

MIL-C-10436L
15 MAY 87
SUPERSEDING
MIL-C-0010436K(ME)
14 March 1986 and
USED IN LIEU OF
MIL-C-10436J
12 February 1974

MILITARY SPECIFICATION
COMPASS, MAGNETIC, UNMOUNTED: LENSATIC, LUMINOUS,
5 DEGREE AND 20 MIL
GRADUATIONS

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 **Scope.** This specification covers an induction-damped, tritium excited, luminous dial, lensatic, unmounted magnetic compass, 5 degree and 20 mil graduations. It is designed for individual issue and for intended use as described in section 6 of this specification.

1.2 **Purpose.** The purpose of the specification is to standardize the preparation of the compass and associated documentation.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: USA Belvoir Research, Development, and Engineering Center, ATTN: STRBE-TSE, Fort Belvoir, VA 22060-5606 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document, or by letter.

AMSC N/A

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

FSC 6605

MIL-C-10436L**2. APPLICABLE DOCUMENTS****2.1 Government documents.**

2.1.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of these documents shall be those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation.

SPECIFICATIONS**FEDERAL**

L-P-387

- Plastic Sheet, Laminated, Thermo-setting (For Designation Plates).

PPP-B-601

- Boxes, Wood, Cleated-Plywood.

PPP-B-636

- Boxes, Shipping, Fiberboard.

MILITARY

MIL-T-704

- Treatment and Painting of Materiel.

MIL-C-43745

- Case, Field, First Aid Dressing-
Unmounted, Magnetic Compass, LC-1.**STANDARDS****FEDERAL**

FED-STD-313

- Material Safety Data Sheets,
Preparation and the Submission of.**MILITARY**

MIL-STD-105

- Sampling Procedures and Tables for
Inspection by Attributes.

MIL-STD-129

- Marking for Shipment and Storage.

MIL-STD-889

- Dissimilar Metals.

MIL-STD-1186

- Cushioning, Anchoring, Bracing, Blocking
and Waterproofing with appropriate Test
Methods.

2.1.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this specification to the extent specified herein. Unless otherwise specified, the issues shall be those in effect on the date of the solicitation.

DEPARTMENT OF INTERIOR, U.S. GEOLOGICAL SURVEY**ISOGONIC CHARTS**

Epoch 1980 Map No. I1283 Magnetic Declination of the U.S.

Epoch 1980 Map No. I1370 Magnetic Total Intensity of the U.S.

Epoch 1975 Map No. I914 Magnetic Vertical Intensity of the U.S.

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Epoch 1975 Map No. I913 Magnetic Horizontal Intensity of the U.S.

(Application for copies should be addressed to the Map Distribution, U.S. Geological Survey, Box 25286, Federal Center, Denver, CO 80225.)

NATIONAL BUREAU OF STANDARDS (NBS)

NBS Handbook 116 American National Standard N540 - Classification of Radioactive Self-Luminous Light Sources.

(For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. Order by SD Catalog No. C13.11;116.)

CODE OF FEDERAL REGULATIONS

Title 10 (Nuclear Regulatory Commission)

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

DRAWINGS

ME

TA13208E4680

- Compass, Magnetic, Unmounted:
Lensatic, Luminous Dial, Tritium
Excited, Induction-Damped, 5 Degree
and 20 Mil Graduations, with Carrying
Case.

(Copies of specifications, standards, drawings, publications, and other Government documents required by contractors in connection with specific acquisition functions should be obtained from the contracting 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 specified, the issues of the documents which are DOD adopted shall be those listed in the issue of the DoDISS specified in the solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS shall be the issue of the non-Government documents which is current on the date of the solicitation.

CAMBRIDGE UNIVERSITY PRESS

CIE Proceedings - 1931

(Application for copies should be addressed to the Cambridge University Press, 32 East 57th Street, New York, NY 10022.)

(Non-Government standards and other publications are normally available from

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the organizations which prepare or which distribute the documents. These documents also may be available in or through libraries or other informational services.)

2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein, the text of this specification shall take precedence. Nothing in this specification, however, shall supersede applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Description. The compass shall be as shown on top assembly TA13208E4680, and shall be as specified herein.

3.1.1 Drawings. The drawings forming a part of this specification are magnetic compass and vial drawings. No deviation from dimensions, tolerances, materials, or processes coded as quality assurance provisions (QAPs), no deviation from specified materials, and no deviation from drawings defining vials to contain radioactive material are permissible without prior approval of the contracting officer. Any data (e.g. shop drawings, layouts, flow sheets, processing procedures, etc.) prepared by the contractor or obtained from a vendor to support fabrication and manufacture of the production item shall be made available, upon request, for inspection by the contracting officer or his designated representative.

3.2 First article. Unless otherwise specified (see 6.2), the first article shall be subjected to inspection (see 4.4 and 6.3). Any changes or deviations of compasses from the approved first article during production will be subject to the approval of the contracting officer. Approval of the first article shall not relieve the contractor of his obligation to furnish compasses conforming to this specification.

3.2.1 Pilot model. The approved first article shall be a pilot model. Any changes or deviations from the pilot model during production shall be subject to the approval of the contracting officer. Approval of the first article as a pilot model will not relieve the contractor of his obligation to furnish compasses that conform to all requirements of this specification.

3.2.2 Nuclear Regulatory Commission license. The contractor shall obtain a specific license from the Nuclear Regulatory Commission to manufacture and distribute tritium excited luminous sources in the form prescribed on the drawings and Title 10 (Nuclear Regulatory Commission) of the Code of Federal Regulations. The first article shall not be submitted for test until the contractor possesses this license. The license shall be made available for review by the contracting officer or the contracting officer's representative.

