

DIRECTION INDICATOR, MAGNETIC (STABILIZED TYPE)
(Stabilized Magnetic Compass)

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Revised

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1. **PURPOSE:** To specify minimum requirements for gyroscopically stabilized (or integrated) magnetic direction indicators for use in aircraft, the operation of which may subject the instrument to the environmental conditions specified in Section 3.4.
2. **SCOPE:** This specification covers minimum requirements for gyroscopically stabilized (or integrated) magnetic direction indicators for use in aircraft.

3. **GENERAL REQUIREMENTS:**

3.1 **Material 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 **Radio Interference:** The instrument shall not be the source of objectionable interference, under operating conditions at any frequencies used on aircraft, either by radiation or feed-back, in radio sets installed in the same aircraft as the instrument.

3.3 **Identification:** The following information shall be legibly and permanently marked on each unit or attached thereto:

- (a) Name of Instrument
- (b) S.A.E. Spec. AS 399
- (c) Rating (Electrical, Vacuum, etc.)
- (d) Manufacturer's Part Number
- (e) Manufacturer's Serial Number or date of Manufacture
- (f) Manufacturer's Name and/or Trade-Mark

3.4 **Environmental Conditions:** The following conditions have been established as design criteria only. Tests shall be conducted as specified in Sections 5, 6 and 7.

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

<u>Instrument Location</u>	<u>A</u>	<u>B</u>
Heated Areas (Temperature Controlled)	-30 to 50 C	-65 to 70 C
Unheated Areas (Temperature Uncontrolled)	-55 to 70 C	-65 to 70 C

3.4.2 **Humidity:** The instrument shall function and not be adversely affected when exposed to a relative humidity up to and including 95% at a temperature of approximately 32 C.

Section 7C of the SAE Technical Board rules provides that: "All technical reports, including standards approved and practices recommended, are advisory only. Their use by anyone engaged in industry or trade is entirely voluntary. There is no agreement to act in conformity to or be guided by any technical report. In formulating and approving technical reports, the Board and its Committees will not investigate or consider patents which may apply to the subject matter. Prospective users of the report are responsible for protecting themselves against infringement of patents."

- 3.4.3 **Altitude:** The instrument shall function and not be adversely affected when subjected to a pressure and temperature range equivalent to -1000 to +40,000 feet standard altitude, except as limited by application of Section 3.4.1.
- 3.4.4 **Vibration:** When installed in accordance with the instrument manufacturer's instructions, the units shall function and shall not be adversely affected when subject to the following vibrations:

<u>Type of Instrument Mounting</u>	<u>Cycles Per Minute*</u>	<u>Amplitude*</u>	<u>Maximum Acceleration</u>
Shock Mounted Panel Instruments	500 - 3000	0.005 inch	0.8 g
Unshock Mounted Panel Instruments	500 - 3000	0.010 inch	1.3 g
Structure Mounted Instruments	500 - 3000	0.030 inch	3.8 g

*Note: It is understood that the unit shall withstand vibration at higher frequencies, but the acceleration values need not exceed those shown above.

When specified by the purchaser for use in rotary wing aircraft, the frequency range shall be 150 - 3000 cycles per minute.

4. DETAIL REQUIREMENTS:

- 4.1 **Indicating Method:** One of the following methods of indication shall be employed:

- Method I Horizontal drum dial with fixed lubber's line. The graduations shall move to the right for right turns.
- Method II Rotating vertical dial with fixed lubber's line. Dial shall rotate counter-clockwise for right turns.
- Method III Rotating pointer with fixed graduated dial. Pointer shall rotate clockwise for right turns. Dial position may be settable.

- 4.2 **Operating Limits:** The instrument shall indicate magnetic heading throughout the 360 degree scale range, during dives, climbs or banks up to at least 60 degrees displacement from level flight.

4.3 Dial Markings:

- 4.3.1 **Increments:** The indicators shall be provided with degree graduations at intervals not to exceed 5 degrees, with major graduations every 10 degrees and with numerals at intervals not greater than 30 degrees, except that the 0, 90, 180 and 270 degree positions shall be marked N, E, S and W respectively.
- 4.3.2 **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 simultaneously visible.
- 4.3.3 **Finish:** Unless otherwise specified, luminescent (self-activating) material shall be applied to major graduations, numerals and pointers.

