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MIL-I-17244E(SHIPS)
20 April 1971
SUPERSEDING
MIL-I-17244D(SHIPS)
7 November 1969
(See 6.9)

MILITARY SPECIFICATION
INDICATORS, TEMPERATURE, DIRECT-READING,
BIMETALLIC, (3 AND 5 INCH DIAL)

1. SCOPE

1.1 Scope. This specification covers bimetallic, shock-resistant, direct-reading temperature indicators of the 3 and 5 inch dial sizes.

1.2 Classification. Temperature indicators shall be of a design having the following variables (see 6.3):

<u>ITD</u>	<u>3</u>	<u>18</u>	<u>A</u>	<u>2</u>
Design (see 1.2.1)	Dial size (see 1.2.2)	Range (see 1.2.3)	Case form (see 1.2.4)	Stem length (see 1.2.5)

1.2.1 Design. Indicator design shall be one of the following:

<u>Symbol</u>	<u>Instrument design</u>
ITD	Indicator, temperature, direct reading
ITM	Indicator, temperature, max-and-min

1.2.2 Dial size. Indicator dial size shall be one of the following:

<u>Symbol</u>	<u>Dial diameter (inches)</u>
3	3 inches
5	5 inches

1.2.3 Range. Indicator temperature ranges shall be one of the following:

<u>Symbol</u>	<u>Ranges °F.</u>
18	-40 to 180
24	20 to 240
55	50 to 550
75	50 to 750
12	200 to 1200

1.2.4 Case form. Indicator case form shall be one of the following:

<u>Symbol</u>	<u>Forms (see figure 1)</u>
A	Back connected
O	Bottom connected

1.2.5 Stem length. Stem lengths shall be as follows:

<u>Symbol</u>	<u>Stem length (see figure 2)</u>
2	2 inches
4	4 inches
6	6 inches

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2. APPLICABLE DOCUMENTS

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

SPECIFICATIONS

FEDERAL

- L-P-516 - Plastic Sheet and Plastic Rod, Thermosetting, Cast.
- L-T-80 - Tape, Pressure-Sensitive Adhesive (Aluminum-Backed).

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- MIL-S-901 - Shock Tests, H.I. (High-Impact); Shipboard Machinery, Equipment and Systems, Requirements for.
- MIL-D-1000 - Drawings, Engineering and Associated Lists.
- MIL-D-1000/2 - Drawings, Engineering and Associated Lists.
- MIL-P-5516 - Packing, Preformed, Petroleum Hydraulic Fluid Resistant, 160°F.
- MIL-Q-9858 - Quality Program Requirements.
- MIL-P-15137 - Provisioning Technical Documentation for Repair Parts for Electrical and Mechanical Equipment (Naval Shipboard Use).
- MIL-G-23652 - Gasket and Packing Material Petroleum and Phosphate Ester Fluid Resistant.
- MIL-W-24270 - Wells for Indicators or Thermal Elements, General Specification.

STANDARDS

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- MIL-STD-129 - Marking for Shipment and Storage.
- MIL-STD-130 - Identification Marking of U.S. Military Property.
- MIL-STD-735 - Test Methods and Test Equipment for Thermometers Used in Machinery and Piping Systems.
- MIL-STD-758 - Packaging Procedures for Submarine Repair Parts Utilizing Transparent, Flexible, Heat Sealable Film.

HANDBOOK

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- H-1 - Cross-Index of Chemical Equivalent Specification and Identification Code (Ferrous and Nonferrous Alloys).

(Copies of specifications, standards, drawings and publications required by suppliers 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 or request for proposal shall apply.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- A-276 - Hot Rolled, Cold Finish Stainless and Heat Resisting Steel Bars.
- B-209 - Aluminum-Alloy Sheet and Plate.

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

- B18.6.3-62 - Slotted and Recessed Head Machine Screws and Machine Screw Nuts.

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

NATIONAN BUREAU OF STANDARDS

HANDBOOK

- H-28 - Screw Thread Standards for Federal Service.

(Application for copies should be addressed to the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402.)

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UNIFORM CLASSIFICATION COMMITTEE
Uniform Freight Classification Rules.

(Application for copies should be addressed to the Uniform Classification Committee, 202 Union Station, 516 West Jackson Boulevard, Chicago, Illinois 60606.)

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

3. REQUIREMENTS

3.1 Qualification. Indicators furnished under this specification shall be products which are qualified for listing on the applicable qualified products list at the time set for opening of bids (see 4.2 and 6.5).

3.2 Design. Bimetal temperature indicators shall be furnished in the ITD or ITM designs with forms in accordance with figure 1. Indicators shall include a bimetal sensing element, enclosed in a metal protective tube, connected to the pointer stem on one end and the other end fixed in place inside the protective tube. The protective tube shall have a permanent mark on the external surface at a distance as shown on figure 2 to designate immersion depth for calibrating without the well. Changes in temperature around the bimetal sensing element shall cause a rotation of the indicating pointer. The protective tube shall be welded to the case, which encloses the dial and the indicating pointer. A transparent window shall be furnished to protect the dial and pointer. Means shall be provided, external to the case, for adjusting the calibration at least five subdivisions. The calibration device shall be slotted in accordance with ANSI B18.6.3 and shall be identified on the case. A bezel shall be attached to the case to hold the window securely in place. The entire enclosure shall be gas-tight.

3.2.1 Wells. Wells shall be in accordance with MIL-W-24270. Inserting the indicator stem in the well and tightening the jam nut shall prevent loosening or swiveling of the indicator under all conditions of testing.

3.2.2 Numbering system. Each manufacturer shall have a numbering system which satisfies the following:

- (a) Identifies manufacturer and model number.
- (b) Furnishes a separate number for each variation in design.

3.3 Materials. Indicator parts shall be in accordance with table I. Wells shall be in accordance with 3.2.1. Chemically equivalent metal materials in accordance with MIL-HDBK-1 may be substituted for those specified herein as long as the physical and chemical characteristics are similar.

Table I - Materials.

