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AEROSPACE STANDARD

AS 8021

Issued 3-16-81
Revised

F-02-25

MINIMUM PERFORMANCE STANDARD FOR DIRECTION INSTRUMENT, NON-MAGNETIC (GYROSCOPICALLY STABILIZED)

1. PURPOSE: This Aerospace Standard (AS) defines minimum performance requirements under standard and environmental conditions for Gyroscopically Stabilized Non-Magnetic Direction Instruments for use in aircraft.

2. SCOPE: This document establishes the minimum requirements for design and qualification of equipment identified as Gyroscopically Stabilized Non-Magnetic Direction Instruments.

3. GENERAL REQUIREMENTS:

3.1 Operation of Controls: The operation of controls intended for use during flight, if any, in all possible position combinations and sequences shall not result in a condition whose presence or continuation would be detrimental to the continued performance of the equipment.

3.2 Accessibility of Controls: Controls which are not normally adjusted in flight shall not be readily accessible to flight personnel, when the equipment is installed in accordance with the manufacturer's instructions.

3.3 Compatibility of Components: If the equipment components require matching for proper operation, they shall be identified in a manner that will provide for proper matching. The instructions furnished by the manufacturer must contain data detailing these limitations.

3.4 Fire Resistance: Except for small parts (such as knobs, fasteners, seals, grommets, and small electrical parts) that would not contribute significantly to the propogation of a fire, all materials must be self-extinguishing when tested in accordance with the requirements of Federal Aviation Regulation 25.1359 (d) and Appendix F thereto, with paragraph (b) of Appendix F or may be configured as used.

3.5 Interchangeability: Instruments and components which are identified with the same manufacturer's part number shall be interchangeable.

3.6 Malfunction Indication: Integral means shall be provided to indicate failures and/or the existence of the following conditions:

(a) Gyro in fast erection mode, required of electrical instruments except manually caged indicators with automatic release
(b) Gyro operating at speed below the minimum designated by the manufacturer for the instrument to meet the performance requirements herein. The requirement applies to electrical and remotely operated instruments.

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Additionally, the indicator or display of the repeating or remote indicating type of gyroscopically stabilized instrument shall be provided with means to indicate the following failures:

(c) Loss of synchro excitation
(d) A mechanical obstruction in the indicator dial drive mechanism
(e) Primary power loss to the indicator or display
(f) Servo Amplifier power loss
(g) Electrical failure in the servo drive motor phases

The indicating means shall indicate the failure or malfunction in a positive and conspicuous manner.

3.7 Instrument Cover Glass Reflectance: The total reflectance of the instrument cover glass including the integral lighting wedge, if applicable, shall not exceed 10 percent of the incident light. This reflectance applies over the visible light spectrum from 450 nanometers to 600 nanometers, and over an incident solid angle of 60 degrees perpendicular to the viewing plane.

3.8 Indicating Method: One of the following methods of indication shall be employed:

Method I Rotating dial display with fixed datum line. The line shall rotate counterclockwise for right turns.

Method II Horizontal scale display with fixed datum line. The graduations shall move to the left for right turns.

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

3.10 Dial Markings:

3.10.1 Graduations: The indicators shall be provided with degree graduations at intervals not to exceed five (5) degrees, with major graduations every ten (10) degrees and with numerals at intervals not greater than 30 degrees, except that the 0, 90, 180, and 270 degrees positions may be marked N, E, S, and W, respectively.

3.10.2 Visibility: Index and dial markings shall be visible from any point within the upper half of a frustum of a cone, the side of which makes an angle of at least 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.

3.11 Caging Provisions: Unless the gyro assembly has restricted freedom of operation in the pitch and roll axes, a means shall be provided for caging and/or releveling the gyro. A means shall be provided to indicate when the gyro is caged, except when it is not possible to leave the gyro in the caged condition.

3.12 Course Setting Provisions: A means shall be provided for manually setting the directional indicator to any heading desired.

4. MINIMUM PERFORMANCE REQUIREMENTS UNDER STANDARD TEST CONDITIONS:

4.1 Starting: Rated instrument performance rotor speed shall be achieved within three minutes after normal power is applied for both air and electric operated instruments. By application of 50 percent of rated vacuum or pressure for air operated instruments and 80 percent of rated voltage for electrically operated instruments, the gyro rotor shall start and continue to rotate. If the instrument incorporates a gyro speed monitoring device which provides a positive indication when the gyro speed is below that necessary to meet instrument performance, the starting time may exceed three minutes, but shall not be greater than five minutes.