3.3 Material. Material shall be as specified herein and as shown on the applicable drawings. Materials not specified shall be selected by the contractor and shall be subject to all provisions of this specification.

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3.3.1 Material deterioration prevention and control. The item(s) shall be fabricated from compatible materials, inherently corrosion resistant or treated to provide protection against the various forms of corrosion and deterioration that may be encountered in any of the applicable operation and storage environments to which the item may be exposed.

3.3.2 Dissimilar metals. Dissimilar metals shall not be used in intimate contact with each other unless protected against galvanic corrosion. Dissimilar metals and methods of protection are defined and detailed in MIL-STD-889.

3.3.3 Identification of materials and finishes. The contractor shall identify the specific material, material finish or treatment for use with component and subcomponent, and shall make information available upon request to the contracting officer or designated representative.

3.3.4 Luminous material. Luminous material shall consist of a phosphor and a phosphor exciter encapsulated in vials. The isotope hydrogen-3 (tritium) in the gaseous form shall be the phosphor exciter. The tritium gas shall be obtained from the Oak Ridge National Laboratory, Oak Ridge, Tennessee. The vials shall contain not more than one percent of tritium oxide and not more than six percent total impurities. (see 6.2.2)

3.3.4.1 Verification of luminous materials. When specified (see 6.2), the contractor shall provide 2 sets (see 6.6) of 7 vials for destructive evaluation of the vial and vial contents (see 6.7).

3.4 Neck lanyard. The contractor shall furnish a nylon endless circular neck lanyard with each compass. The lanyard shall be 60 inches ± 2 inches in circumference and made of 3/32 inch diameter nylon cord. The lanyard shall be pigmented to approximate the color "green 383" cited in MIL-T-704.

3.5 Carrying case. A carrying case conforming to MIL-C-43745 shall be furnished with each compass. Markings on inside of flap may be omitted.

3.5.1 Instruction card. An instruction card with white lettering on a dark green field shall be moisture-sealed by laminating in clear plastic, 2-1/2 inches x 4 inches nominal size, in accordance with L-P-387, type GCP-F. An instruction card shall be inserted into each compass carrying case for user application. Additional instruction cards shall be provided as specified (see 6.2). Data printed legibly on cards shall be as follows:

INSTRUCTIONS:

- (1) Rotate bezel ring until luminous line is lined up with luminous lines on cover.
- (2) Turn ring counterclockwise to number of clicks required. Determine clicks by dividing azimuth desired by 3. Example: 51 degrees = 17 clicks counterclockwise.

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(3) Turn compass until north arrow is directly under luminous line.

(4) Proceed forward in direction of front cover luminous sight lines.

3.6 Magnetic performance. The compass shall operate in a magnetic field with a horizontal component equal to the local standard ± 0.01 oersted and vertical component of the local standard ± 0.03 oersted (Continental United States). The local standards shall be established by U.S. Geological Survey (Department of the Interior) Epoch 1980 Map No. I1283, Magnetic Declination of the U.S.; Epoch 1980 Map No. I1370, Magnetic Total Intensity of the U.S.; Epoch 1975 Map No. I914, Magnetic Vertical Intensity of the U.S.; and Epoch 1975 Map No. I913, Magnetic Horizontal Intensity of the U.S., and shall be used during dial assembly balancing (see 3.7.6).

3.7 Mechanical performance. These tests shall be performed with the compass in the operational position, and away from all magnetically attracting metals external to the compass.

3.7.1 Shock. The compass, shall not be damaged when dropped twice, once face up and once on its side from a height of 3 feet onto a sand-covered solid surface (see 4.6.3.3.1).

3.7.2 Damping. The magnetic assembly shall come to rest within 6 seconds of time after being deflected 540 mils ± 20 mils from the equilibrium position (see 4.6.3.3.2).

3.7.3 Freedom of rotation when tilted. The dial and magnet assembly shall remain free when the compass is tilted 8 degrees ± 0.1 degree from the horizontal and rotated 360 degrees in a plane normal to the longitudinal axis of the pivot, when tested as specified in 4.6.3.3.3.

3.7.4 Compass error and magnetic performance. The error in magnetic azimuth, including that caused by pivot friction, shall be not more than 40 mils (see 4.6.3.3.4).

3.7.5 Friction error. The error caused by friction between the pivot and jewel shall be not more than 20 mils (see 4.6.3.3.5).

3.7.6 Dial assembly balance. The dial assembly shall be balanced after the needle is magnetized, and self-luminous sources installed (see 4.6.3.3.3).

3.7.7 Low and high temperatures. Complete compasses shall show no evidence of damage, and when the compass is opened at the low and high temperatures, the dial shall seek north and rotate smoothly and freely (see 4.6.3.3.6).

3.7.8 Water leakage. The complete compass shall be capable of being submerged into water without any evidence of leakage into the bowl assembly (see 4.6.3.3.8.2).

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3.7.9 Impact. When tested as specified in 4.6.3.3.9, the vials shall show no evidence of leakage, breaking, checking, shattering or spalling.

3.8 Luminosity working standards.

3.8.1 Photometer standards. When specified (see 6.2), the contractor shall furnish to the Government, 16 luminous source standards for photometer standardization. The standards shall be manufactured by the vial tube manufacturer. The standards shall be flat glass tubes, 0.6 to 1.0 inch square by a maximum of 0.2 inch thick. One of the square surfaces of each tube shall be painted white, and upon drying, the white paint shall be covered with black paint. The outer surface of the other side of each tube shall be a natural clear surface. The tube shall contain the same self-luminous material as required on applicable drawings and as specified in 3.3.4. The tubes shall emit a dominant wave length of 530 nanometers (nm) ± 30 nm. The luminosity of each tube shall not vary by more than 5 percent across the clear flat surface and the luminosity intensities shall be as follows:

- a. Eight tubes - 80 microlamberts ± 12 microlamberts
- b. Eight tubes - 120 microlamberts ± 18 microlamberts

These standards shall be used for photometer standardization and shall be recertified at intervals not to exceed six months. The total activity of the radioactive inventory shall be furnished to the Commander, U.S. Army Belvoir Research, Development and Engineering Center, ATTN: STRBE-VR, Fort Belvoir, VA 22060-5606.

