SAE Aerospace
An SAE International Group

AEROSPACE STANDARD

SAE AS443

REV. A

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COMPASS, MAGNETIC, NON-STABILIZED TYPE (FOR TURBINE-POWERED, SUBSONIC AIRCRAFT)

FOREWORD

Changes in the revision are format/editorial only.

1. SCOPE:

This SAE Aerospace Standard (AS) covers a direct reading magnetic compass.

1.1 Purpose:

This document establishes the essential minimum safe-performance standards for non-stabilized magnetic direction instruments, primarily for use with turbine-powered, subsonic, transport aircraft that may subject the instruments to the environmental conditions specified in paragraph 3.3.

2. APPLICABLE DOCUMENTS:

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1 NTIS Publications:

Available from NTIS, Springfield, VA 22161.

NACA Report 1235

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3. GENERAL REQUIREMENTS:

3.1 Materials and Workmanship:

3.1.1 Materials: Materials shall be of a quality which experience and/or tests have demonstrated to be suitable and dependable for use in aircraft instruments.

3.1.2 Workmanship: Workmanship shall be consistent with high-grade aircraft instrument manufacturing practice.

3.2 Identification:

The following information shall be marked legibly and permanently on the instrument or attached thereto:

a. Name of instrument
b. SAE AS443A
c. Manufacturer's part number
d. Manufacturer's serial number or date of manufacture
e. Manufacturer's name and/or trademark

3.3 Environmental Conditions:

The following conditions have been established as minimum design requirements. Tests shall be conducted as specified in Sections 5, 6, and 7.

3.3.1 Temperature: When installed in accordance with the instrument manufacturer's instructions, the instrument shall function over the range of ambient temperature shown in Column A below and shall not be affected adversely by exposure to the range of temperature shown in Column B below.

TABLE 1

Instrument Location	A	B
Pressurized areas	-30 to 70 °C	-65 to 70 °C

3.3.2 Altitude: When installed in accordance with the instrument manufacturer's instructions, the instruments shall function from sea level conditions up to the altitudes and temperatures listed below. (Altitude pressure values are per NACA Report 1235.) The instrument shall not be affected adversely following exposure to extremes in ambient pressure of 50 to 3 inches Hg absolute, respectively:

TABLE 2

Instrument Location	Altitude	Temperature
Pressurized areas	15,000 feet	50 °C

3.3.3 Vibration: When installed in accordance with the instrument manufacturer's instructions, the instrument shall function and shall not be affected adversely when subjected to vibrations having the following characteristics:

TABLE 3

Instrument Location	Frequency (cps)	Maximum Double Amplitude (inches)	Maximum Acceleration (g)
Instrument Panel	5-30 30-1000	0.020	- 0.25

3.3.4 Humidity: The instrument shall function and shall not be affected adversely by exposure to any relative humidity in the 0 to 95% range at a temperature of approximately 70 °C.

4. DETAIL REQUIREMENTS:

4.1 Display Marking:

4.1.1 Finish: Unless specified otherwise by the user, matte white material shall be applied to all graduations, numerals, and indicating means. Non-functional surfaces and markings shall be durable dull black.

4.1.2 Indicating Method: The method of indication shall employ a horizontal compass card with fixed lubber's line. Graduations move to the right for right turns.

4.1.3 Graduations: The instrument shall be provided with graduations at intervals not to exceed 5 degrees, with major graduations every 10 degrees and with numerical markings at intervals not greater than 30 degrees. The 0, 90, 180, and 270-degree cardinal headings may be marked N, E, S, and W, respectively; or in numerical marking the last digit (0) may be omitted.

4.1.4 Visibility: Index and dial markings shall be visible from any point within the frustum of a cone the side of which makes an angle of 30 degrees with the perpendicular to the dial, and the small diameter of which is the aperture of the instrument case. At least two numerals shall be visible simultaneously.

4.1.5 Operating Limits: During straight flight the instrument shall indicate magnetic headings throughout the 360-degree scale range during dives, climbs, or banks up to at least 20 degrees displacement from level flight.

4.2 Compensation Provisions:

Means shall be provided for compensating for semi-circular deviation. Compensating effect shall be between 20 and 40 degrees in each direction for each axis when adjusted for maximum effect.

5. TEST CONDITIONS:

5.1 Atmospheric Conditions:

Unless specified otherwise, all tests required by this Aerospace Standard shall be made at an atmospheric pressure of approximately 29.92 inches Hg absolute, an ambient temperature of approximately 25 °C and a relative humidity not exceeding 85%. When tests are conducted with the atmospheric pressure or temperature differing substantially from these values, allowance shall be made for the variation from the specified conditions.