Indicator part	Material	Material specification	Additional requirements
Case	Corrosion-resisting steel	ASTM-A-276, 300 series	Case shall have satin or brushed finish.
Dial	Corrosion-resisting steel	ASTM-A-276	Dials shall have a white or silvered background with black graduation and markings.
	Aluminum	ASTM-B-209	
Windows for applicable ranges:			
	-40° to 180°F.	Plastic	L-P-516, G3
	20° to 240°F.	Plastic	L-P-516, G3
	50° to 550°F.	Plastic	L-P-516, G3
	50° to 750°F.	Surface compressed (chemically) glass sheets	As approved by NAVSEC
200° to 1200°F.	Surface compressed (chemically) glass sheets	As approved by NAVSEC	
Gaskets	Rubber Buna N (for 180°F. or below)	MIL-G-23652 MIL-P-5516	Shapes as required. Gaskets shall be suitable for not less than 210°F. on ranges above 240°F.

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Table I - Materials (Cont'd).

Indicator part	Material	Material specification	Additional requirements
Indicating pointer	As approved by NAVSEC	-----	Pointer shall be nonreflective black and be of a plain and unembellished design.
Index pointers	As approved by NAVSEC	-----	(Maximum and minimum indicator only). Pointers shall be painted red and shall be of a plain and unembellished design.
Reset knob	Corrosion-resisting steel or brass (nickel plated)	ASTM-A-276	(Maximum and minimum indicator only). Reset knob shall be accessible to the operator.
Protective tube	Corrosion-resisting steel	ASTM-A-276	All joints in the protective tube shall be welded and leak tight.
Jam nut	Corrosion-resisting steel	ASTM-A-276 300 series	

3.4 Detailed design. Case forms, protective tube and stem dimensions and tolerances shall be as specified on figures 1 and 2.

3.4.1 ITM indicators. ITM indicators shall be identical to the ITD design except that it shall include 2 index pointers and a reset knob. The indicating pointer shall be designed so it actuates the index pointers to indicate the maximum and minimum temperature experienced by the sensing element. The reset knob shall be designed to reset the index pointers without damage to the indicating pointer or mechanism and shall be sealed to maintain a gas-tight enclosure.

3.4.2 Dials. Indicators shall be designed to have either 3 inch or 5 inch dial sizes. The 3 inch dial size shall be used for all ranges up to and including 50° to 550°F. The 5 inch dial size shall be used for ranges 50° to 750°F. and 200° to 1200°F.

3.4.2.1 Markings and graduations. The dial shall have a graduated arc which shall cover not less than 300 degrees. The units (°F.), manufacturer's trademark, manufacturer's instrument number and Federal stock number (see 6.6), shall be indicated on the dial. The dial ranges and graduations shall be in accordance with table II and footnotes thereto, as specified (see 6.3).

Table II - Scale graduations and accuracies.

Range of scale °F.	Accuracy ^{1/} ± °F.	Number of degrees between graduations	Number of degrees between numbers	Maximum dial indicator
-40 to 180	2.2	2	20	160
20 to 240	2.2	2	20	240
50 to 550	5.0	5	50	550
50 to 750	7.0	10	100	750
200 to 1200	10.0	10	100	1200

^{1/} ITM indicators. Additional error of plus or minus 1 percent of the range span permitted when index pointers are in contact with the indicating pointer.

^{2/} Accuracy between 600° and 1100°F. shall be within plus or minus 1 percent of full scale. Remainder of the scale, accuracy shall be within plus or minus 1-1/2 percent.

3.4.2.1.1 Contract identification. A pressure sensitive label in accordance with L-T-80 shall be permanently attached to the outer surface of the case having contract number and date calibrated.

3.4.2.2 Metric units for graduation. When specified (see 6.3), units of graduation shall be metric units designated therein. Temperature units shall be in degrees Celsius (Centigrade).

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3.4.3 Case forms. Case forms shall be furnished in A and O forms.

3.4.3.1 Stem lengths. Stem lengths shall be furnished in 2, 4 and 6 inch lengths (see table III).

Table III - Stem lengths.

Stem length (Inches)	Jam nut threads	Dial size (Inches)	Range (Symbol)
2	3/4-28UNS	3	18, 24
4	3/4-28UNS	3	18, 24, 55
6	3/4-28UNS	5	75, 12

3.4.3.2 Bimetallic element. The bimetal element strip shall be fusion joined and its edges smooth and true. The element shall be welded in place.

3.4.3.3 Heat transfer medium. A heat transfer medium may be used to surround the bimetal element inside the protective tube. The medium shall not polymerize nor change its state at temperatures 50°F. above or below the dial range. The medium shall have no adverse effects on the metal parts to which it is exposed and means shall be provided to prevent leakage from the protective tube regardless of the temperature level or orientation.

3.4.4 Threads. Threads shall be in accordance with Handbook H-28. Taper pipe threads shall not be used.

3.5 Performance requirements. Performance requirements shall be in accordance with table IV.

Table IV - Performance requirements.

Test	Requirement	Test paragraph
Accuracy	See table II	4.6.1
Accuracy repeat-ability	Repeatability shall be within $\pm 1/2$ percent of range span	4.6.1.2
Inclination	$\pm 1/2$ percent of the range span (maximum)	4.6.2
Thermal response (lag)	Not to exceed 15 seconds lag	4.6.3
Load	150 pounds. No calibration shift permitted	4.6.4
Enclosure leakage	Shall show no signs of leakage	4.6.5
Fog	Shall show no signs of condensed moisture (fog) inside enclosure	4.6.6
Vibration	Accuracy shall be within limits of table II before and after the vibration test. Pointer oscillation shall not exceed 3 percent of the range span. Center of oscillation shall be within ± 1 subdivision of the reading obtained under static condition. Indices of maximum and minimum indicators shall not shift during vibration test. A calibration shift placing data outside the data band established by the repeatability test (4.7.1.2), or significant wear on any vital part constitutes failure. Failure also results from any instrument behavior not covered above which could be a serious vibration performance defect. Significant wear is defined as wear which causes dimensional changes to gear teeth visible to the naked eye or which causes increased gearing backlash. Wear to other vital parts is significant if it affects indicator performance.	4.6.7
Shock - 9 Blows	Calibration shift as a result of the shock test, calibration adjustment shall bring performance within the requirements for accuracy and repeatability specified in this table, shall not exceed ± 3 percent of range span.	4.6.8

See footnote at end of table.