3.8.2 Compass standards. When specified (see 6.2), the contractor shall furnish Belvoir RD&E Center, two completely assembled compasses of known luminosity and activity, at the beginning of a contract and each six months thereafter. (If the interval between the last time the assembled compasses were submitted and the end of the contract is less than four months, the compasses may not be furnished.) Each assembled compass shall contain seven vials; four according to drawing 13219E0783, two according to drawing 13219E0785, and one according to drawing 13219E0784. Each vial shall age 30 days prior to being assembled into the compass. The luminosity of each of the compass vials will be measured at Belvoir RD&E Center, and returned to the contractor with the associated readings. These two compasses shall be used as standards during testing in 4.6.3.3.7. In the event there is a discrepancy in values, the Belvoir RD&E Center values shall be used.

3.9 Luminous vials.

3.9.1 Thermal shock. The luminous vials shall show no signs of degradation when tested in accordance with 4.6.3.1.1.

3.9.2 Brightness.

3.9.2.1 Vials. The brightness of the various luminous vials shall be as specified on the applicable drawings.

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3.9.2.2 Assembled compasses. The brightness of the various luminous vials installed in the completed compasses shall meet the following minimum requirements when tested as specified in 4.6.3.1.2: front and rear sights, 75 microlamberts; north arrow, 75 microlamberts; east and west, 50 microlamberts; bezel, 75 microlamberts; bowl, 100 microlamberts. See 4.6.3.3.10.

3.10 Diffusion.

3.10.1 Vials, supplier. When a vial is submerged in a measured amount of distilled or deionized water for 24 hours at 23 ± 5 °C, the tritium allowed to diffuse into water shall not exceed 0.025 microcuries /day, when tested as specified in 4.6.3.1.4.

3.10.2 Vials, installer. When a vial is submerged in a measured amount of distilled or deionized water for 24 hours at 23 ± 5 °C, the tritium allowed to diffuse into the water shall not exceed 0.014 microcuries/day, when tested as specified in 4.6.3.2.2.

3.11 Compass radiological.

3.11.1 Contamination. When the completed compass is wiped as specified in 4.6.3.3.8.1, the disintegration rate per minute (dpm) shall be less than 900 dpm for the compass at the time of production.

3.11.2 Diffusion. The completed compass with all the luminous vials installed shall be submerged in 300 ml of distilled or deionized water for 24 hours at 23 ± 5 °C. The tritium allowed to diffuse into the water shall not exceed 0.05 microcuries/day, when tested as specified in 4.6.3.3.8.2.

3.12 Markings.

3.12.1 Lot identification. Lot identification shall be rubber stamped with permanent type ink inside the cover of the compasses. The marking shall include year, month of manufacture and lot number, e.g. 86-2-002.

3.12.2 Radiation marking.

3.12.2.1 Specific license marking. The bottom of the compass shall be molded or metal stamped as required by applicable Nuclear Regulatory Commission Byproduct Materials License. It shall include the radiation caution symbol (not in color), quantity of isotope, the byproduct-materials license number, and appropriate control instructions of the using service (see 6.4). A warning against disassembly of the compass shall also be included.

3.12.2.2 Marking of a license exempt item. The bottom of the compass shall be molded or metal-stamped to include the Nuclear Regulatory Commission manufacturer's identification number, XXXmCi 3H (where XXX shall be replaced by the actual nominal activity), and "CONTROLLED DISPOSAL REQUIRED" (see 6.5). The cover of the compass shall be molded or metal-stamped to include the designated NSN (605-01-196-6971) for a license exempt item.

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3.13 Government-loaned property. When specified (see 6.2), the Government will loan the contractor 8 of 80 microlambert and 8 of 120 microlambert source standards as specified in 3.8.1a and 3.8.1b (total of 16 tubes) for periods not to exceed six months. Also when specified (see 6.2), the Government will loan the contractor two compass standards as specified in 3.8.2 for periods not to exceed six months.

3.14 Workmanship. All parts, components, and assemblies of the compass including castings, molded parts, stampings, bearings, and machined surfaces shall be clean and free from dirt, oil, fins, pits, sprues, scale, flux, and other harmful extraneous material. All edges shall be rounded and beveled.

3.14.1 Threaded connections. All holes shall be drilled, or drilled and tapped, and all burrs and chips shall be removed. Screws shall be tight to properly seat components.

3.14.2 Bends. Bending of any metal parts as a result of manufacturing processes shall not result in fracturing or fissuring of the material.

3.14.3 Assembled vials. All luminous vials, after final assembly of the compass shall be free from extraneous paint, adhesive, or other foreign materials which reduce the luminosity.

3.15 Safety data sheet. Material safety data sheets shall be prepared in accordance with FED-STD-313 (see 6.2.1)

4. QUALITY ASSURANCE PROVISIONS

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

4.1.1 Responsibility for compliance. All items must meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of assuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling in quality conformance (4.5) does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to acceptance of defective material.

4.2 Classification of inspections. Inspections shall be classified as follows:

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- a. In-process vial inspection (see 4.3).
- b. First article inspection (see 4.4).
- c. Quality conformance inspection (see 4.5).
- d. Inspection of packaging (see 4.8).