4.2 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 while reversing the direction of rotation every 6 revolutions. With the platform level, and the gyro operating at equilibrium speed and uncaged, the dial 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 reading noted. The amount of drift of the dial in either direction during the ten minute test period shall not exceed 4 degrees. This test shall be run four times with the instrument case rotated 90° with respect to the outer gimbal between each test.

4.3 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 axis at 360 (±30) degrees per minute and the drift of the dial shall not exceed two degrees. The test shall be repeated rotating the turn table in the opposite direction.

5. MINIMUM PERFORMANCE REQUIREMENTS UNDER ENVIRONMENTAL CONDITIONS: Unless otherwise specified herein, the procedures applicable to a determination of the performance of directional instruments under environmental conditions are set forth in Radio Technical Commission for Aeronautics (RTCA) Document No. DO-160, entitled "Environmental Conditions and Test Procedures for Airborne Electronic/Electrical Equipment and Instruments", dated February 1975. Performance tests specified after subjection to test environments may be made after exposure to several environmental conditions. The order of tests shall be in accordance with paragraph 3.2, page 4, of DO-160. The test procedures specified or referenced are satisfactory for use in determining the performance of directional instruments under standard and extreme environmental conditions. Alternate approved test procedures that provide equivalent results may be used. As many instruments as deemed necessary to demonstrate that all instruments will comply with the requirements of this paragraph, shall be tested in accordance with the manufacturer's recommendations.

5.1 Performance Standard for Use During Environmental Tests: The following performance standard shall be used when performance testing during an environmental test is required:

(a) There shall be no more than five degrees drift in either direction during a ten minute period. Roll, pitch, and yaw motion is not required for this test.

5.2 Temperature - Altitude - Humidity:

(a) Low-Temperature - The instrument shall be subjected to the tests of DO-160, paragraph 4.4. During the test, the instrument shall operate electrically and mechanically and the requirements of paragraph 5.1 of this Standard shall be met. Following the test, the requirements of paragraph 4.0 of this Standard shall be met at standard conditions.

(b) High Temperature - The instrument shall be subjected to the tests of DO-160, paragraph 4.5.1 and 4.5.2. During the test, paragraph 4.5.1, the instrument shall operate electrically and mechanically and there shall be no evidence of materials such as potting and sealing compounds exuding or dripping from the instrument. When subjected to the tests of paragraph 4.5.2, the instrument shall operate electrically and mechanically and the requirements of paragraph 5.1 of this Standard shall be met. Following the test, the requirements of paragarph 4.0 of this Standard shall be met at standard conditions.

(c) Altitude - The instrument shall be subjected to the tests of DO-160, paragraphs 4.6.1, 4.6.2, and 4.6.3. During the test, paragraph 4.6.1, the instrument shall operate electrically and mechanically and the requirements of paragraph 5.1 of this Standard shall be met. After being subjected to the tests of paragraph 4.6.2, the requirements of paragraph 4.0 of this Standard shall be met at standard conditions, and after being subjected to the tests of paragraph 4.6.3, the requirements of paragraph 4.0 shall be met.

(d) Humidity - The instrument shall be subjected to the tests of DO-160, paragraph 6.0. After the instrument is subjected to the appropriate tests of paragraph 6.0, it shall meet the requirements of paragraph 4.0 of this Standard at standard conditions.

5.3 Shock: The instrument shall be subjected to the tests of DO-160, paragraphs 7.1 and 7.2.

(a) After the instrument is subjected to the tests of paragraph 7.1, it shall meet the requirements of paragraph 4.0 of this Standard under standard conditions.

(b) Following the tests of paragraph 7.2, the instrument or dummy load shall have remained in its mounting and no parts of the instrument or its mounting base become detached and free of the shock tested equipment.

5.4 Vibration: The instrument shall be subjected to the tests of DO-160, paragraph 8.2. During the test, it shall operate electrically and mechanically and the requirements of paragraph 5.1 shall be met. Following the test, the requirements of paragraph 4.0 of this Standard shall be met at standard conditions.

5.5 Power Input:

(a) Normal Electrical Input Varaition Test

1. The instrument shall be subjected to the tests of DO-160, paragraph 16.3.1. During the test, it shall meet the requirements of paragraph 5.1 of this Standard.

2. The instrument shall be subjected to the tests of DO-160, paragraph 16.3.2. During the test, it shall meet the requirements of paragraph 5.1 of this Standard.

(b) Abnormal Electrical Input Variations Test

1. The instrument shall be subjected to the tests of DO-160, paragraph 16.3.3. During the test, it shall operate electrically and mechanically, and degradation of performance is permissible. There shall be no evidence of the presence of fire or smoke during the test of paragraph 16.3.3.2. After returning to normal input it shall meet the requirements of paragraph 4.0 of this Standard.