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Table IV - Performance requirements (Cont'd).

Test	Requirement	Test para.,aph
Thermal stability ^{1/}	Drift shall not exceed 1/4 percent of the range span after 96 hours. However, if the drift is greater than 1/4 percent but less than 1 percent of the range span the test shall be extended an additional 288 hours to a total of 384 hours and then terminated. If the indicator shows a drift of less than 1 percent of the range span it will be acceptable.	4.6.9

^{1/} Applicable only to 50° to 750°F. and 200° to 1200°F.

3.6 Drawings. Drawings shall be in accordance with category F, form 2 of MIL-D-1000 and type IV of MIL-D-1000/2 and shall cover all designs (see 1.2.1) for which approval is required. Drawings shall include the following information:

- (a) Sectional views and details necessary to verify conformance to this specification.
- (b) Materials and details of parts.
- (c) Dimensions required to assure interchangeability.
- (d) Operating data, ranges, scale markings and other data required for proper selection.
- (e) Location, size and fastening data for all connections.
- (f) Test approval data, including approval letter, report numbers and dates, as applicable.
- (g) Complete weight.
- (h) Special consideration which may affect service selection.
- (i) Performance data.

3.6.1 Drawings shall be submitted to the Naval Ship Engineering Center (NAVSEC) for approval.

3.7 Certification data sheets. Under each contract, regardless of procuring activity, certification data sheets shall be furnished in accordance with MIL-D-1000/2, type III and the following:

- (a) General data:
 - (1) Design and source of the equipment.
 - (2) Contract source and number.
 - (3) Applicable ships.
 - (4) Specification number and date.
 - (5) Drawing number.
 - (6) Quantity of each variation.
 - (7) Quantity of repair parts (if applicable).
- (b) Application data:
 - (1) Manufacturer's instrument number.
 - (2) Federal stock number, CID or EIC number.
 - (3) Ship's instrument number.
 - (4) Well design material, type of joint to mountings and service.
 - (5) Temperature indicator design.
 - (6) Dial size.
 - (7) Range.
 - (8) Case form.
 - (9) Stem length.

3.7.1 Copies of certification data sheets. Unless otherwise specified (see 6.3), a copy of the certification data sheet shall be furnished to the following:

- (a) Technical Division, Ships Parts Control Center, Mechanicsburg, Pennsylvania 17055.
- (b) NAVSEC, Center Building, Prince George's Center, Hyattsville, Maryland 20782.

3.7.2 Approval. Certification data sheets shall be approved by the procuring activity.

3.8 Repair parts. Repair parts (assembled indicators) parts shall be furnished in accordance with MIL-P-15137 (see 6.3, 6.4 and 6.6).

3.8.1 Tender load list. Mechanical instrument repair and calibration shops on tenders and repair ships shall be furnished assembled indicators as a back-up for replacing defective indicators from the fleet (see 6.6.1).

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3.9 Identification of product. Equipment assemblies and parts shall be marked for identification in accordance with MIL-STD-130.

3.10 Instructions. An 8 by 11 instruction sheet shall be furnished for each indicator describing procedures for calibration adjustment and installation.

3.11 Workmanship. Contractor's production and inspection processes shall be established so that the end results will produce a completed product in strict compliance with this specification.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the supplier may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.1.1 Quality program. The supplier shall provide and maintain a quality program acceptable to the Government for supplies and services covered by this specification. The quality program shall be in accordance with MIL-Q-9858 (see 6.3 and 6.4).

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

- (a) Qualification inspection (see 4.3).
- (b) Quality conformance inspection (see 4.4).

4.3 Qualification tests.^{1/} Qualification tests shall be conducted at a laboratory satisfactory to the Naval Ship Engineering Center. Qualification tests shall consist of the examination and tests of table VII.

4.3.1 Samples for qualification tests. Sample indicators listed in table V, for which qualification approval is desired, shall be submitted for qualification testing. Approval of either symbol 18 or 24 temperature range will qualify both ranges. Qualification approval will be granted only for the indicators which have been submitted and which have successfully passed the qualification tests of table VII.

Table V - Samples for qualification tests.

Quantity	Design	Dial size (Inches)	Range (Symbol)	Case form	Stem length (Inches)
1	ITD	3	18 or 24	A	2
1	ITD	3	18 or 24	O	2
1	ITD	3	18 or 24	A	4
1	ITD	3	18 or 24	O	4
1	ITD	3	55	A	4
1	ITD	3	55	O	4
1	ITD	5	75	A	6
1	ITD	5	75	O	6
1	ITD	5	12	A	6
1	ITD	5	12	O	6
1	ITD	3	24	A	4

4.4 Quality conformance inspection.

4.4.1 Lot. For purposes of inspection, a lot shall consist of all indicators grouped according to design (ITD or ITD) offered for delivery at one time.

4.4.2 Sampling for quality conformance inspection. A random sample of assembled indicators shall be selected from each lot (see 4.4.1) in accordance with table VI for the examination and tests of table VII. The acceptable quality level (AQL) equals 1-1/2 percent and provides for an average outgoing quality limit (AOQL) of 2 percent.

^{1/} Application for Qualification tests shall be made in accordance with "Provisions Governing Qualification SD-6" (see 6.5 and 6.5.1).

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4.4.2.1 Rejection. When one sample fails the inspection at other than the highest sampling rate, sampling shall revert to the first line of table VI. However, when the cumulative sample exceeds 35, one failure shall be allowed and when the cumulative sample exceeds 65, two failures shall be allowed before reverting to the first line of table VI. If one sample fails during sampling at the highest rate (1/4), this shall be cause for rejection of the lot.

Table VI - Sampling for quality conformance inspection.