4.3 In-process vial inspection.**4.3.1 Vial supplier's inspection.**

4.3.1.1 **Examination.** All luminous vials shall be examined and tested as specified in 4.6.1.1. Any vial failing to pass examination shall be considered defective.

4.3.1.2 Tests.

4.3.1.2.1 **Individual.** All completed luminous vials shall be subjected to the tests specified in 4.6.3.1.1 and 4.6.3.1.3. These tests shall be conducted prior to performing examination 4.6.1.1.

4.3.1.2.2 **Sample tests.** A sample of luminous vials selected in accordance with 4.5.1, shall be tested as specified in 4.6.3.1.4. The sample shall consist of 125 standard samples as defined in 6.6.

4.3.2 Vial installer's inspection.

4.3.2.1 **Examination.** All luminous vials shall be examined as specified in 4.6.1.2. Any vial failing to pass any examination shall be considered defective.

4.3.2.2 Tests.

4.3.2.2.1 **Vials.** All luminous vials shall be tested as specified in 4.6.3.2. Nonconformance to these tests shall constitute failure of that vial only.

4.4 First article inspection. (First article compasses shall consist of 10 completely assembled units as described in 6.3.)

4.4.1 **Compass brightness.** After the compasses have been dark adapted for 1 hour, the brightness of each vial in each completely assembled first article compass shall be determined as specified in 4.6.3.3.7. Failure to meet the brightness limits as specified in 3.9.2.2 shall constitute failure of this test and shall be cause for rejection of the first article compasses.

4.4.2 **Examination.** The first article compasses shall be examined as specified in 4.6.1.3. Presence of one or more defects shall be cause for rejection of the first article compasses.

4.4.3 **Tests.** The first article compasses shall be tested as specified in table I, groups A and B. Failure of any test shall be cause for performing the inspection specified in 4.4.4.

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TABLE I. Test schedule.

	Test Paragraph	Requirement Paragraph
GROUP A		
Shock.	4.6.3.3.1	3.7.1
High and low temperature.	4.6.3.3.6	3.7.7
Damping.	4.6.3.3.2	3.7.2
Freedom of rotation when tilted		
/Dial assembly balance.	4.6.3.3.3	3.7.3, 3.7.6
Compass error and magnetic performance.	4.6.3.3.4	3.7.4
Friction error.	4.6.3.3.5	3.7.5
Impact.*	4.6.3.3.9	3.7.9
GROUP B		
Luminosity.	4.6.3.3.7	3.9.2.2
Contamination.**	4.6.3.3.8.1	3.11.1
Diffusion and water leakage.	4.6.3.3.8.2	3.7.8, 3.11.2
Final luminosity.	4.6.3.3.10	3.9.2.2

* To be performed during first article testing only.

** To be performed prior to group A testing for both first article and production compasses.

NOTE: No reduced inspection allowed on contamination, or diffusion and water leakage tests.

4.4.4 Disassembly inspection. Failure of any test by the first article models shall be cause for disassembly, in the presence of a Government representative, of the first article models to the extent necessary to determine the cause of the failure. Each disassembled part shall be examined in detail for compliance with this specification and referenced drawings in regard to materials, dimensions, tolerances, and workmanship. Parts not complying with such requirements shall be cause for rejection of all the first article compasses.

4.5 Quality conformance inspection.

4.5.1 Sampling. Sampling for examination and tests shall be in accordance with MIL-STD-105, general inspection level II, lot size 3200, code letter K (sample size 125), AQL 2.5% defective, single sampling plan. Selection of the 125 samples shall be made using a random number generator/source.

4.5.2 Examination.

4.5.2.1 Individual examination. Each production compass product shall be

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compared to an approved first article model by examination in a darkroom for uniformity of light, proper source alinement, and adhesive bonding, after the compasses have been dark adapted for a period of not less than 1 hour. The absence of light uniformity as compared to an approved first article model, or improper source alinement or bonding shall constitute failure of that compass only. In cases of question, the luminosity of the vial shall be determined as specified in 4.6.3.3.7. Failure of one or more vials to meet the brightness limits as specified in 3.9.2.2 shall constitute failure of that compass only.

4.5.2.2 Samples. Samples selected in accordance with 4.5.1 shall be examined as specified in 4.6.1.3.

4.5.3 Tests.

4.5.3.1 Samples. Samples selected in accordance with 4.5.1 shall be tested as specified in table I, groups A and B (4.4.3). Any sample failing to pass any test shall be considered defective. At the option of the contracting officer, group B tests may be conducted by the Government at a Government installation (see 6.2).

4.6 Inspection procedure.**4.6.1 Examination.**

4.6.1.1 Vial supplier's examination. All vials shall be examined at the place of manufacture after the thermal shock and brightness tests have been performed, for the following defects:

- 101. Luminous vial material not as specified.
- 102. Complete interior surface of vial not coated as specified.
- 103. Luminous vial dimensions not as specified.
- 104. Nuclear Regulatory Commission license missing.

4.6.1.2 Vial installer's examination. After installation of luminous vials to component parts, the vials shall be examined by the installer, for the following defects:

- 105. Adhesive for bonding luminous vials not as specified.
- 106. Installed luminous vials not located or bonded properly on the component part.

