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INCH-POUND

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(See 6.10)

MILITARY SPECIFICATION

# COMPASSES, SHIP, NAVY, NO.1, MAGNETIC (REFLECTOR TYPE, 7-1/2 INCH CARD) AND BINNACLE, REFLECTOR TYPE

This specification is approved for use by the Naval Sea Systems Command, Department of the Navy, and is available for use by all Departments and Agencies of the Department of Defense.

## 1. SCOPE

1.1 Scope. This specification covers a magnetic compass with a 7-1/2 inch compass card and a binnacle which supports and provides adjustment capability to the compass.

1.2 Classification.

1.2.1 Magnetic compass. The magnetic compass covered by this specification shall be designated Navy No. 1 ship magnetic compass (reflector type 7-1/2 inch card).

1.2.2 Binnacle. Binnacles covered by this specification shall be designated binnacle, reflector type.

## 2. APPLICABLE DOCUMENTS

2.1 Government documents.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Naval Sea Systems Command, SEA 55Z3, Department of the Navy, Washington, DC 20362-5101 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 FSC 6605

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2.1.1. Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications (DODISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATIONS

FEDERAL

| | |
|---|---|
| TT-E-490 | - Enamel, Silicone Alkyd Copolymer, Semigloss (for Exterior and Interior Non-Residential Use) |
| PPP-F-320 | - Fiberboard, Corrugated and Solid, Sheet Stock (Container Grade) and Cut Shapes |

MILITARY

| | |
|---|---|
| MIL-S-901 | - Shock Test, H.I. (High Impact) Shipboard Machinery Equipment, and Systems, Requirements for |
| MIL-P-15024 | - Plates, Tags, and Bands for Identification of Equipment |
| MIL-E-17555 | - Electronic and Electrical Equipment, Accessories, and Provisioned Items (Repair Parts): Packaging of |
| MIL-L-19140 | - Lumber and Plywood, Fire-Retardant Treated |
| MIL-P-24441 | - Paint, Epoxy-Polyamide, General Specification for |
| MIL-P-24441/1 | - Paint, Epoxy-Polyamide, Green Primmer, Formula 150, Type I |
| MIL-P-24441/6 | - Paint, Epoxy-Polyamide, Exterior Topcoat, Dark Gray, Formula 155-Ro = 6, Type I |

STANDARDS

FEDERAL

| | |
|---|---|
| FED-STD-595 | - Colors Used in Government Procurement. |

MILITARY

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|---|---|
| MIL-STD-130 | - Identification Marking of U.S. Military Property |
| MIL-STD-167-1 | - Mechanical Vibrations of Shipboard Equipment (Type I - Environmental) and (Type II - Internally Excited) |
| MIL-STD-270 | - Metallic Materials for Low Magnetic Applications, Magnetic Permeability and Electrical Conductivity, Characteristics of (METRIC) |

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|---|---|
| MIL-STD-454 | - Standard General Requirements for Electronic Equipment |
| MIL-STD-810 | - Environmental Test Methods and Engineering Guidelines |
| MIL-STD-889 | - Dissimilar Metals |
| MIL-STD-1310 | - Shipboard Bonding, Grounding, and Other Techniques for Electromagnetic Compatibility and Safety |

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Navy Publishing and Printing Service Office, Bldg. 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.1.2 Other government documents, drawings, and publications. The following other government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation.

PUBLICATIONS

H.O. Publication No. 226 - Defense Mapping Agency, Hydrographic Office, Handbook of Magnetic Compass Adjustment.

NBS Special Publication 330 - The International System of Units (SI) - National Bureau of Standards.

(Application for copies should be addressed to the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402-0001.)

2.2 Non-government publications. The following documents(s) form a part of this document 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 the documents not listed in the DODISS are the issue of the documents cited in the solicitation (see 6.2).

SOCIETY OF AUTOMOTIVE ENGINEERS

AMS 3151 - Fluid, Aircraft Compass, Aerospace Material Specification

(Applications for copies should be addressed to the Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA, 15096.)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

F 1166 - Standard Practice for Human Engineering Design for Marine Systems, Equipment and Facilities.

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103-1187.)

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(Non-Government standards and other publications are normally available from the organizations that prepare or 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 document and the references cited herein (except for related associated detail specifications, or specifications sheets), the text of this document shall take precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 First article. When specified (see 6.2), a sample shall be subjected to first article inspection (see 6.3) in accordance with 4.3.

3.2 General requirements.

3.2.1 Technology. Equipment manufactured in accordance with this specification may utilize new technology provided form, fit and function are maintained. The equipment manufactured incorporating new technology shall meet or exceed the requirements of this specification. Unless otherwise specified in the contract or purchase order the contractor shall submit a waiver to incorporate the new technology. Units of measure used in this specification are in accordance with NBS Special Publication 330.

3.2.2 Materials and processes. Materials and processes shall be in accordance with this specification. Materials and processes not specified shall be selected by the contractor and shall be subject to all provisions of this specification.

3.2.2.1 Dissimilar metals. Dissimilar metals shall not be used in intimate contact with each other unless protected against galvanic corrosion. The selection and production of dissimilar metal combinations shall be in accordance with MIL-STD-889.

