SAE Aerospace
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AEROSPACE STANDARD

SAE AS397

REV. A

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Direction Instrument, Non-Magnetic, Stabilized Type (Directional Gyro)

FOREWORD

This document has been declared “NONCURRENT”. It is recommended, therefore, that this document not be specified for new designs. “NONCURRENT” refers to those documents which have previously been widely referenced and may continue to be required on some existing designs. “NONCURRENT” documents are available from SAE upon request.

1. PURPOSE:

   To specify minimum requirements for non-magnetic gyroscopically stabilized direction indicators for use in aircraft, the operation of which may subject the instruments to the environmental conditions specified in Paragraph 3.3.

2. SCOPE:

   This Aeronautical Standard covers two basic types as follows:

   Type I - Air Operated
   Type II - Electrically Operated

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 Identification:

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

(a) Name of Instrument
(b) Aeronautical Standard AS 397A
(c) Manufacturer's part number
(d) Manufacturer's serial number or date of manufacture
(e) Manufacturer's name and/or trade-mark
(f) Rating, if applicable (Electrical, Vacuum, etc.)

3.3 Environmental Conditions:

The following conditions have been established as design requirements only. Tests shall be conducted as specified in Section 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 adversely affected by exposure to the range of temperatures shown in Column B below:

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

3.3.2 Humidity: The instrument shall function and shall not be adversely affected when exposed to any relative humidity in the range from 0 to 95% at a temperature of approximately 32C.

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

Instrument Location in Airframe	Cycles Per Sec.	Max. Double Amplitude (Inches)	Max. Acceleration
Power Plant Mounted	5 - 150	0.100	20g
Wings and Empennage	5 - 500	0.036	10g
Fuselage	5 - 500	0.036	5g
Panel or Rack (with Shockmounts)	5 - 50	0.020	1.5g

3.3.4 Altitude: The instrument shall function and shall not be adversely affected when subjected to a pressure and temperature range equivalent from -1000 feet to 40,000 feet standard altitude per NACA Report 1235 except as limited by application of Paragraph 3.3.1. The instrument shall not be adversely affected when subjected to a pressure of 50 in. Hg. absolute.

3.4 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 feedback, in radio equipment installed in the same aircraft as the instrument.

3.5 Magnetic Effect:

The magnetic effect of the instrument shall not adversely affect the operation of other instruments installed in the same aircraft.

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. Graduations move to the right for right turns.

Method II - Rotating vertical dial with fixed lubber's line at the top. Dial rotates counterclockwise for right turns.

Method III - Rotating pointer with fixed graduated dial. Pointer rotates clockwise for right turns.

4.2 Operating Limits:

The instrument shall indicate heading throughout the 360 degree scale range. During dives, climbs or banks up to and at least 55 degrees displacement from level flight the instrument shall remain functional; however, the heading error involved through the gimbal system need not be corrected.

4.3 Dial Markings:

4.3.1 Graduations: Degree graduations shall be provided at intervals not to exceed 5 degrees with major graduations at 10, 20, 30 etc., degrees and with legible numerals at intervals not greater than 30 degrees throughout the scale range of 360 degrees. In the numerical marking the last digit (zero) shall be omitted. (Thus, 6 at 60 degrees, 9 at 90 degrees, etc.)

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 by the user, matte white material shall be applied to major graduations, numerals and pointers. Non-functional surfaces shall be a durable dull black.

4.4 Course Setting Provisions:

A means shall be provided for manually setting the directional indicator dial (or pointer) indication to any heading desired.

4.5 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.

4.6 Power Malfunction Indication:

Means shall be incorporated in the instrument to indicate when adequate power (voltage and/or current) is not being made available to all the phases required for the proper operation of the instrument. The indicating means shall indicate a failure or a malfunction in a positive manner.

5. TEST CONDITIONS:

5.1 Atmospheric Conditions:

Unless otherwise specified, all tests required by this Aeronautical Standard shall be conducted at an atmospheric pressure of approximately 29.92 inches of mercury and at an ambient temperature of approximately 25C and at a relative humidity of not greater than 85 percent. 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 conducted with the instrument subjected to a vibration of 0.002 to 0.005 inch double amplitude at a frequency of 1500 to 2000 cycles per minute. 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 used which will provide frequencies and amplitudes consistent with the requirements of Paragraph 3.3.3 with the following characteristics:

5.3.1 Linear Motion Vibration: Vibration equipment shall be such as to allow vibration to be applied along each of three mutually perpendicular axes of the instrument.