4.6.1.3 Compass examination. The completed compass shall be examined after performing the tests in 4.6.2 for the following defects:

- 107. Index line on the capsule cover not fixed; and when compass is sighted on a known magnetic azimuth, the compass does not read within 40 mils of known azimuth. This may be accomplished during compass error test, 4.6.3.3.4.
- 108. The bezel crystal does not remain in a fixed position relative to the

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- bezel ring.
109. Compass cover, thumb loop, and lens bracket do not remain in desired position, or lens bracket does not move independently with thumb loop held.
 110. Detent spring does not permit distinct individual detent action, or bezel is not secure against accidental rotation.
 111. Retaining ring does not permit required rotation or does not secure bezel assembly to the case.
 112. Lifting mechanism does not operate uniformly, contacts pivot, or does not hold dial assembly against capsule cover when compass is closed, or does not release dial assembly when lens bracket is opened 35 degrees or more from the bezel crystal.
 113. Materials not as specified.
 114. Identification or special markings incorrect, illegible, or missing.
 115. Treatment and painting not as specified.
 116. Dimensions not as specified, or assembly incorrect.
 117. Dial assembly not balanced.
 118. Workmanship not as specified.
 119. Tritium excited sources not installed in true position and bonded correctly.
 120. Sightwire not tight, in place, or more than 0.005 inches above surface of the cover.
 121. Light sources not uniform in intensity when visually examined.
 122. When compass is fully open, gap between case and cover on scale side is not between 0.004 and 0.015 inches wide.
 123. Bottom surfaces of the case and cover not within 0.015 inches of the same plane.
 124. The edge of the scale on the case and cover not within 0.030 inches of the same plane.
 125. Instruction card not as specified.
 126. Materials are not resistant to corrosion or deterioration, or treated to be made resistant to corrosion or deterioration for the applicable storage and operating environment as specified.
 127. Dissimilar metals of MIL-STD-889 are not effectively insulated from each other as specified.
 128. Contractor does not have documentation available for identification of material, material finishes, or treatments.
 129. Material Safety Data Sheet not prepared in accordance with FED-STD-313.

4.6.2 **Tests.** The compass shall be tested as specified herein; table 1, groups A and B (4.4.3) shall be performed in the sequences specified, unless otherwise specified.

4.6.3 **Test procedure.**

4.6.3.1 **In-process test procedure at vial supplier.**

4.6.3.1.1 **Thermal shock.** All luminous vials shall be subjected to two continuous cycles of thermal shock. Begin the cycle by immediately placing the

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vials in a temperature of -52 ± 2 °C for 15 minutes. Immediately remove the vials from the cold environment to a temperature of 68 ± 3 °C for another 15 minutes. This completes one cycle. After the final cycle the vials shall be returned to room temperature. The vials shall be tested as specified in 4.6.3.1.3.

4.6.3.1.2 **Brightness.** All brightness tests shall be determined by the photoelectric photometry method which is corrected for photopic vision (1931 CIE color matching function). The contractor's photometer shall be standardized using the luminous working standards (see 3.8) that were standardized within the previous six months.

4.6.3.1.3 **Brightness, vials.** After each luminous vial has been dark adapted for not less than 1 hour, it shall be examined for brightness. Each vial shall be visually compared with acceptable standard vials of known luminosity (see 3.8.1) for proper brightness. Vials with questionable luminosity shall be discarded. Failure to meet the brightness limits as specified in 3.9.2.1 shall constitute failure of the vial only.

4.6.3.1.4 **Vial supplier's diffusion test.** The vial supplier shall perform a diffusion test on all sample units. The lot sample of vials shall be submerged in a covered container in a measured amount of distilled or deionized water for 24 hours at 23 ± 5 °C. The water shall be analyzed for its radioactive content according to 4.6.3.1.5. A lot sample having a radioactive content exceeding 0.025 microcuries/day shall be cause to divide the lot sample into groups of 10 and retested. Any group that exceeds 0.025 microcuries/day shall be divided into single vials and retested. Any single vial exceeding 0.025 microcuries/day shall be rejected and require a test of another complete sample.

4.6.3.1.5 **Diffusion test - accuracy and procedures.** The analysis of tritium content in the diffusion test shall be made with a scintillation counter. The system calibration shall be established using quenched standards. Total system plus standards errors in the standardization shall not be in excess of 10 percent. Efficiencies of the unknown samples shall be established by the channels-ratio method, the external channels-ratio method, or the "H" number method of quench compensation. Counting time shall be established as such that at the test limits, the error (1 standard deviation) shall not be greater than 15 percent. The scintillation solution shall consist of a liquid scintillation grade of toluene with 8 grams/liter toluene of butyl PBD, 0.5 percent grams/liter PBBO, and 10 percent Beckman biosolve solubilizer BBS3 or any commercial acceptable liquid scintillation cocktail. The counting bottles shall be a low potassium liquid scintillation borosilicate glass bottle or polyethylene liquid scintillation vial. When polyethylene scintillation vials are used, a set of quench standards traceable to the National Bureau of Standards shall be made up in the polyethylene vials to determine efficiency. If the quench standards are in glass bottles, a correction factor shall be determined so that the correct results will be obtained from samples in polyethylene scintillation vials.

4.6.3.2 **In-process test procedures at vial installer.**

4.6.3.2.1 **Vials, darkroom.** After the luminous vials have been dark adapted for

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not less than 1 hour, they shall be inspected for dead or dim vials which are to be discarded. In cases of question, the luminosity of the vial shall be determined as specified in 4.6.3.1.2. A nonconforming vial shall constitute failure of that vial only.

4.6.3.2.2 Vial installer's diffusion test. The vial installer shall perform a diffusion test prior to installing vials into the component parts of the compass. This test shall be performed on 100 percent of the vials. A group of 100 vials shall be submerged in a covered container in a measured amount of distilled or deionized water for 24 hours at 23 ± 5 °C. The water shall be analyzed for its radioactive content according to 4.6.3.1.5. A group of 100 vials having a radioactive content exceeding 0.04 microcuries/day shall require the group to be divided into smaller groups of 10 and retested. Any group of 10 that exceeds 0.04 microcuries/day shall be divided into single vials and retested. Any single vial exceeding 0.04 microcuries/day shall be rejected.