3.2.2.2 Hard magnetic materials. The magnets in the compass and the binnacle shall be of hard magnetic material. Hard magnetic material is defined as having a high remanence (greater than 6000 gauss) and a high coercivity (greater than 400 oersteds).

3.2.2.3 Soft magnetic materials. The soft iron correctors used in the binnacle shall be constructed of soft magnetic material. Soft magnetic material is defined as having low remanence and low coercivity (less than two oersteds), and shall be of the highest commercial pure soft iron of 99.85 percent or greater purity, worked and heat treated to avoid internal mechanical stress, as specified in MIL-STD-270.

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3.2.2.4 Non-Ferrous low permeability materials. Unless otherwise specified, all materials used in the construction of the compass (with the exception of the magnets themselves), shall be of non-ferrous, low permeability (non-magnetic) material. For the purposes of this specification this material is specified as having a magnetic permeability ($\mu$) of less than 1.05 gauss per oersted.

3.2.3 Interchangeability. Interchangeability and design tolerances shall be in accordance with Requirement 7 of MIL-STD-454. In addition to the requirements of MIL-STD-454, all parts having the same manufacturers part number shall be functionally and dimensionally interchangeable. Following any such part replacement, the equipment shall meet the requirements of this specification.

3.2.4 Painting and color. The compass and the binnacle shall be painted except for any surfaces or parts where painting would impair meeting the requirements of this specification. Painting shall consist of four coats of paint in accordance with MIL-P-24441 as follows:

- first coat - Green epoxy-polyamide primer in accordance with MIL-P-24441/1
- second coat - Dark gray epoxy-polyamide top coat in accordance with MIL-P-24441/6
- third and fourth coat - Haze gray silicone alkyd enamel in accordance with TT-E-490, color 26270 in accordance with FED-STD-595

3.2.5 Safety. Safety of the compass and the binnacle shall be in accordance with Requirement 1 of MIL-STD-454.

3.2.6 Shock. The compass and the binnacle shall meet Grade A Deck Mounted Subassembly, Class I, Lightweight Type C criteria shock (see 4.6.5).

3.2.7 Vibration. The compass and the binnacle shall be capable of meeting the requirements of MIL-STD-167-1. The compass card shall deflect no more than 5 degrees from its static equilibrium position (see 4.6.6).

3.2.8 Environmental. The compass and the binnacle shall be capable of meeting the requirements of MIL-STD-810.

3.2.8.1 Temperature. The compass and the binnacle shall be capable of meeting the requirements of MIL-STD-810, with a high temperature value of 160 degrees Farenheit (°F) and a low temperature value of minus 60 °F, (see 4.6.7.1).

3.2.8.2 Humidity. The compass and the binnacle shall be capable of meeting the humidity requirements of MIL-STD-810 (see 4.6.7.2).

3.2.8.3 Salt fog. The compass and the binnacle shall be capable of meeting the salt fog requirements of MIL-STD-810 (see 4.6.7.3).

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3.2.8.4 Solar radiation. The compass and the binnacle shall be capable of meeting the solar radiation requirements of MIL-STD-810 (see 4.6.7.4).

3.3 Compass requirements. The magnetic compass consists of a compass bowl enclosing the compass card with attached directional magnet and float assembly, a pivot system, and a compass fluid to reduce the weight of the compass card assembly on the bowl pivot. The compass bowl contains expansion bellows to compensate for the volume change of the fluid due to temperature fluctuations, and a filler hole with an airtight plug to add fluid if necessary. The compass bowl is attached to a gimbal system to maintain the compass erect under ship motion conditions. The compass bowl provides reference marks (lubber lines) on its bezel, aligned with the heading and athwartships axes of the ship. When the compass card is viewed through either the compass bowl top glass, or through the bottom glass by the reflector assembly of the binnacle, the ships heading lubber line shows the ships heading with respect to magnetic north.

3.3.1 Compass fluid. The compass fluid shall meet the requirements as specified in AMS 3151.

3.3.2 Compass card assembly. The compass card assembly shall consist of the compass card, the magnet and float assembly, and pivot system. The compass card and the magnet assembly shall be centered and aligned so that the zero degree to 180 degrees axis of the compass card is coincidental with the magnetic axis of the magnet and float assembly. The accuracy of the alignment shall be 20 minutes of arc (see 4.6.4.6). All compass card assembly components shall be of a composition that neither affects nor is affected by the compass fluid.

3.3.2.1 Compass card. The compass card shall be a circular disk 7.63 inches (19.38 centimeters) in diameter. The thickness shall be such that the compass card does not warp or distort in any manner while in the compass bowl. It shall be white in color with perforated markings to facilitate bottom and top illumination.