5.3.2 Circular Motion Vibration: Vibration equipment shall be such that a point on the instrument case will describe a circle in a plane inclined 45 degrees to the horizontal plane, the diameter of which is equal to the double amplitude specified.

5.4 Power Conditions:

Unless otherwise specified all tests shall be conducted at the power rating recommended by the manufacturer.

5.5 Position:

Unless otherwise specified, all tests shall be made with the instrument (indicators, amplifiers, transmitters, etc.) mounted in their normal operating position.

6. INDIVIDUAL PERFORMANCE REQUIREMENTS:

All instruments shall be subjected to whatever tests the manufacturer deems necessary to demonstrate specific compliance with this Aeronautical Standard including the following requirements where applicable.

6.1 Type I Requirements:

6.1.1 Starting: The gyro rotor shall start to rotate and continue to run on a suction not to exceed 50 percent of rated value. Rated instrument performance speed shall be reached within two minutes after normal rated suction is applied.

6.1.2 Roll, Pitch and Yaw: The instrument shall be mounted on a test platform which is adjusted to oscillate in roll, pitch and yaw, with a total amplitude of 3 degrees about each axis, at a frequency of 5 to 7 oscillations per minute. With the platform level, and the gyro operating at equilibrium speed and uncaged, the dial (or pointer) reading shall be noted. The platform shall then be started in its roll, pitch and yaw movement. At the end of a ten minute period the oscillation shall be stopped, the platform realigned to its starting position, and the instrument dial (or pointer) reading noted. The amount of drift of the dial (or pointer) in either direction during the ten minute test period shall not exceed 4 degrees.

6.1.3 Heading Stability: The instrument shall be mounted on a turn table, tilted 54 (±1) degrees from the vertical and the reading noted. The turn table shall be rotated one complete revolution about its vertical axis at 360 (±30) degrees per minute and the drift of the dial (or pointer) shall not exceed two degrees. The test shall be repeated rotating the turn table in the opposite direction.

6.2 Type II Requirements:

6.2.1 Starting: The gyro rotor shall start to rotate and continue to operate at a speed sufficient for proper performance of the instrument on an applied voltage not to exceed 80 percent of the rated voltage. This speed shall be reached within two minutes after application of this voltage.

6.2.2 Roll, Pitch and Yaw: Same as for Type I.

6.2.3 Heading Stability: Same as for Type I.

6.3 Dielectric:

Ungrounded instruments or grounded instruments prior to connection of internal ground wire, shall be tested by either the method of inspection of Paragraph 6.3.1 or 6.3.2.

6.3.1 Insulation Resistance: The insulation resistance measured at 500 volts D.C. (200 volts for hermetically sealed, inert gas filled instruments) between all electrical circuits connected together and the metallic case shall not be less than 20 megohms.

6.3.2 Dielectric Strength: The insulation shall withstand without evidence of damage the application of a sinusoidal voltage at a commercial frequency between all electrical circuits connected together and the metallic case, for a period of five seconds. The RMS value of the sinusoidal voltage applied shall be either five (5) times the maximum instrument operating voltage, or 500 volts, whichever is lower, except that on hermetically sealed (inert gas filled instruments) the test voltage shall be 200 volts RMS.

6.3.2.1 Instruments having a permanent internal ground connection shall be tested as follows:

The insulation shall withstand without evidence of damage the application of a sinusoidal voltage at a commercial frequency between each electric circuit and the metallic case, for a period of five (5) seconds. The RMS value of the sinusoidal voltage applied shall be 1.25 times the maximum circuit operating voltage obtainable between the test points.

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.

7.1 Low Temperature:

The instruments, or components shall be subjected to the temperature indicated in the following table in accordance with their location in the aircraft. After exposure to this temperature for five hours, the instrument shall start upon application of rated power. The amount of drift of the dial (or pointer) in either direction during a ten minute period shall not exceed five degrees.

Instrument Location	Temperature
Heated Area (Temperature Controlled)	-30 C
Unheated Area (Temperature Uncontrolled)	-55 C

7.2 High Temperature:

The requirements of Paragraph 7.1 shall apply except that the exposure temperature shall be 50C for heated areas and 70C for unheated areas.