4.6.3.3 Test procedure for completed compass. (see 4.5.3.1).

4.6.3.3.1 Shock. The compass in the open position shall be dropped twice from a height of 3 feet onto a solid surface, covered with 4 inches of 40 grit kiln-dried sand. The sand may be covered with a sheet of plastic not greater than 2 mils thick. The compass shall hit the sand or plastic face up on one drop and edgewise on the second. Any evidence of damage to the compass or failure to operate as specified herein shall constitute failure of this test.

4.6.3.3.2 Damping. The compass magnet shall be deflected 540 mils ± 20 mils from the equilibrium position and released. Time required to come to rest in excess of 6 seconds shall constitute failure of this test.

4.6.3.3.3 Freedom of rotation when tilted. The compass shall be tilted 8 degrees ± 0.1 degree from the horizontal and uniformly rotated 360 degrees at approximately 10 seconds of time per revolution in a plane normal to the longitudinal axis of the pivot. The compass shall be rotated 1 complete revolution in the clockwise direction and 1 revolution in the counterclockwise direction. The lens bracket end of the compass shall be in the using position during this test. Inability of the dial or magnetic assembly to remain free while being rotated shall constitute failure of this test.

4.6.3.3.4 Compass error and magnetic performance. The compass shall be placed in a horizontal position on a fixed point, and by means of the sighting slot and wire, the compass shall be sighted on three targets of known magnetic azimuths approximately 120 degrees apart. Without tapping the compass, the dial shall be read under the index line on the capsule crystal, using the magnifier. The difference between the known azimuths and readings taken is the compass error. An error in excess of 40 mils or failure of the compass to function correctly shall constitute failure of this test.

4.6.3.3.5 Friction error. The compass dial assembly shall be magnetically deflected 40 mils ± 5 mils by an external force acting in the horizontal plane of the compass card. The needle shall be permitted to come to rest. The external

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force shall then be removed in a radial direction in the same horizontal plane. The compass dial shall then be read. The procedure shall be repeated by deflecting the magnet 40 mils ± 5 mils in the opposite direction. One-half difference between the two readings is the friction error. An error in excess of 20 mils shall constitute failure of this test.

4.6.3.3.6 Low and high temperature. The completed compass shall be subjected to one complete cycle each of both low and high temperature operation. The compass in its closed position shall be subjected to a temperature of -44 ± 2 °C for a period of 30 minutes without the benefit of solar radiation. After this period and at this temperature the compass shall be opened and examined. The compass shall then be closed, and after stabilizing at room temperature, shall be subjected to a temperature of 68 ± 3 °C for a period of 30 minutes. After this period and at this temperature the compass shall be opened and examined. After examination at both low and high temperature tests, any evidence of damage or failure of the compass dial to seek north and rotate smoothly and freely, shall constitute failure of this test.

4.6.3.3.7 Luminosity. After the compass has been dark adapted for not less than 1 hour, it shall be examined visually for dead or dim vials. The compass shall be visually compared to an acceptable standard compass of known luminosity (see 3.8.2). If the compass has any dead or dim vials it shall be considered a failure. In cases of question, the luminosity of the vials shall be determined as specified in 4.6.3.1.2. A compass containing any vials not conforming to 3.9.2.2 shall constitute failure of this test.

4.6.3.3.8 Radiological.

4.6.3.3.8.1 Contamination. A piece of Whatman-50 filter paper, or equivalent, moistened with deionized or distilled water shall be used to wipe the compass. All exterior surfaces of the opened completed compass (unit's usable position) shall be thoroughly wiped with the filter paper. The amount of tritium contamination on the filter paper shall be determined by using a liquid scintillation counting technique. The paper shall be placed in the liquid scintillation solution within one minute after wiping the compass. The liquid scintillation counting system shall have sufficient sensitivity to measure 100 picocuries or less of tritium. This test shall be performed by the contractor prior to the performance of the table 1, group A tests. The contractor shall furnish filter paper, solution, and bottles. The scintillation solution shall be as specified in 4.6.3.1.5. The bottles shall be as specified in 4.6.3.1.5. The test solution in the bottle with the used filter paper inside shall be identified with the sample compass it represents by the use of a waterproof marking system on the bottle. The five compasses and their corresponding contamination wipes shall be forwarded to Belvoir RD&E Center, ATTN: STRBE-VR, for liquid scintillation counting. Disintegration rate of more than 900 dpm per compass shall constitute failure of this test.

4.6.3.3.8.2 Diffusion and water leakage. The completed compass with all the luminous sources installed shall be submerged in 300ml of distilled or deionized water for 24 hours at 23 ± 5 °C. The compass shall be removed from the water.

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The water shall be analyzed in accordance with 4.6.3.1.5. This is the test procedure for tritium diffusion, and if the radioactive content of the water exceeds 0.1 microcuries/day, it shall constitute failure of the test. The compass also shall be examined for water leakage, and if there is water in the compass bowl at the completion of the test, it shall constitute failure of the water leakage test. Failure of the compass of either of these tests shall be cause for refusal by the Government to continue acceptance of the production compasses until evidence has been provided by the contractor that corrective action has been taken to eliminate the deficiencies.

4.6.3.3.9 **Impact.** Unless otherwise specified (see 6.2), the first article compasses only shall be subjected to the performance testing procedures of Chapter 7 of National Bureau of Standards Handbook 116, Test Level 2. Nonconformance to 3.7.9 shall constitute failure of this test. Damage to the compass, other than the vial, does not constitute failure of this test.