Number of assembled indicators (total)	Number of assembled indicators (increments)	Sampling rate	Sample cumulative (see 4.4.2.1)
Up to 7	7	1/4	2
17	10	1/5	4
35	18	1/6	7
56	21	1/7	10
106	50	1/10	15
181	75	1/15	20
356	175	1/25	27
756	400	1/50	35
1,556	800	1/80	45
3,556	2000	1/100	65
7,156	3600	1/120	95
14,656	7500	1/150	145

Table VII - Tests.

Tests	Test schedule		Requirement paragraph	Test paragraph
	Qualification tests	Quality conformance inspection		
Examination	X	X	---	4.5
Accuracy	X	X	3.5	4.6.1
Accuracy repeatability	X	X	3.5	4.6.1.2
Inclination	X	-----	3.5	4.6.2
Thermal response	X	-----	3.5	4.6.3
Load	X	-----	3.5	4.6.4
Enclosure leakage	X	X	3.5	4.6.5
Fog	X	X	3.5	4.6.6
Vibration	X	-----	3.5	4.6.7
Shock	X	-----	3.5	4.6.8
Thermal stability ^{1/}	X	-----	3.5	4.6.9

^{1/} Applicable only to 50° to 750°F. and 200° to 1200°F. range.

NOTE: Accuracy verification in accordance with 4.6.1.1 shall be performed after load, vibration, shock and stability tests to determine effects of the tests.

4.5 Examination. The indicators shall be examined to determine conformance to the requirements of this specification, the drawings, and classification of defects in table VIII.

Table VIII - Classification of defects.

Category	Defects
Critical	None
Major:	
101	Dimensions of stem or protective tube nonconforming.
102	Fails the load test.
103	Jam nut dimensions and threads nonconforming.
104	Materials nonconforming.
105	Indicators do not meet the fog or enclosure leakage test.
106	Joints in stem or protective tube not welded.
Minor:	
201	Calibration adjustment not furnished or not identified.
202	Scale arc is not 300 degrees.
203	Range not a standard range.
204	Instruction sheet not furnished.
205	Preparation for delivery, packing, packaging and marking of containers nonconforming.

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4.6 Test procedures. Tests shall be conducted in accordance with the requirements of this specification, MIL-STD-735, where applicable, and without the well, except where specified. At no time during or as a result of testing shall the following occur:

- (a) Indicating or index pointer contact the window or dial.
- (b) Pointer stem rub against the dial or window.
- (c) Calibration adjustment malfunction.

4.6.1 Accuracy test. Accuracy test shall be conducted as specified in MIL-STD-735 and shall include the following (except for range 200° to 1200°F. in which case accuracy test to 1100°F. only):

- (a) Maximum dial indicator shall conform to table II.
- (b) Immersion depth shall conform to figure 2.
- (c) Accuracy shall conform to table IV.

The maximum bulb temperature during the test shall not exceed the highest temperature in the range.

4.6.1.1 Accuracy verification. Accuracy verification shall be the same as the calibration test, except that only three points on the dial need be checked in an upscale or downscale direction. One point shall be in the lower 25 percent of the range span, one at 40 to 60 percent and one in the upper 25 percent. This test shall be used, except for the initial calibration test.

4.6.1.2 Accuracy repeatability. The indicators shall be tested for initial accuracy three times. The spread of the data at any point in the test range shall not exceed the requirements of table IV. All data shall meet the accuracy requirements of table IV.

4.6.2 Inclination test. With the indicator held so as to face the dial and with the pointer in a vertical position, the instrument shall be rotated to place the pointer 60 degrees to the left and then 60 degrees to the right or vertical. The indicator shall be within the accuracy specified in table IV in both positions. The indicator shall be at ambient condition during the test.

4.6.3 Thermal response (lag) test. Thermal response shall be determined in accordance with MIL-STD-735. Test temperature and bath medium shall be in accordance with table IX. The response time shall be in accordance with table IV. The indicators shall be stored upright with the stems vertical for one-half hour before the response test.

Table IX - Test temperatures and bath mediums.

Range (Symbol)	Bath medium	Initial temperature °F. ^{1/}	T ₁ start timing, °F.	T ₂ stop timing, °F.	Bath temperature °F.
18	Water	50	80	143	180
24	Water	50	80	143	180
55	Water	50	80	143	180
75	Salt	400	500	626	700
12	Salt	400	500	626	700

^{1/} Maximum value.

4.6.4 Load test. The indicator, while mounted into its well shall withstand the load requirements of table IV applied to the case in accordance with figure 3, without permanently distorting the alignment of the case with the bulb and well such that operation is affected. There shall be no leakage or damage to any part of the indicator and the indicator shall be within the accuracy requirements of table IV subsequent to the load test.

4.6.5 Enclosure leakage test. The entire indicator, not mounted in a well, shall be submerged in a water bath at room temperature for a period of 30 minutes. Then, the indicator shall be immersed in a fresh water bath between 150° and 160°F. for 15 minutes, followed by immersion in a cold bath between 40° and 50°F. for 15 minutes. This procedure shall be repeated for a total of two complete cycles. The transfer from one bath to another shall be accomplished as rapidly as practicable. The requirements of table IV shall be met. This test shall be performed before and after the load test of 4.6.4.

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4.6.6 Fog test. After completion of the final cycle of the test specified in 4.6.5, the indicator shall be immediately placed in a cooling cabinet held at a temperature between 35° and 40°F. After 1 hour the indicator shall be visually examined to determine conformance to table IV.

4.6.7 Vibration test. The vibration test shall consist of two parts; an exploratory test (see 4.6.7.1), and an endurance test (see 4.6.7.2). Indicator stem temperature during all tests shall be 70° to 85°F. Mounting fixture and orientation for indicator vibration tests shall be as shown on figure 4.

4.6.7.1 Exploratory vibration test. The indicator shall be subjected to a rapid exploratory test from 5 Hertz (Hz) to 500 Hz in 1 Hz increments, each frequency to be maintained for a minimum of 5 seconds. Displacement or vibratory amplitudes shall be as specified in table X.

4.6.7.1.1 Subsequent to the rapid exploratory scan, the indicator shall be subjected to a detailed resonance search from 500 Hz to 5 Hz in 5 Hz increments. Each 5 Hz incremental frequency shall be maintained for a minimum of two minutes. Additionally, any frequency where resonance of any part of the indicator was detected during the initial rapid exploratory test shall be subjected to the two minute detail resonance search. Displacements shall be as specified in table X.