3.3.2.1.1 Compass card graduations. All graduations, numbers and lettering on the compass card shall be perforated to allow the passage of light from the illumination fixtures of the binnacle. The compass card shall have 360 graduations equally spaced around the outer portion of the card face. Each graduation shall be recessed 0.09 inch (0.23 millimeters) from the edge of the card, and 0.06 inch (0.15 cm) in length, 0.015 inch (0.381 mm) width, every fifth graduation shall be 0.12 inch (0.30 cm) in length, and every tenth graduation shall be 0.18 inch (0.46 cm) in length. Each graduation shall coincide with an imaginary radius originating at the center of the compass card and extending to the outer edge of the card, each radius being displaced one degree of arc from its adjacent radii on either side. Each tenth (0.18 inch) graduation shall be identified with a number corresponding to its degree value from zero through 350. The numbers on the compass card when viewed through the top glass of the compass shall increase in a clockwise direction. The numbers shall be 0.19 inch (0.48 cm) in height, 0.025 inch (0.635 mm) line width, with their bottom edge on an imaginary circle of radius 3.27 inches (8.30 cm) whose center is coincidental with the center of the compass card. The compass card shaLl have letters at the

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cardinal and intercardinal angles. The cardinal angle letters (N at 0 degrees, E at 90 degrees, S at 180 degrees, and W at 270 degrees) shall be 0.24 inch (0.161 cm) in height, 0.035 inch (0.889 mm) line width, with their bottom edge on an imaginary circle of radius 2.49 inches (6.32 cm) whose center coincides with the center of the compass card. The letters shall be centered on the imaginary extension of their respective graduations. The letters for the intercardinal angles (NE at 45 degrees, SE at 135 degrees, SW at 225 degrees, and NW at 315 degrees) shall be 0.19 inch (0.48 cm) in height, 0.03 inch (0.76 mm) line width, with their bottom edge on an imaginary circle of radius 2.49 inches (6.32 cm) whose center coincides with the center of the compass card.

3.3.2.2 Magnet and float assembly. The magnet and float assembly shall be permanently attached to the bottom side of the compass card. It shall be centered on the face of the card and be of a minimum diameter so as not to obscure the markings on the card face. The magnets shall be of sufficient strength to achieve an accuracy of 20 minutes of arc (see 4.6.4.6). The magnet and float assembly shall be constructed to have a period in the range from 8.5 to 12 seconds (see 4.6.4.2). The float shall not leak nor lose its buoyancy over time due to the porosity of its material. The float shall be of sufficient buoyancy to prevent damage to the pivot and to achieve the minimal compass error due to pivot friction but not more than 10 minutes of arc (see 4.6.4.5). The error due to swirl shall not be greater than four degrees (see 4.6.4.7).

3.3.2.3 Pivot system. The pivot system shall maintain the orientation of the compass card centered horizontally within the compass bowl while providing freedom of horizontal rotation (see 4.6.4 and 4.6.9). The pivot system shall facilitate the rapid return of the compass card assembly to its normal position within the compass bowl in the event it loses contact with its mating surface (see 4.6.4.5 and 4.6.9).

3.3.3 Compass bowl. The compass bowl shall be a sealed unit to prevent leakage of the compass fluid out of the bowl and to prevent the entrance of contaminants into the bowl. The bowl shall provide allowance for the expansion or contraction of the compass fluid with respect to the environmental conditions. The bowl including bellows shall be completely filled with compass fluid to prevent the formation of bubbles as tested in accordance with 4.6.8. The compass bowl shall be constructed to be pendulous in its gimbal assembly when installed in the compass binnacle. The bowl shall be constructed of material that neither affects nor is affected by the compass fluid. The bowl shall allow unrestricted viewing of the top of the compass card and shall provide 40 degrees sector view of the forward portion of the bottom side of the compass card including all graduations when viewed through the periscope assembly of the binnacle. The bowl shall physically interface with the pivot system to meet the requirements specified in 3.3.2 and 3.3.2.3. The top of the compass bowl shall have a fixed bezel with lubber lines etched at 0 degrees, 90 degrees, 180 degrees, and 270 degrees relative to the axis of ships heading. The inner diameter of the bezel shall be large enough to allow a full view of all compass card graduations. The outer diameter of the bezel shall be 9.262 + .000 - .005 inches (23.525 + .000 - .012 cm). The top of the bezel shall be positioned with respect to the compass card to minimize parallax, but in no instance shall the parallax exceed one

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degree when reading the compass card. The minimum inner dimensions of the compass bowl shall allow 14 degrees freedom of movement of the compass card assembly with a maximum error of one degree (see 4.6.4.3a).

3.3.4 Gimbal system. The gimbal system shall provide a two axis freedom of movement to the compass bowl. The axes of both gimbals shall coincide with the horizontal plane of the compass card. The inner gimbal shall provide rotation about the ships roll axis. The outer gimbal shall provide rotation about the ships pitch axis. The gimbal system shall provide 33 degrees freedom of tilt from the horizontal while maintaining the compass bowl level and balanced in its supports when installed in the binnacle and tested in accordance with 4.6.4.3b. The outer gimbal shall be no more than 11.25 inches (28.57 cm) in diameter with the exception of the two knife edge pivot arms. The pivot arms length shall extend 0.37 inch (0.93 cm) from the outer edge of the gimbal, shall be 0.32 inch (0.81 cm) in width tapering to a knife edge at the bottom along their entire length, and shall be 0.237 inch (0.93 cm) in height.