4.6.3.3.10 **Final luminosity.** At the completion of the Government verification testing of the five compasses from each lot (4.6.3.3.11), a luminosity measurement of all the compass self-luminous sources shall be performed at the Belvoir RD&E Center in accordance with 4.6.3.1.2. A compass containing any vials not conforming to 3.9.2.2 shall constitute failure of this test. The results of these measurements shall be identified by compass and become the property of Belvoir RD&E Center.

4.6.3.3.11 **Government verification testing.** The contracting officer shall require the contractor to furnish completed compasses to Belvoir RD&E Center for Government verification testing as follows:

- a. Twenty compasses shall be randomly selected using a random number generator/source, from the first 200 production compasses of a lot. These 20 compasses will be tested by the Government in accordance with this specification. Failure of any of the 20 shall be cause for rejecting the 200 production compasses and refusal by the Government to continue acceptance of production compasses until evidence has been provided by the contractor that corrective action has been taken to eliminate the deficiencies. Within 12 working days after testing has been completed, 15 of the compasses will be returned to the contractor along with results. The other 5 will be retained by the Government for comparative purposes and to establish an historical audit trail.
- b. Five compasses shall be randomly selected using a random number generator/source, from each production lot of 3,200 compasses for contamination, diffusion, leakage, and luminosity testing by the Government in accordance with this specification (4.6.3.3.8.1). These 5 compasses shall not have been previously selected in any sample, but shall be chosen from the remaining compasses of the lot. There shall be no substituting. The contractor shall perform a contamination wipe test on the 5 compasses. These compasses shall not be washed or cleaned in any way following the test. The compasses and wipes shall be forwarded to Belvoir RD&E Center. Upon completion of the stated

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tests, the Government will notify the contractor of the results within 7 working days. Failure of any of the 5 compasses shall be cause for refusal by the Government to continue acceptance of the production compasses until evidence has been provided by the contractor that corrective action has been taken to eliminate the deficiencies.

4.7 Inspection comparison. The government may select compasses at any time during the contract production period and subject these compasses to the examination specified in 4.6.1.3 and the test specified in table I, groups A and B (4.4.3), to determine conformance to the requirements of this specification. The inspection will be performed by the Government, at a site selected by the Government, on units selected at random from those which have been accepted by the Government and will not include the previously inspected first article model compasses. In addition to any test specified as part of the inspection comparison, the Government reserves the right to conduct any and all other tests contained in this specification as part of the inspection comparison, and failure of such additional tests shall have the same effect as failure of these tests specified as inspection comparison.

4.8 Inspection of packaging

4.8.1 First article pack inspection. The first article pack shall be examined for the defects specified in 4.8.2.3. Presence of one or more defects shall be cause for rejection of the first article pack. Any deficiencies shall be corrected and the pack re-examined for conformance to this specification.

4.8.2 Quality conformance inspection of packaging.

4.8.2.1 Unit of product. For the purpose of inspection, a completed pack prepared for shipment shall be considered a unit of product.

4.8.2.2 Sampling. Sampling for examination shall be in accordance with MIL-STD-105.

4.8.2.3 Examination. Samples selected in accordance with 4.8.2.2 shall be examined for the following defects. AQL shall be 1.0 percent defective.

- 130. Preservation not as specified (see 5.2).
- 131. Assembled compasses not intermediate packed as specified (see 5.3).
- 132. Assembled compasses not packed as specified for level A, B and C. (see 5.4.2, 5.4.3, and 5.4.4).
- 133. Marking not as specified (see 5.5).
- 134. Special marking not as specified (see 5.5).

5. PACKAGING

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5.1 First article pack. The contractor shall furnish a first article pack for examination within the time frame specified (see 6.2), to prove prior to starting production packaging, that the applied packing and marking comply with requirements of this specification. Examination shall be as specified in Section 4 and shall be subject to surveillance and approval by the Government (see 6.4). The first article pack may be accomplished by utilizing either a first article compass or production compass. When the first article compass is utilized, and the Government requests a comparison between the first article compass and the production compass, any packing shall be removed by the contractor at no expense to the Government.

5.2 Preservation. Each assembled compass, complete with neck lanyard and instruction card, shall be enclosed inside the carrying case, and the carrying case flap closed and snapped.

5.3 Intermediate packing. Each assembled compass, preserved as specified in 5.2, shall be intermediate packed in quantities of 20 in a fiberboard box conforming to PPP-B-636, type CF, class weather resistant, variety SW, style optional, grade W5C. The box shall be closed and waterproofed.

5.4 Packing. The packing for the assembled compass shall be level A, B, or C as specified (see 6.2). Packing of vials only shall be as specified in 5.4.1.

5.4.1 Vials. Vials to be shipped for testing only to the Belvoir RD&E Center, shall be packed in the quantity specified (see 6.2) in accordance with applicable Nuclear Regulatory Commission Regulations.

5.4.2 Level A. Five intermediate packs (see 5.3) (quantity of 100 compasses) shall be packed in close fitting boxes conforming to PPP-B-601, overseas type, style optional. Strapping in accordance with the box specification shall be class 1, finish B. Any cushioning, anchoring or blocking and bracing shall be in accordance with MIL-STD-1186.

5.4.3 Level B. Five intermediate packs (see 5.3) (quantity of 100 compasses) shall be packed in close fitting boxes conforming to PPP-B-636, type CF, class weather resistant, variety SW, style optional, grade V3C. Strapping shall be in accordance with box specification except that round wire strapping shall not be used. Any cushioning, anchoring or blocking and bracing shall be in accordance with MIL-STD-1186.