5.2 Vibration to Minimize Friction:

Unless specified otherwise, all tests for performance may be conducted while the instrument is subjected to a vibration of 0.001 to 0.005 inch double amplitude at a frequency of 10 to 60 cycles per second. The term double amplitude, as used herein, indicates the total displacement from positive maximum to negative maximum.

5.3 Vibration Equipment:

Vibration equipment shall be such as to allow vibration to be applied along each of three mutually perpendicular axes of the instrument at frequencies and amplitudes consistent with requirements of 3.3.3.

5.4 Position:

Unless specified otherwise, all tests shall be conducted while the instrument is in its normal operating position.

5.5 Magnetic Field Strength:

Unless specified otherwise, all tests required by this Aerospace Standard shall be made with a horizontal field strength of approximately 0.18 gauss and a vertical field strength of approximately 0.54 gauss, in the direction normal in the northern hemisphere. When tests are made with field values substantially different from these values, allowance shall be made for variations from the specified tolerances.

5.6 Compensators:

Unless specified otherwise, all tests shall be made with magnetic compensators removed or adjusted to neutral positions.

6. INDIVIDUAL PERFORMANCE REQUIREMENTS:

All instruments shall be subjected to tests by the instrument manufacturer to demonstrate specific compliance with this Aerospace Standard, including the following requirements where applicable.

6.1 Leakage:

Liquid-filled instruments shall not show evidence of leakage after having been placed in a bell jar and subjected to a pressure equivalent to 50,000 feet, standard altitude, for a period of 1 hour.

6.2 Scale Error:

When the instrument is placed on magnetic headings at 30-degree intervals starting from North, the indicated headings shall correspond to actual magnetic headings within 4 degrees.

6.3 Friction:

The card shall be deflected 5 degrees from its equilibrium position, released, allowed to come to rest, and read. The test shall be repeated deflecting the card 5 degrees in the opposite direction. Without vibration or tapping the difference between the two readings at rest shall not exceed 2 degrees.

6.4 Damping:

When the instrument has been deflected 30 degrees, first to the right and then to the left from its equilibrium position, the time required for the indicated heading to pass through the 25-degree angle toward the original heading shall not exceed 5.0 seconds or be less than 1.0 second. The maximum overswing past the original indicated heading shall not exceed 15 degrees.

6.5 Heeling Error:

When the instrument is tilted 20 degrees from the normal level position, the magnetic element shall be free to rotate through 360 degrees. When the instrument is tilted 10 degrees, the indicated heading shall not differ from the indicated heading with the instrument unit in normal level position by more than 4 degrees. The instrument compass card shall be visible as specified in 4.1.4.

6.6 Swirl:

When the instrument is rotated in azimuth in its normal upright position, at a rate of 30 degrees per second through 360 degrees, stopping successively at each cardinal point, the overswing of the compass card at each of these points shall not exceed 6 degrees.

6.7 Compensation:

With the instrument unit on N heading and the compensator adjusted for minimum effect, the scale error with the compensator shall not differ from the scale error without the compensator by more than 2 degrees. The maximum adjustable compensation effect shall be between 20 and 40 degrees in each direction for each axis. When the instrument is placed on any cardinal heading and the opposite axis compensator is adjusted for maximum effect, the indicated reading shall not change more than 2 degrees.

6.8 Dielectric:

Each instrument shall be tested by the method of inspection listed in 6.8.1 and 6.8.2.

6.8.1 Insulation Resistance: The insulation resistance measured at 200 volts DC for 5 seconds between all electrical circuits connected together and the metallic case shall not be less than 5 megohms. Insulation resistance measurements shall not be made on circuits where the potential will appear across elements such as windings, resistors, capacitors, etc., since this measurement is intended only to determine adequacy of insulation.

6.8.2 Overpotential Tests: The lighted instrument shall not be damaged by the application of a test potential between electrical circuits and between electrical circuits and the metallic case. The test potential shall be a sinusoidal voltage of a commercial frequency with an rms value of five times the maximum circuit voltage, except where the condition specified in 6.8.2.1 applies. The potential shall start from zero and be increased at a uniform rate to its test value. It shall be maintained at this value for 5 seconds and then reduced at a uniform rate to zero. Since these tests are intended to insure proper electrical isolation of the circuit components in question, these tests shall not be applied to circuits where the potential will appear across elements such as windings, resistors, capacitors, bulbs, etc.