3.4 Binnacle requirements.

3.4.1 Dimensions. The binnacle shall support the compass at the pivot points of its pitch gimbal at a height of 40.0 inches (101.6 cm) above the ships deck. The binnacle shall provide sufficient internal clearance to permit the compass bowl and the compass gimbals adequate freedom of movement to achieve the specified tilts of 3.3.4. The binnacle shall accommodate the compass gimbal pivot pegs (as specified in 3.3.4) at the athwartships locations necessary to allow rotation about the pitch axis. The binnacle shall have provisions for an optional installation of a periscope assembly to provide viewing of the bottom of the compass card from the ships compartment directly beneath the binnacle. The periscope assembly shall be of sufficient length to provide a display a minimum distance of 15 inches from the overhead of the ships compartment directly beneath the binnacle. The assembly shall contain the necessary optics to provide the viewer with a non-inverted display of the magnetic compass heading.

3.4.2 Corrector capabilities. The binnacle shall contain each of the following corrective assemblies: Fore and aft corrector magnets, athwartships corrector magnets, vertical corrector magnets, quadrantal correctors, and flinders bar correctors, with capabilities of adjustment to conform with H.O. Publication No. 226. Their placement shall allow the installation of the periscope reflector assembly in accordance with 3.4.1.

3.4.2.1 Fore and aft (b) corrector magnets. These shall be straight magnets of circular section. They shall be of sufficient magnetic strength to provide an adjustable correction capability with a range of plus or minus 40 degrees (in 0.5 degree increments) (see 4.6.10.1). They shall be placed such that their axis lay horizontally fore and aft with respect to the ship. They shall be placed a minimum distance of twice their length from the compass magnet assembly (center-to-center). The axial centers of the magnets shall lay in the vertical athwartships plane passing through the center of the compass magnet and float assembly.

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3.4.2.2 Athwartships (C) corrector magnets. These shall be identical to the fore and aft corrector magnets in size, field strength, and adjustable correction capability range. They shall be aligned with their axial centers horizontally athwartships with respect to the ship. They shall be placed a minimum distance of twice their length from the compass magnet and float assembly. The centers of the magnets shall lay in the vertical fore and aft plane passing through the center of the compass magnet and float assembly. The athwartships corrector magnets shall provide plus or minus 40 degrees of adjustment (see 4.6.10.2).

3.4.2.3 Vertical (heeling) corrector magnets. These shall be straight magnets of circular section. The magnets shall be placed in a fixture capable of holding up to eight of the magnets in a circular pattern at a minimum distance of twice their length from the compass magnet and float assembly. The holding fixture shall facilitate placement of the magnets vertically below the center of the compass magnet assembly coincidental with the intersection of the fore and aft and athwartships vertical planes through the compass. The vertical corrector magnets shall provide a vertical field at the compass card magnets ranging form plus 0.75 to minus 0.75 oersted (see 4.6.10.3).

3.4.2.4 Quadrantal (D) correctors. The quadrantal correctors shall be soft iron spheres of 5.0 inches (12.7 mm), 7.0 inches (17.8 mm), and 9.0 inches (22.9 cm) in diameter with a bottom stem for mounting. The seven inch and nine inch spheres shall be hollow to minimize their weight. The spheres one pair at any time, shall be mounted on two brackets, one sphere on either side of the binnacle, along the athwartships axis plane. The mounting bracket shall allow movement of the spheres horizontally along the athwartships vertical plane at distances from 4.0 inches (10.2 cm) to 9.0 inches (22.9 cm), from the centers of the spheres to the side of the binnacle, while maintaining the center of the spheres in the horizontal plane of the compass magnet and float assembly. Each sphere shall have a mounting stem with an appropriate height to fix it in the compass magnet and float assembly horizontal plane without necessitating movement of the mounting bracket. Each sphere shall have a locknut to secure it in position along the mounting bracket. Each mounting bracket shall have a scale, graduated in one-quarter inch increments, numbered every whole inch, along the entire distance of sphere travel, to indicate the distance of the sphere center to the side of the binnacle. The quadrantals shall provide a minimum of plus 14 degrees correction of the D coefficient to the compass. (See H.O. Publication No. 226.)

3.4.2.5 Flinders bar. The flinders bar shall be a group of cylindrical soft iron bars of diameter 2.25 to 2.45 inches (5.71 to 6.22 cm), and of lengths 12.0 inches (30.5 cm), 6.0 inches (15.2 cm), 3.0 inches (7.6 cm), 1.5 inches (3.8 cm), and 0.75 inch (2) (1.90 cm) totalling 24.0 inches (60.9 cm)). Non-metallic bars of corresponding dimensions shall also be provided. The flinders bar shall be contained in a vertical non-magnetic tube 2.5 inches internal diameter, mounted externally on the forward side of the binnacle, at such height that the top of the tube shall extend three-quarters inch above the horizontal plane of the compass card assembly when the compass is installed in the binnacle.

