULB



KEY
A – BULB LENGTH
B – SENSITIVE PORTION
C – INSERTION LENGTH
D – IMMERSION LENGTH

c. THREADED WELL (UNION BULB)

FIGURE 16—Bulb design

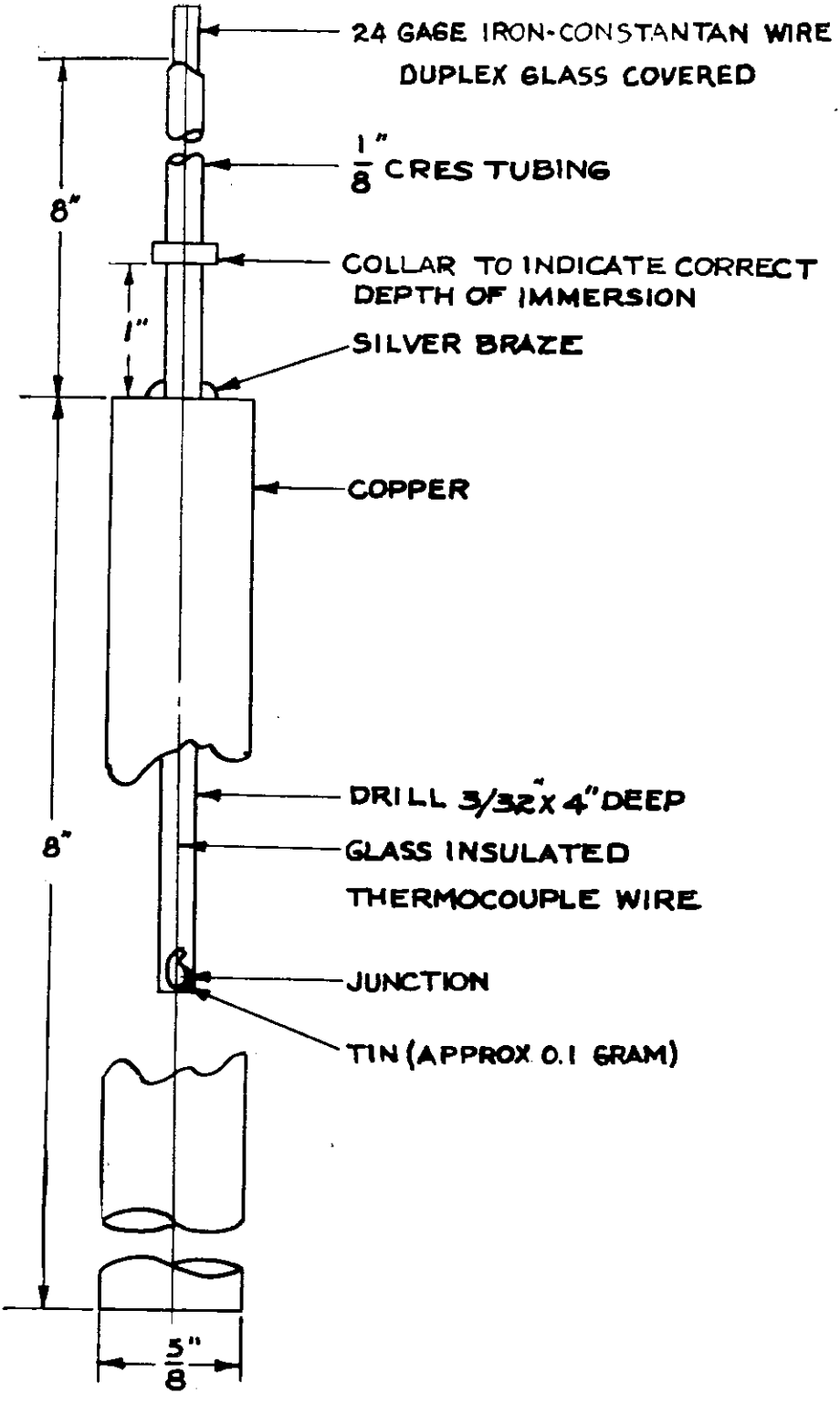


FIGURE 17—Test cylinder

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SPECIFICATION ANALYSIS SHEET

Form Approved
Budget Bureau No. 119-R004

INSTRUCTIONS

This sheet is to be filled out by personnel either Government or contractor, involved in the use of the specification in procurement of products for ultimate use by the Department of Defense. This sheet is provided for obtaining information on the use of this specification which will insure that suitable products can be procured with a minimum amount of delay and at the least cost. Comments and the return of this form will be appreciated. Fold on lines on reverse side, staple in corner, and send to preparing activity *(as indicated on reverse hereof)*.

SPECIFICATION

ORGANIZATION *(Of submitter)*	CITY AND STATE

CONTRACT NO.	QUANTITY OF ITEMS PROCURED	DOLLAR AMOUNT
		$

MATERIAL PROCURED UNDER A

☐ DIRECT GOVERNMENT CONTRACT ☐ SUBCONTRACT

1. HAS ANY PART OF THE SPECIFICATION CREATED PROBLEMS OR REQUIRED INTERPRETATION IN PROCUREMENT USE?

A. GIVE PARAGRAPH NUMBER AND WORDING.

B. RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES.

2. COMMENTS ON ANY SPECIFICATION REQUIREMENT CONSIDERED TOO RIGID

3. IS THE SPECIFICATION RESTRICTIVE?

☐ YES ☐ NO IF "YES", IN WHAT WAY?

4. REMARKS *(Attach any pertinent data which may be of use in improving this specification. If there are additional papers, attach to form and place both in an envelope addressed to preparing activity)*

SUBMITTED BY *(Printed or typed name and activity)*	DATE

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