4.6.7.1.2 During the exploratory vibration tests the indicator shall perform within the limits of table IV. Testing will be terminated when and if the indicator exceeds the performance limits of table IV.

Table X - Displacement criteria.

Frequency range (Hz)	Displacement (inches, peak to peak)
5 to 20	0.300
21 to 500	22.67 (1/freq.) ^{-1.5}

4.6.7.2 Vibration endurance test. The vibration endurance test shall include tests designed to evaluate the vibrational effects on the bimetallic element (see 4.6.7.2.1), and the effects of vibration on component wear (see 4.6.7.2.2).

4.6.7.2.1 Vibration endurance test of bimetallic element. The endurance test of the bimetallic element shall be run at the resonant frequency producing the most damage potential during the exploratory test. Generally, this is the resonant frequency producing the greatest pointer oscillation. Displacement shall be in accordance with table X. The test shall be run for one hour or until the indicator fails to meet the performance requirements of table IV, whichever occurs first. If performance requirements are met during the test, an accuracy verification must be performed.

4.6.7.2.2 Vibration component wear test. The vibration component wear test shall be run at the frequency causing the worst excitation of the indicator case as noted during the exploratory test. Test duration shall be 100 hours or until significant wear or damage is produced, whichever occurs first. Displacements shall be in accordance with table X. Accuracy verification must be performed subsequent to this test. In the event that the case does not exhibit a resonant frequency anywhere in the test frequency range, the wear test shall be run at 400 Hz. If significant wear occurs in less than 100 hours or pointer behavior does not meet performance requirements during the wear test, the sample fails and testing shall be terminated. Performance requirements are specified in table IV.

4.6.8 Shock test. Shock test shall be conducted as specified in MIL-STD-725 and shall include the following:

- (a) Indicator shall be mounted in accordance with fixture 4C, mounting platform No. 2 of MIL-S-901. The indicator shall be mounted not nearer than 3 inches from the side and rear of the platform.
- (b) No electrical-load conditions.
- (c) Indicator shall undergo calibration check after shock test.
- (d) Calibration shift shall be within the requirements of table IV.

4.6.9 Thermal stability test (50° to 750°F. and 200° to 1200°F. range only). Thermal stability test shall be conducted on range 50° to 750°F. up to 750°F. and 200° to 1200°F. up to 1100°F. as specified in MIL-STD-735 and shall include the following:

- (a) Drift - The indicator shall be tested for drift in accordance with MIL-STD-735 and shall meet the requirements of table IV of this specification.

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4.7 Inspection of preparation for delivery. The packaging, packing and marking shall be inspected for compliance with section 5 of this document.

5. PREPARATION FOR DELIVERY

(The preparation for delivery requirements specified herein apply only for direct Government procurements. For the extent of applicability of the preparation for delivery requirements of referenced documents listed in section 2, see 6.8.)

5.1 Domestic shipment and early equipment installation and for storage of onboard repair parts (see 5.3.1 and 6.3).

5.1.1 Indicators.

5.1.1.1 Preservation and packaging. Preservation and packaging which may be the supplier's commercial practice, shall be sufficient to afford adequate protection against corrosion, deterioration and physical damage during shipment from the supply source to the using activity and until early installation.

5.1.1.2 Packing. Packing shall be accomplished in a manner which will insure acceptance by common carrier at the lowest rate and will afford protection against physical or mechanical damage during direct shipment from the supply source to the using activity for early installation. The shipping containers or method of packing shall conform to the Uniform Freight Classification Rules or other carrier regulations, as applicable to the mode of transportation and may conform to the supplier's commercial practice.

5.1.1.3 Marking. Shipment marking information shall be provided on interior packages and exterior shipping containers in accordance with the contractor's commercial practice. The information shall include nomenclature, Federal stock number or manufacturer's part number, contract or order number, contractor's name and destination.

5.1.1.4 Onboard repair parts (assembled indicators). Repair parts for onboard stowage and future use shall be packaged level A, packed level C and marked levels A and C respectively in accordance with the applicable requirements of this specification. For submarines, packaging methods shall be modified in accordance with MIL-STD-758.

5.2 Domestic shipment and storage or overseas shipment. The requirements and levels of preservation, packaging, packing and marking for shipment shall be specified by the procuring activity (see 5.3.2 and 6.3).

(5.2.1 the following provides various levels of protection during domestic shipment and storage or overseas shipment, which may be required when procurement is made.

5.2.1.1 Preservation and packaging. Preservation and packaging shall be level A or C, as specified (see 6.3).

5.2.1.1.1 Level A.

5.2.1.1.1.1 Cleaning. Indicators shall be cleaned in accordance with process C-1, of MIL-P-116.

5.2.1.1.1.2 Drying. Indicators shall be dried in accordance with one or more of the drying procedures listed in MIL-P-116.

5.2.1.1.1.3 Unit packaging. Indicators shall be packaged method III, MIL-P-116 as follows: Each indicator shall be wrapped in MIL-C-81013, type II, cushioning material 1/2 inch thick and inserted into a close fitting PPP-B-636 box fiberboard type CF or type SF, class domestic.

5.2.1.1.1.4 Intermediate packaging. Five indicators packaged as described in 5.2.1.1.1.3 shall be placed in a close fitting intermediate container, conforming to the requirements of PPP-B-636 type CF or SF, class domestic.

5.2.1.1.2 Level C. Cleaning, drying, and packaging shall be in accordance with manufacturer's commercial practice.

5.2.1.2 Packing. Packing shall be level A or C, as specified (see 6.3).

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5.2.1.2.1 Level A. Indicators packaged as described in 5.2.1.1 shall be packed in a box fiberboard PPP-B-636, type CF overseas class or type SF overseas class. The container shall be closed and strapped in accordance with appendix of the applicable container specification.

5.2.1.2.2 Level C. Indicators packaged as specified in 5.2.1.1 shall be packed in a manner to insure carrier acceptance and safe delivery at destination. Containers shall be in accordance with Uniform Freight Classification Rules or other carriers applicable to the mode of transportation.