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3.4.3 Illumination. Illumination of the compass card, both top and bottom shall be provided by the binnacle. Electrical power shall be ships 115 volt, 60 cycle, single-phase. The illumination shall be in accordance with ASTM F 1166. The wiring for such lighting shall be properly shielded to minimize any possibility of stray magnetic field effects on the compass. The compass shall be properly grounded in accordance with MIL-STD-1310 see 4.6.3 and 4.6.11.

3.4.4 Compass compensating coils. Provisions shall be made to accommodate mounting of compass compensating coils Type K-2.

3.5 Identification marking. The compass and the binnacle shall have appropriate identification marking in accordance with of MIL-STD-130 and MIL-P-15024.

3.6 Workmanship. The workmanship of the equipment construction shall be in accordance with Requirement 9 of MIL-STD-454.

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 (examinations and tests) 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 ensure supplies and services conform to prescribed requirements.

4.1.1. Responsibility for compliance. All items shall 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 ensuring that all product or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material.

4.1.2 Failure criteria. The equipment, or portions thereof, subjected to a test specified herein shall be considered to have failed the tests when any of the following occur:

(a) Performance parameters exceed the limits specified in the applicable paragraph of section 3.
(b) Catastrophic or structural failure.
(c) Distortion or displacement of mechanical parts that cause difficulty of servicing or replacing a part.

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(d) Any condition that results in a hazard to personnel or equipment safety.
(e) Deterioration, corrosion, or change in performance limits causing failure to meet operational service requirements.
(f) Leakage or discoloration of fluid that would cause a decrease in service life or reliability.

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

(a) First article inspection (see 4.3).
(b) Quality conformance inspection (see 4.4).

4.3 First article inspection. Five units of each type covered by this specification shall be subjected to the examinations and tests specified in tables I and II. The tests shall be performed in the order listed. A post test visual inspection shall be conducted in conjunction with the tests of 4.6.5, 4.6.6, and 4.6.7 and shall include disassembly of the test item.

4.4 Quality conformance inspection. Quality conformance inspections shall be as specified in tables III and IV. Group classifications shall be as defined in MIL-STD-961. The number of items tested shall be as determined in accordance with the requirements of the contract.

4.5 Inspection conditions. Unless otherwise specified, all inspections shall be performed in accordance with the test conditions specified in the applicable test method documents or applicable paragraph(s) in this specification.

4.6 Performance tests. The compass error caused by the magnetic influence of any testing equipment shall be noted prior to initiating the test and shall be taken into consideration when determining the actual compass error during a test.

4.6.1 Visual examination. Visual examination shall be conducted to ensure compliance with requirements as specified below:

(a) Materials (see 3.2.2)
(b) Paint and color (see 3.2.4)
(c) Size (see 3.3 and 3.4)
(d) Identification marking (see 3.5)
(e) Workmanship (see 3.6)

4.6.2 Safety. Safety of the equipment shall meet the requirements of MIL-STD-454.

4.6.3 Bonding and grounding. Electrical continuity (bonding) shall be measured on metallic chassis, shields, parts, and outer covers at a common potential. The requirements of MIL-STD-1310 shall be met.

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4.6.4 Compass performance. Unless otherwise specified herein, the tests comprising 4.6.4 and 4.7 shall be performed with the compass operating in a magnetic field with a horizontal component equal to plus 0.00018 Tesla (plus 1.8 gauss) and a vertical component equal to plus 0.00054 Tesla (plus 5.4 gauss).

4.6.4.1 Damping. The compass card shall be deflected by a hand held magnet 30 degrees from its static equilibrium position, held until stable, then released. The amount of swing of the compass card beyond its static equilibrium position shall be noted. The displacement shall be repeated in the opposite direction and the overswing noted. The average of the two values shall not exceed 15 degrees. Any larger value shall constitute failure of this test.

4.6.4.2 Period. The compass card shall be deflected by a hand held magnet 45 degrees from its static equilibrium position, held until stable, then released. A timer is started when the compass card passes through its static equilibrium position and stopped when the compass card passes through the static equilibrium position the second time. Record the time. Repeat the procedure with the displacement from the opposite direction and record the time. The average of the two times shall be within the range specified in 3.3.2.2. Any average outside this range shall constitute a failure of this test.

4.6.4.3 Freedom of rotation when tilted. The compass card assembly shall remain free without rubbing and shall indicate magnetic north accurately within the range of 3.3.3 for any static position when:

a. The compass bowl is tilted 14 degrees from the horizontal and rotated slowly through 360 degrees
b. The compass binnacle (with the compass installed) is tilted 33 degrees from the horizontal and rotated slowly through 360 degrees

Any interference which causes the compass card to indicate a greater error than the range of 3.3.3 from magnetic north shall constitute a failure of this test.

4.6.4.4 Induced tilt. The tilt induced to the compass card assembly shall not result in interference by the compass bowl when the assembly is rotated slowly through 360 degrees and subjected to vertical magnetic field intensities ranging from plus 0.00044 Tesla to minus 0.00044 Tesla. Any interference caused by the tilt of this test shall constitute a failure of this test.