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- 4.4 Power Variation: All units shall properly function with $\pm 15\%$ variation in D.C. voltage and/or $\pm 10\%$ variation in A.C. voltage and frequency, provided the A.C. voltage and frequency vary in the same direction.
- 4.5 Compensation Provisions: Means shall, if necessary, be provided for compensating for semi-circular deviation. Compensating effect shall not exceed 30 degrees in each direction for each axis when adjusted for maximum effect.
- 4.6 Gyro Caging Provisions: Unless the gyro assembly has unrestricted freedom of operation in the pitch and roll axes, means shall be provided for caging and/or releveling the gyro. Means shall be provided to indicate when the gyro is caged, except when it is not possible to leave the gyro in caged condition.
- 4.7 Synchronizing Provisions: Automatic or manual means shall be provided to bring the indicated heading into alignment with the magnetic heading. If manual synchronization is required, an indication of alignment shall be provided.
- 4.8 Power Indication: Means shall be provided to permit the operation of a device to indicate whether the instrument is receiving power.
5. TEST CONDITIONS:
- 5.1 Atmospheric Conditions: Unless otherwise specified, all tests required by this specification shall be made at an atmospheric pressure of approximately 29.92 inches of mercury and at an ambient temperature of approximately 22 C. When tests are made with the atmospheric pressure or the temperature substantially different from these values, allowance shall be made for the variation from the specified conditions.
- 5.2 Vibration (to minimize friction): Unless otherwise specified, all tests for performance may be made with the instrument subjected to a vibration of 0.002 to 0.005 inch amplitude at a frequency of 1500 to 2000 cycles per minute. The term amplitude as used herein indicates the total displacement from positive maximum to negative maximum.
- 5.3 Power: Unless otherwise specified, all tests for performance shall be conducted at a power rating recommended by the manufacturer.
- 5.4 Magnetic Field Strength: Unless otherwise specified, all tests required by this specification 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 strength values substantially different from these values, allowance shall be made for variations from the specified tolerances.
- 5.5 Position: Unless otherwise specified, all tests shall be made with indicators and transmitters in normal level position.
- 5.6 Compensators: Unless otherwise specified, all tests shall be made with magnetic compensators removed or adjusted to neutral position.

- 5.7 Vibration Stand: For vibration tests a stand shall be used which will vibrate at any desired frequency between 500 and 3000 cycles per minute and shall subject the instrument to vibration such that a point on the instrument case will describe, in a plane inclined 45 degrees to the horizontal plane, a circle, the diameter of which is equal to the amplitude specified herein.
6. INDIVIDUAL PERFORMANCE REQUIREMENTS: All instruments, or components of such, shall be subjected to whatever tests the manufacturer deems necessary to demonstrate specific compliance with this specification, including the following requirements where applicable.
- 6.1 Starting:
- 6.1.1 Potential: The gyro shall start to rotate and continue to run on application of 50 percent of rated suction for air operated instruments and 80 of rated voltage for electrically operated instruments.
- 6.1.2 Operation Interval: Rated performance shall be obtained within 3 minutes after the application of rated power.
- 6.2 Scale Error: When the magnetic-sensitive unit 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 Heeling: When the instrument is tilted 10 degrees about the roll or pitch axis and rotated 360 degrees in azimuth in 30 degree increments, the indicated headings shall not differ from the indicated headings with the instrument in normal level position by more than 4 degrees. The instrument shall remain at each heading for 5 minutes before reading.
- 6.4 Compensation: With the instrument on N heading and the magnetic compensator adjusted for minimum effect, the scale error with compensator shall not differ from the scale error without compensator by more than 2 degrees. The range of adjustable compensation effect shall not exceed 30 degrees in each direction for each axis.
- When the instrument is placed on any cardinal heading and the opposite axis compensator adjusted for maximum effect, the indicated heading shall not change more than 2 degrees.
- 6.5 Dielectric: The insulation shall be subjected to a dielectric test with an R.M.S. voltage at a commercial frequency applied for a period of five seconds equivalent to five times normal circuit operating voltage except where circuits include components for which such a test would be inappropriate the test voltage shall be 1.25 times normal circuit operating voltage. The insulation resistance shall not be less than 20 megohms at that voltage.
7. QUALIFICATION TESTS: As many instruments as deemed necessary to demonstrate that all instruments will comply with the requirements of this section shall be tested in accordance with the manufacturer's recommendations.