5.2.1.3 Repair parts (submarine, onboard and stock). Level A preservation and packing methods shall be modified in accordance with MIL-STD-758.)

5.3 Use of polystyrene (loose-fill) material.

5.3.1 For domestic shipment and early equipment installation and level C packaging and packing. Unless otherwise approved by the procuring activity (see 6.3), use of polystyrene (loose-fill) material for domestic shipment and early equipment installation and level C packaging and packing applications such as cushioning, filler and dunnage is prohibited. When approved, unit packages and containers (interior and exterior) shall be marked and labelled as follows:

"CAUTION

Contents cushioned with polystyrene (loose-fill) material.
Not to be taken aboard ship.
Remove and discard loose-fill material before shipboard storage.
If required, recushion with cellulosic material bound fiber,
fiberboard or transparent flexible cellular material."

5.3.2 For level A packaging and level A and B packing. Use of polystyrene (loose-fill) material is prohibited for level A packaging and level A and B packing applications such as cushioning, filler and dunnage.

5.4 Marking. In addition to any special marking required by the contract or order, unit packages, intermediate packages and shipping containers shall be marked in accordance with the requirements of MIL-STD-129.

6. NOTES

6.1 Small quantity availability. This specification is designed primarily for use on large production contracts. Users requiring small quantities may find it advantageous to obtain indicators through the Navy Supply System contingent upon the following:

- (a) ITD indicators (see 6.7) satisfy the application.
- (b) The user has a Navy contract for which the indicators are intended.
- (c) Lead time of at least 3 months prior to required delivery.

The prospective user should consult his local DCAS for further guidance in processing DD Form 1148 (copies available from local DCAS office).

6.2 Intended use. The indicators specified herein are intended for applications in accordance with Drawing 810-1385917.

6.2.1 ITM design to be furnished with 3 inch dial size, back angle form 2 inch insertion length, -40° to 130°F. and 20° to 240°F. ranges.

6.2.2 Six inch stem length. Indicators are intended for use on 50° to 750°F. range, and 200° to 1200°F., 5-inch dial size, 4-inch insertion length with 2-inch extension neck well.

6.3 Ordering data. Procurement documents should specify the following:

- (a) Title, number and date of this specification.
- (b) Design, dial size, case form, stem length and range (see 1.2).
- (c) Dial ranges and graduations (see 3.4.2.1 and 3.4.2.2).
- (d) Copies of drawings (see 3.6.1).
- (e) Copies of certification data sheets (see 3.7.1).

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- (f) Quality assurance provisions (see 4.1.1).
- (g) Level of packaging and packing required (see 5.1 and 5.2).
- (h) When polystyrene "loose-fill" material is approved (see 5.3.1).

6.4 Management control system documents. The following management control system documents should be included on DD Form 1660:

- (a) MIL-P-15137 (see 3.8).
- (b) MIL-Q-9858 (see 4.1.1).

6.5 With respect to products requiring qualification, awards will be made only for products which are at the time set for opening of bids, qualified for inclusion in applicable Qualified Products List QPL 17244 whether or not such products have actually been so listed by that date. The attention of the suppliers is called to this requirement, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. The activity responsible for the Qualified Products List is the Naval Ship Engineering Center, Prince George's Center, Center Building, Hyattsville, Maryland 20782, and information pertaining to qualification of products may be obtained from that activity. Application for Qualification tests shall be made in accordance with "Provisions Governing Qualification SD-6" (see 6.5.1).

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

6.6 Repair parts determination. Four percent or minimum replacement unit (MRU) of each stock number installed shall be furnished.

6.6.1 Tender load list determination. Four percent of the population installed on the service ships should be furnished in the mechanical instrument shop on tenders and repair ships, as a rotational supply system for replacing defective units.

6.7 Stock numbers. The list of stock numbers shown in table XI covering stock design of bimetallic indicators is furnished for identification purposes and may be used by Naval supply and fleet activities for identifying the required equipment or by contractors or sub-contractors for Naval ships and machinery, as applicable.

Table XI - Navy stock list.

Temperature indicator description symbols						Federal stock numbers
Design	Dial size	Range	Case form	Stem length	Jam nut threads	
ITD	3	12	O	2	3/4-28UNS	1H6635-732-5230
ITD	3	24	O	2	3/4-28UNS	1H6635-782-5247
ITD	3	18	A	2	3/4-28UNS	1H6635-782-5244
ITD	3	24	A	2	3/4-28UNS	1H6635-732-5249
ITD	3	18	O	4	3/4-28UNS	1H6635-782-5232
ITD	3	24	O	4	3/4-28UNS	1H6635-732-5234
ITD	3	18	A	4	3/4-28UNS	1H6635-732-5231
ITD	3	24	A	4	3/4-28UNS	1H6635-782-5236
ITD	3	55	O	4	3/4-28UNS	1H6635-966-6102
ITD	3	55	A	4	3/4-28UNS	1H6635-841-1439
ITD	5	75	O	4	3/4-28UNS	1H6635-522-8862
ITD	5	75	A	4	3/4-28UNS	1H6635-522-8857

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Table XI - Navy stock list (Cont'd)

Temperature indicator description symbols						Federal stock numbers
Design	Dial size	Range	Case form	Stem length	Jam nut threads	
ITD	5	75	O	6	3/4-28UNS	
ITD	5	75	A	6	3/4-28UNS	
ITD	5	12	O	6	3/4-28UNS	
ITD	5	12	A	6	3/4-28UNS	
ITM	3	24	A	2	3/4-28UNS	1H6685-404-3715
ITM	3	18	A	2	3/4-28UNS	
Well extension (see figure 5)						NSI ^{1/}

^{1/} NSI - No stock number assigned.

6.8 Sub-contracted material and parts. The preparation for delivery requirements of referenced documents listed in section 2 do not apply when material and parts are procured by the supplier for incorporation into the equipment and lose their separate identity when the equipment is shipped.