4.6.4.5 Friction error. The compass card shall be deflected by a hand held magnet one degree from its static equilibrium position, held until stable, and then released. The position the compass card settles on shall be noted. The test shall be repeated with the deflection in the opposite direction. The two readings shall be averaged and the result shall not differ from the static equilibrium position by more than the requirements of 3.3.2.2. A difference of greater than that specified in 3.3.2.2 shall constitute a failure of this test.

4.6.4.6 Compass error test. The compass shall be mounted on a turntable and the ships heading lubber line aligned with the magnetic north-south axis. The turntable shall be positioned at 0 degrees, 90 degrees, 180 degrees, and 270

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degrees and compass card readings taken. The error readings at any position shall not be greater than the requirements of 3.3.2. Any error greater than that specified in 3.3.2 shall constitute a failure of this test.

4.6.4.7 Swirl. The compass shall be rotated through 720 degrees of rotation in a horizontal plane at the rate of four degrees per second. The total angular departure of the compass card assembly from its static equilibrium position shall not exceed the limits of 3.3.2.2 during or after this rotation. Any error greater than the limits of 3.3.2.2 shall constitute a failure of this test.

4.6.5 Shock. The compass, when mounted in the binnacle, shall not be damaged when tested in accordance with MIL-S-901 for the criteria of 3.2.6. Any reduction of equipment capability as specified by this specification or damage discovered by the post test disassembly inspection shall constitute a failure of this test.

4.6.6 Vibration. The compass shall be subjected to the vibration specified in MIL-STD-167-1, type I, environmental criteria. Any deflection greater than specified in 3.2.7 shall constitute failure of this test.

4.6.7 Environmental. The compass and the binnacle shall suffer no damage when tested in accordance with MIL-STD-810 criteria.

4.6.7.1 Temperature. The compass and binnacle shall be tested in accordance with MIL-STD-810, method 501.2 (both procedure I and procedure II if first article test) for the values in 3.2.8.1.

4.6.7.2 Humidity. The compass and binnacle shall be tested in accordance with MIL-STD-810, method 507.2, Humidity. (Procedure III if first article test.)

4.6.7.3 Salt fog. The compass and binnacle shall be tested in accordance with MIL-STD-810, method 505.2, Solar Radiation, (both procedure I and II if first article test).

4.6.7.4 Solar radiation. The compass and binnacle shall be tested in accordance with MIL-STD-810, method 505.2, solar radiation, (both procedure I and II if first article test).

4.6.8 Bubbles. No bubbles shall develop or form in the compass fluid as a result of the shock, vibration or temperature tests. The compass shall be inverted and then returned to its upright position. No bubbles shall appear in the compass fluid.

4.6.9 Pivot seating. The compass shall show no evidence of looseness nor wobble on the pivot after the vibration test (4.6.6). After inverting the compass (4.6.8) the compass card assembly shall readily reseat itself on the pivot.

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4.6.10 Binnacle correctors. The following tests shall be accomplished with an accepted Navy No. 1 magnetic compass installed in the binnacle under test.

4.6.10.1 Fore and aft. An initial compass reading shall be taken and noted. The fore and aft corrector magnets shall be adjusted through their maximum range of movement while allowing the compass to settle when the magnets are at the extremes of adjustment and noting the compass readings at those points. The difference from the initial reading and the two readings taken at the extremes of adjustment shall be averaged, and that average shall be equal to or greater than the requirements of 3.4.2.1.

4.6.10.2 Athwartships. An initial compass reading shall be taken and noted. The athwartships corrector magnets shall be adjusted through their maximum range of movement while allowing the compass to settle when the magnets are at the extremes of adjustment and noting the compass readings at those points. The difference from the initial reading and the two readings taken at the extremes of adjustment shall be averaged, and that average shall be equal to or greater than the requirements of 3.4.2.2.

4.6.10.3 Vertical (heeling). The binnacle shall be level and the compass removed. A magnetometer probe shall be placed at the point where the magnet assembly of the compass would be in normal installation. A measurement shall be made with the vertical magnets at the closest position of adjustment to the probe. The measurement shall be compared with the requirements of 3.4.2.3. The measurement shall be equal or greater then the outer range value of 3.4.2.3.

4.6.11 Illumination. The illuminating of the compass card (both top and bottom) provided by the binnacle lighting shall be in accordance with ASTM F 1166.

4.7 Inspection of packaging. Sample packs and the inspection of packaging (preservation, packing and marking) for shipment, stowage, and storage shall be in accordance with the requirments of section 5 and the documents specified therein.