5.4.4 Level C. Five intermediate packs (see 5.3) (quantity of 100 compasses) shall be packed in snug fitting boxes conforming to PPP-B-636, type CF, class domestic, variety SW, style optional, grade 275. Enclosure of boxes shall be in accordance with box specification. The items shall be cushioned or blocked so that there is no movement inside the box.

5.5 Marking. Intermediate packs and shipping boxes shall be marked in accordance with MIL-STD-129. All intermediate packs shall have appropriate radioactive labels on them. In addition to the marking requirements of MIL-STD-129, the following special marking shall be included on each intermediate

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pack and shipping box:

"Storage of compasses in any one location, such as one warehouse section, shall be limited to 20,000 compasses."

6. NOTES

6.1 **Intended use.** The compasses, with radioactive vials to facilitate use during periods of darkness, are for obtaining magnetic azimuths for ground navigation, reconnaissance, and fire control purposes.

6.2 **Ordering data.** Procurement documents should specify the following:

- a. Title, number, and date of this specification.
- b. When first article tests are not required (see 3.2.1).
- c. When 2 sets of 7 compass vials of luminous material are required, see 3.3.4.1 and 6.7).
- d. When 16 photometer standards are required (see 3.8.1 and 6.7).
- e. When 2 compasses are required as standards (see 3.8.2).
- f. Government loaned property (see 3.13 and 6.7).
- g. When the Government will conduct any or all of the first article model examinations and tests. When the Government will conduct some but not all of the first article examination and test, the contracting officer should specify which examination and tests will be conducted by the Government and which examination and tests shall be conducted by the contractor (see 3.2).
- h. When the Government will conduct group B testing (see 4.5.3.1).
- i. When contamination test counting will be performed at Fort Belvoir, (see 4.6.3.3.8.1).
- j. Number of additional instruction cards required (see 3.5.1).
- k. Whether marking of compasses are to be for specific licenses or for general licenses (see 3.12.2.1 and 3.12.2.2).
- l. When the impact test is not required (see 4.6.3.3.9).
- m. Addresses for submittal of Material Safety Data Sheets (see 6.2.1).
- n. Time frame for submission of first article pack (see 5.1).
- o. Level of packing required (see 5.4).
- p. Quantity of vials required (see 5.4.1).
- q. When chemical agent resistant coating (CARC) is specified.

6.2.1 **Material safety data sheet.** Since the specification describes a product which contains a hazardous (radioactive) material, a Material Safety Data Sheet shall be prepared in accordance with FED-STD-313. One copy shall be submitted to the Contracting Officer, address as specified (6.2). In addition, a copy shall be provided to the Military Service or Federal department/agency address in 20.5 of FED-STD-313, of the same service or agency that purchased the item.

6.2.2 **Disposal of radioactive waste.** Dispose of radioactive waste material in accordance with AR700-64, Radioactive Commodities in the DoD Supply System.

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6.3 First article. When a first article inspection (4.4) is required, the items shall be preproduction models. The first article shall consist of 10 units. The contracting officer should include specific instructions in acquisition documents regarding arrangements for examination, tests, and approval of the first article test results and disposition of the first article.

6.4 First article pack. Any changes or deviations of production packaging from the approved first article packaging will be subject to the approval of the contracting officer. Approval of the first article pack will not relieve the contractor of his obligation to pack and mark the compasses in accordance with his specification (see 3.12.2.1).

6.5 Marking of a license exempt item. The contracting officer should take the necessary action to assure proper marking when the contractor is furnishing a license exempt item (see 3.12.2.2).

6.6 Standard sample. A standard sample set consisting of 7 vials is defined as follows:

- a. Four vials conforming to drawing 13219E0783.
- b. Two vials conforming to drawing 13219E0785.
- c. One vial conforming to drawing 13219E0784.

6.7 Set of vials, photometer standards, and Government loaned property. The contracting officer shall require that the sets of vials specified in 3.3.4.1 and photometer standards specified in 3.8.1 be delivered to Commander, U.S. Army Belvoir Research, Development, and Engineering Center, ATTN: STRBE-VR, Fort Belvoir, VA 22060-5606. In addition, the contracting officer shall make provisions for the Belvoir RD&E Center to calibrate the photometer standards provided in accordance with 3.8.1 and loan the photometer standards to the contractor for six month periods (see 3.13).

6.8 Subject term (key word) listing.

Compass, lensatic
 Graduations, 5 degree and 20 mil
 Induction damped
 Magnetic, unmounted
 Military specification
 Self-luminous dial, tritium excited

Custodian:

Army - ME
 Air Force - 99

Preparing activity:

Army - ME

Project 6605-0350

Review activity:

Navy - SH

User activity:

Navy - MC

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions - Reverse Side)

1. DOCUMENT NUMBER MIL-C-10436L		2. DOCUMENT TITLE Compass, Magnetic, Unmounted: Lensatic, Luminous, 5 Degree and 20 Mil Graduations	
3a. NAME OF SUBMITTING ORGANIZATION Carrying Case		4. TYPE OF ORGANIZATION (Mark one) <input type="checkbox"/> VENDOR <input type="checkbox"/> USER <input type="checkbox"/> MANUFACTURER <input type="checkbox"/> OTHER (Specify): _____	
b. ADDRESS (Street, City, State, ZIP Code)			
5. PROBLEM AREAS			
a. Paragraph Number and Wording:			
b. Recommended Wording:			
c. Reason/Rationale for Recommendation:			
6. REMARKS			
7a. NAME OF SUBMITTER (Last, First, MI) - Optional		b. WORK TELEPHONE NUMBER (Include Area Code) - Optional	
c. MAILING ADDRESS (Street, City, State, ZIP Code) - Optional		8. DATE OF SUBMISSION (YYMMDD)	