6.9 CHANGES FROM PREVIOUS ISSUE. THE OUTSIDE MARGINS OF THIS DOCUMENT HAVE BEEN MARKED "*" TO INDICATE WHERE CHANGES (DELETIONS, ADDITIONS, ETC.) FROM THE PREVIOUS ISSUE HAVE BEEN MADE. THIS HAS BEEN DONE AS A CONVENIENCE ONLY AND THE GOVERNMENT ASSUMES NO LIABILITY WHATSOEVER FOR ANY INACCURACIES IN THESE NOTATIONS. BIDDERS AND CONTRACTORS ARE CAUTIONED TO EVALUATE THE REQUIREMENTS OF THIS DOCUMENT BASED ON THE ENTIRE CONTENT AS WRITTEN IRRESPECTIVE OF THE MARGINAL NOTATIONS AND RELATIONSHIP TO THE LAST PREVIOUS ISSUE.

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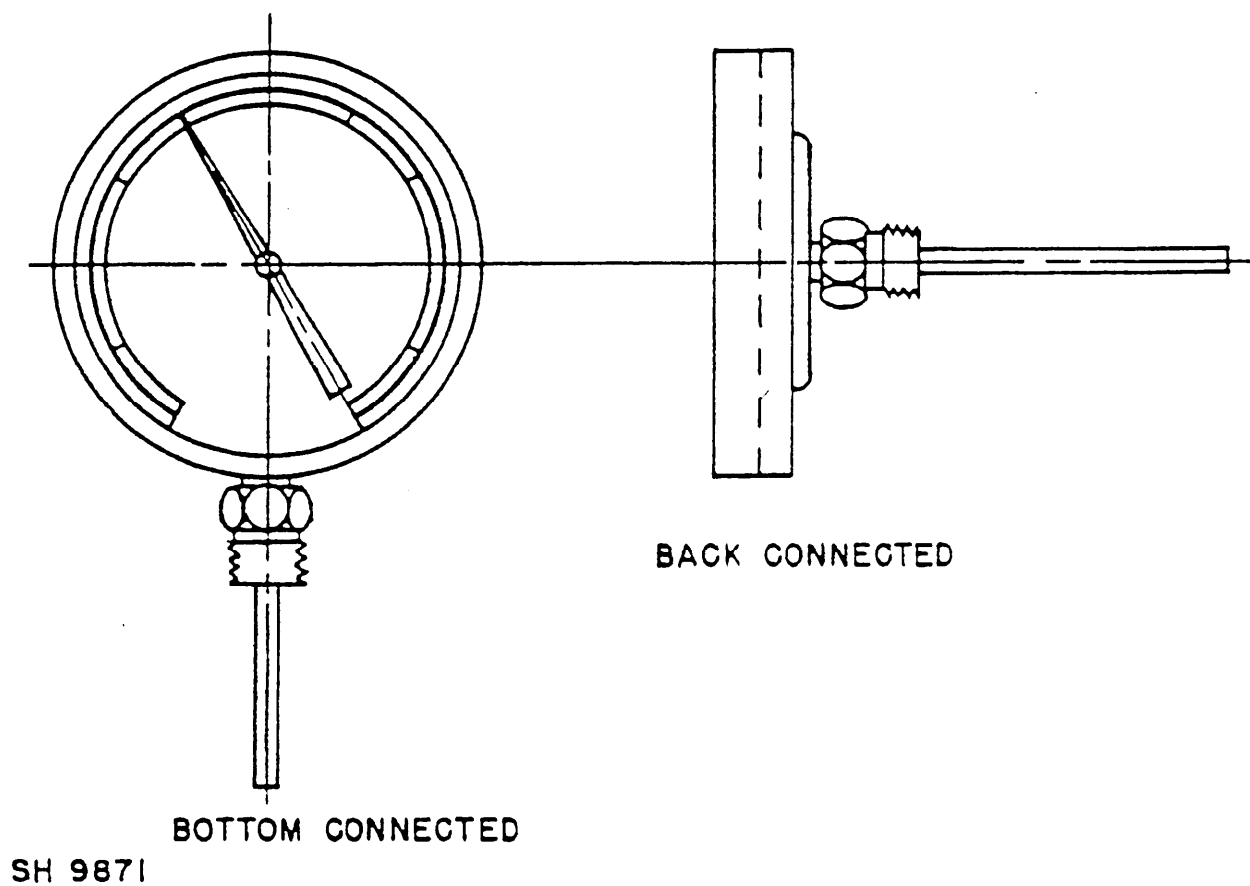
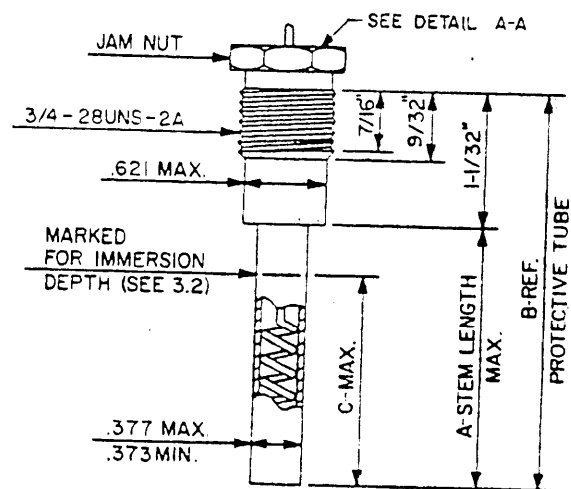


Figure 1 - Case forms.

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DIMENSION TABLE
(INCHES)

A	B $\pm 1/32$	C $\pm 1/32$
2	3-1/32	TO BOTTOM OF BUSHING
4	5-1/32	2
6	7-1/32	3

SH 6976A

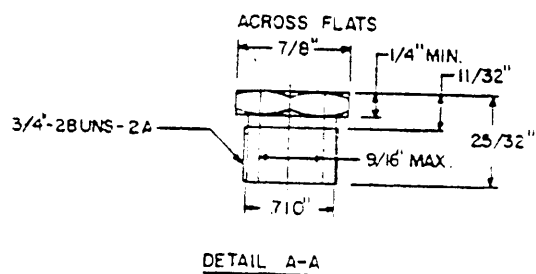


Figure 2 - Protective tube and stem dimensions.