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TABLE I. First article inspection (compass).

| Inspection | Requirement | Test |
|---|---|---|
| Group A | 3.2.2, 3.2.4, 3.3.2 | 4.6.1 |
| Visual Examination | 3.3.3, 3.3.4, 3.5, 3.6 | |
| Compass Performance | 3.3.2, 3.3.3, 3.3.4 | 4.6.4 |
| Safety | 3.2.5 | 4.6.2 |
| Group C | | |
| Shock | 3.2.6 | 4.6.5 |
| Vibration | 3.2.7 | 4.6.6 |
| Environmental | 3.2.8 | 4.6.7 |

TABLE II. First article inspection (binnacle)

| Inspection | Requirement | Test |
|---|---|---|
| Group A | 3.2.2, 3.2.4, 3.4.1 | 4.6.1 |
| Visual Examination | 3.4.2, 3.4.3, 3.4.4 | |
| | 3.5, 3.6 | |
| Binnacle Connectors | 3.4.2 | 4.6.10 |
| Illumination | 3.4.3 | 4.6.3, 4.6.11 |
| Group C | | |
| Shock | 3.2.6 | 4.6.5 |
| Vibration | 3.2.7 | 4.6.6 |
| Environmental | 3.2.8 | 4.6.7 |

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TABLE III. Quality conformance inspection (compass)

| Inspection | Requirement | Test |
|---|---|---|
| Group A | | |
| Visual Examination | 3.2.2, 3.2.4, 3.3.2<br>3.3.3, 3.3.4, 3.5, 3.6 | 4.6.1 |
| Safety | 3.2.5 | 4.6.2 |
| Packaging | 5 | 4.7 |
| Group B | | |
| Visual | 3.2.2, 3.2.4, 3.3<br>3.5, 3.6 | 4.6.1 |
| Safety | 3.2.5 | 4.6.2 |
| Compass Performance | 3.3 | 4.6.4, 4.6.8<br>4.6.9 |
| Packaging | 5 | 4.7 |
| Group C | | |
| Shock | 3.2.6 | 4.6.5 |
| Vibration | 3.2.7 | 4.6.6 |
| Temperature (Procedure II) | 3.2.8.1 | 4.6.7.1 |
| Humidity (Procedure I) | 3.2.8.2 | 4.6.7.2 |
| Salt Fog | 3.2.8.3 | 4.6.7.3 |
| Solar Radiation (Procedure I) | 3.2.8.4 | 4.6.7.4 |
| Group D | | |
| Shock | 3.2.6 | 4.6.5 |
| Vibration | 3.2.7 | 4.6.6 |
| Temperature (Procedure I) | 3.2.8.1 | 4.6.7.1 |
| Humidity (Procedure II) | 3.2.8.2 | 4.6.7.2 |
| Salt Fog (Procedure II) | 3.2.8.3 | 4.6.7.4 |
| Solar Radiation (Procedure II) | 3.2.8.4 | 4.6.7.4 |

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TABLE IV. Quality conformance inspection (binnacle)

| Inspection | Requirement | Test |
|---|---|---|
| Group A | | |
| Visual | 3.2.2, 3.2.4, 3.4.1<br>3.4.2, 3.4.3, 3.4.4<br>3.5, 3.6 | 4.6.1 |
| Safety | 3.2.5 | 4.6.2 |
| Packaging | 5 | 4.7 |
| Group B | | |
| Visual | 3.2.2, 3.2.4, 3.4<br>3.5, 3.6 | 4.6.1 |
| Safety | 3.2.5 | 4.6.2 |
| Binnacle Correctors | 3.4.2 | 4.6.10 |
| Packaging | 5 | 4.7 |
| Group C | | |
| Shock | 3.2.6 | 4.6.5 |
| Vibration | 3.2.7 | 4.6.6 |
| Temperature (Procedure II) | 3.2.8.1 | 4.6.7.1 |
| Humidity (Procedure I) | 3.2.8.2 | 4.6.7.2 |
| Salt Fog | 3.2.8.3 | 4.6.7.3 |
| Solar Radiation (Procedure I) | 3.2.8.4 | 4.6.7.4 |
| Group D | | |
| Shock | 3.2.6 | 4.6.5 |
| Vibration | 3.2.7 | 4.6.6 |
| Temperature (Procedure I) | 3.2.8.1 | 4.6.7.1 |
| Humidity (Procedure II) | 3.2.8.2 | 4.6.7.2 |
| Salt Fog (Procedure II) | 3.2.8.3 | 4.6.7.3 |
| Solar Radiation (Procedure II) | 3.2.8.4 | 4.6.7.4 |

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5. PACKAGING

(The packaging requirements specified herein apply only for Government acquisition. For the extent of applicability of the packaging or preparation for delivery requirements of referenced documents listed in Section 2, see 6.8.)

5.1 Packing requirements. The packaging (preservation, packing and marking) requirements shall be in accordance with MIL-E-17555 for the level of preservation (A, B, C, or Commercial), the level of packing (A, B, C, or Commercial) and marking and other packaging acquisitioning options therein, as specified (see 6.2 and 6.5). In addition, for Navy acquisitions, the following applies:

a. Navy fire-retardant requirements.

(1) Lumber and plywood. Unless otherwise specified (see 6.2), all lumber and plywood including laminated veneer materials used in shipping container and pallet construction, members, blocking, bracing, and reinforcing shall be fire-retardant treated materials conforming to MIL-L-19140 as follows:

Level A and B - Type II - weather resistant.
Category I - general use.

Level C - Type I - nonweather resistant.
Category I - general use.

(2) Fiberboard. Fiberboard used in the construction of interior (unit and intermediate) and exterior fiberboard boxes including interior packaging forms shall conform to the class-domestic/fire retardant or class-weather resistant/ fire retardant materials requirements as specified in the acquisitioning document, of PPP-F-320 and amendments thereto.