2. The equipment shall be subjected to the tests of DO-160, paragraph 16.3.4. During the test, it shall work electrically and mechanically, with degraded performance. There shall be no evidence of the presence of fire or smoke during the test of paragraph 16.3.4.2. After returning to normal power input it shall meet the requirements of paragraph 4.0 of this standard.

3. The equipment shall be subjected to the tests of DO-160, paragraph 16.3.5. After returning to normal power input, it shall meet the requirements of paragraph 4.0 of this Standard.

5.6 Conducted Voltage Transients: The instrument shall be subjected to the tests of DO-160, paragraph 17.0.

(a) Intermittent Transients - Following the tests of paragraph 17.3.2 or paragraph 17.4.1, as appropriate, the instrument shall meet the requirements of 4.0 of this Standard.

(b) Repetitive Transients - When the instrument is subjected to the tests of paragraph 17.4.2, it shall meet the requirements of paragraph 5.1 of this Standard.

5.7 Conducted Audio Frequency Susceptibility Test: The instrument shall be subjected to the tests of DO-160, paragraph 18.0. During the tests, it shall meet the requirements of paragraph 5.1 of this Standard.

5.8 Audio Frequency Magnetic Field Susceptibility: The instrument shall be subjected to the tests of DO-160, paragraph 19.0. During the tests, it shall meet the requirements of paragraph 5.1 of this Standard.

5.9 Radio Frequency Susceptibility and Emission Tests: The instrument shall be subjected to the tests of DO-160, paragraphs 20.0 and 21.0. During the tests, it shall meet the requirements of paragraph 5.1 of this Standard.

5.10 Magnetic Effect: The instrument shall be tested in accordance with DO-160, paragraph 15.0.

5.11 Explosion: Instruments which are to be marked Explosion, Category E, shall be tested in in accordance with DO-160, paragraph 9.0.

5.12 Waterproofness: Instruments which are to be marked Waterproofness, Category W, shall be tested in accordance with DO-160, paragraph 10.0. Following this test, the instrument shall meet the requirements of paragraph 4.0 of this Standard.

5.13 Hydraulic Fluid: Instruments which are to be marked Hydraulic Fluid, Category H, shall be tested in accordance with DO-160, paragraph 11.0. Following this test, the instrument shall meet the requirements of paragraph 4.0 of this Standard.

5.14 Sand and Dust: Instruments which are to be marked Sand and Dust, Category D, shall be tested in accordance with DO-160, paragraph 12.0. Following this test, the instrument shall meet the requirements of paragraph 4.0 of this Standard.

5.15 Fungus Resistance: Instruments which are to be marked Fungus Resistance, Category F, shall be tested in accordance with DO-160, paragraph 13.0. Following this test, the instrument shall meet the requirements of paragraph 4.0 of this Standard.

5.16 Salt Spray: Instruments which are to be marked Salt Spray, Category S, shall be tested in accordance with DO-160, paragraph 14.0. Following this test, the instrument shall meet the requirements of paragraph 4.0 of this Standard.

5.17 Case Grounding: Metallic or other conductive instrument cases shall be connected to aircraft ground through a connector pin. This may be the same pin used for input power low or system ground.

6. MINIMUM ACCEPTANCE TEST REQUIREMENTS UNDER STANDARD CONDITIONS: Tests shall be performed on each Direction Instrument produced to show compliance with the following paragraphs of this Standard:

4.1	Starting
4.2	Roll, Pitch, and Yaw
4.3	Heading Stability
5.5(b)3.	Transient Surge Test

7. TEST PROCEDURES: The following definitions of terms and conditions of tests are applicable to the equipment tests specified herein:

7.1 Atmospheric Conditions: Unless otherwise specified, all tests required by this Standard must be conducted at an atmospheric pressure of approximately 29.92 inches (760 mm) of Mercury, an ambient temperature of approximately +77°F (+25°C), and a relative humidity of not greater than 85 percent. When tests are conducted with the atmospheric pressure or temperature substantially different from these values, allowance must be made for the variation from the specified conditions.

7.2 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 inches (0.05 to 0.03 mm) double amplitude at a frequency of 25 to 33 Hertz. The term "double amplitude" as used herein indicates the total displacement from positive maximum to negative maximum.

7.3 Power Conditions: Unless otherwise specified, all tests must be conducted at the power rating recommended by the manufacturer.

7.4 Mounting Position: Unless otherwise specified, all tests must be made with the instrument (indicator, gyroscope, etc.) mounted in the normal operating position.

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