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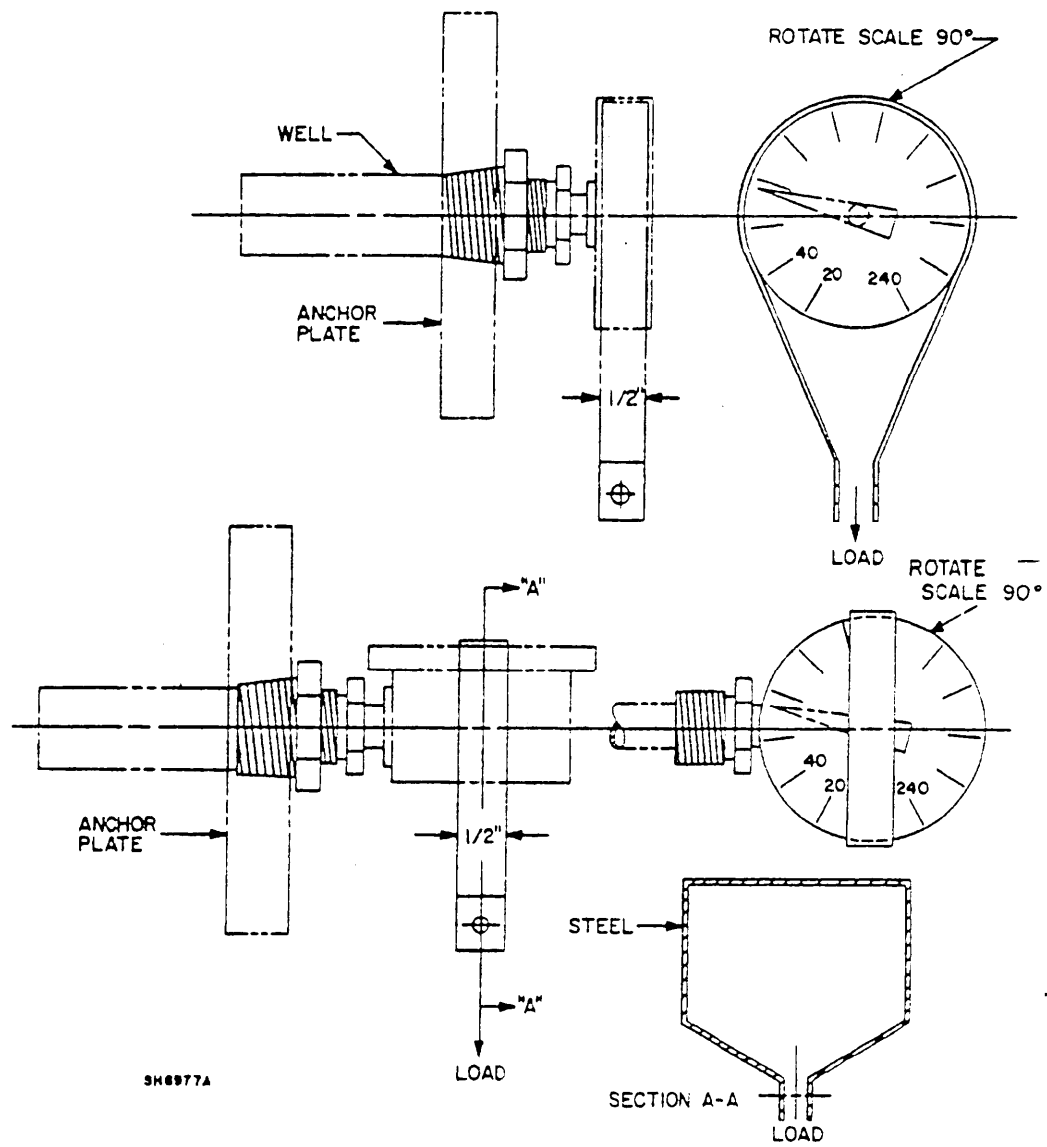
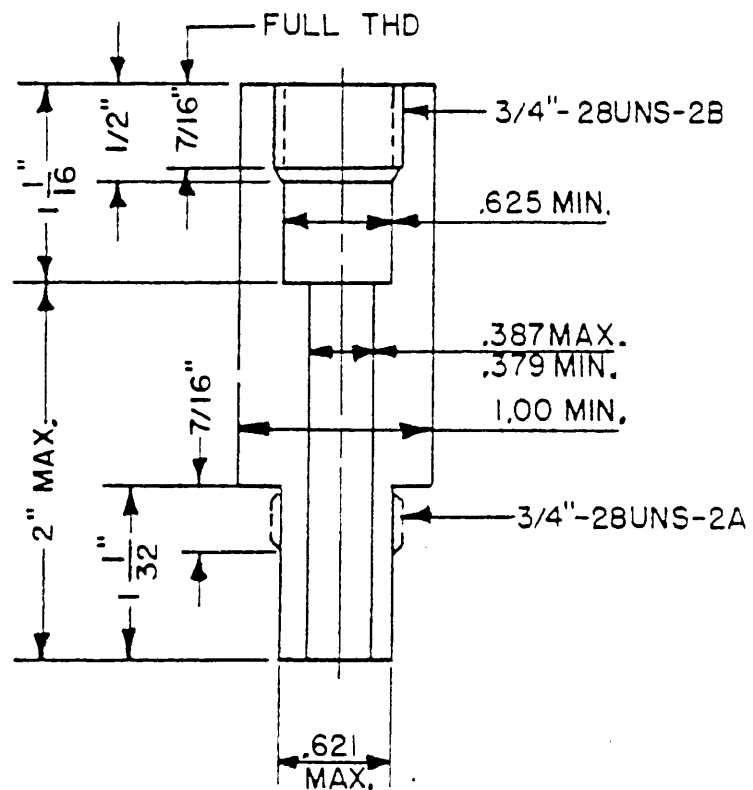


Figure 3 - Load test.

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SH 9960

Figure 5 - Well extension (2 inch) for bimetallic temperature indicators.

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