6. NOTES

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

6.1 Intended use. The compass is to be used as a secondary source of heading information for the vessels on which it is installed. Amplifying information on compass adjustment is available in H.O. Publication No. 226.

6.2 Acquisition requirements. Acquisition documents must specify the following:

(a) Title, number and date of the specification.

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(b) Issue of DODISS to be cited in the solicitation, and if required the specific issue of individual documents referenced (see 2.1.1, 2.1.2 and 2.2).
(c) If first article is required (see 3.1).
(d) Level of preservation, level of packing and other packaging acquisitioning options required (see 5.1).
(e) When fire-retardant treated lumber and plywood is not required (see 5.1 a.(1)).
(f) Class of fire-retardant fiberboard required (see 5.1a(2)).

6.3 First article. When a first article inspection is required, the contracting officer should provide specific guidance to offerors whether the item(s) should be a preproduction sample, a first article sample, a first production item, a sample selected from the first 10 production items, a standard production item from the contractor s current inventory (see 3.1), and the number of items to be tested as specified in 4.3. The contracting officer should also include specific instructions in acquisition documents regarding arrangements for examinations, approval of first article test results and disposition of first articles. Invitations for bids should provide that the Government reserves the right to waive the requirement for samples for first article inspection to those bidders offering a product which has been previously acquired or tested by the Government, and that bidders offering such products, who wish to rely on such production or test, must furnish evidence with the bid that prior Government approval is presently appropriate for the pending contract. Bidders should not submit alternate bids unless specifically requested to do so in the solicitation.

6.4 Technical manuals. The requirement for technical manuals should be considered when this specification is applied on a contract. If technical manuals are required military specification and standards that have been cleared and listed in DOD 5010.12-L, Acquisition Management Systems and Data Requirements Control List (AMSDL) must be listed on a separate Contract Data Requirements List (DD Form 1423), which is included as an exhibit to the contract. The technical manuals must be acquired under separate contract line item in the contract.

6.5 Provisioning. Provisioning technical documentation (PTD), spare parts, and repair parts shall be furnished as specified in the contract. When ordering spare parts or repair parts for the equipment covered by this specification, the contract should state that such spare parts and repair parts should meet the same requirements and quality assurance provisions as the parts used in the manufacture of the equipment. Packaging for such spare parts should also be specified.

6.6 Definitions.

Gauss - (G) CGS unit of measure of magnetic flux density equivalent to $10^{-4}$ Tesla

Heeling Error - The amount of change of deviation occurring when the ship experiences rotation about its roll axis (heeling). The forces created by the ships iron that act vertically at

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the compass (with 0 degrees roll) develop a component in the horizontal plane which results in an error in compass heading (heeling error). The error is positive when the north seeking end of the compass card is drawn to the low side of the ships roll, and negative when drawn to the high side of the ships roll

Maxwell - (Mx) CGS unit of measure of magnetic flux equivalent to $10^{-8}$ weber

Oersted - (Oe) CGS unit of magnetizing force (Magnetic field strength) equivalent to $1000/4\pi$ Ampere turns per meter

Permeability - ($\mu$) a measurement of the ability of a substance to establish magnetic lines of flux when exposed to a magnetic field. Measured relative to the permeability of a vacuum.

Tesla - (T) unit of measure of magnetic flux density (Weber/meter$^2$) equivalent to 1000 gauss

Weber - (Wb) unit of measure of magnetic flux (Volt•second) equivalent to $10^7$ maxwells

6.7 Approval activity. For purposes of this specification, the approving office within the Naval Sea Systems Command is the Navigation Systems Division.

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

6.9 Subject term (key word) listing.

Dissimilar metals
Non-ferrous
Secondary source
Soft iron

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

User activities:
MC

Preparing activity:
Navy-SH
(Project 6605-N435)

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# STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

**INSTRUCTIONS**

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

**I RECOMMEND A CHANGE:**

1. DOCUMENT NUMBER: MIL-C-1193A(SH)
2. DOCUMENT DATE (YYMMDD): 92/01/24
3. DOCUMENT TITLE: COMPASSES, SHIP, NAVY, NO.!, MAGNETIC (REFLECTOR TYPE, 7-1/2 INCH CARD) AND BINNACLE, REFLECTOR TYPE
4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME (Last, First, Middle Initial)

b. ORGANIZATION

c. ADDRESS (Include Zip Code)

d. TELEPHONE (Include Area Code)
(1) Commercial
(2) AUTOVON (If applicable)

7. DATE SUBMITTED (YYMMDD)

8. PREPARING ACTIVITY

a. NAME TECHNICAL POINT OF CONTACT (TOPC):
Mr. Anthony Thompson (SEA 06K335)
PLEASE ADDRESS ALL CORRESPONDENCE TO:

b. TELEPHONE (Include Area Code)
(1) Commercial (703) 602-6451
(2) AUTOVON 8-332-6451

c. ADDRESS (Include Zip Code)
Commander, Naval Sea Systems Command
SEA 55Z3
Department of the Navy
Washington, DC 20362-5101

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