



Designation: F3011 – 21

Standard Specification for Performance of Angle of Attack System¹

This standard is issued under the fixed designation F3011; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This performance specification covers simple systems that provide angle-of-attack information to a pilot, aircraft, or other systems.

NOTE 1—More complex AoA systems can be addressed in annexes in the future.

1.2 In this performance specification, functional operation and minimum performance requirements for an angle-of-attack system are established.

1.3 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *RTCA Standard*:²

DO-160G (or later released version) **Environmental Conditions and Test Procedures for Airborne Equipment**

3. Terminology

3.1 *Definitions*:

3.1.1 *angle of attack, AoA, n* —acute angle between an aircraft's wing chord, wing mean chord, or other defined aircraft longitudinal axis, and the direction of the relative free stream wind.

¹ This test method is under the jurisdiction of ASTM Committee F39 on Aircraft Systems and is the direct responsibility of Subcommittee F39.03 on Design of Avionics Systems.

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² Available from RTCA, Inc., 1150 18th St., NW, Suite 910, Washington, DC 20036, <https://www.rtca.org/>.

3.1.2 *AoA system, n* —collection of components used to provide AoA information to the pilot, aircraft, or other systems.

3.1.2.1 *Discussion*—This may include simple or complex systems, depending on the intended use.

4. General Requirements

4.1 *Product Identification*—One of the major components of an AoA system, shall be labeled with the following information:

- 4.1.1 Part Number,
- 4.1.2 Serial Number, and
- 4.1.3 Manufacturer's Name.

4.2 *Operating Conditions*—The system manufacturer shall specify the following limitations for proper function:

- 4.2.1 The angular operational range of the system,
- 4.2.2 Voltage operating range (min/max), if applicable,
- 4.2.3 Electrical load specifications, if applicable, and
- 4.2.4 Restrictions regarding the use and application of deicing fluids with the system, if applicable.

4.3 *Installation Manual*—The manufacturer of the AoA system shall provide an installation manual that specifies the following information so that an installer can determine appropriate use for an aircraft installation:

- 4.3.1 A full description of the intended function of the system,
- 4.3.2 An explicit compliance statement to this standard, Specification F3011,
- 4.3.3 The operation limitations (including the items in 4.2, Operating Conditions),
- 4.3.4 The environmental conditions (including items in Section 6, Environmental Requirements),
- 4.3.5 Installation and calibration instructions required for safe, accurate, and proper operation of all intended functions of the system, and
- 4.3.6 *Instructions for Continued Airworthiness*—The manufacturer of the AoA system shall provide continued airworthiness procedures necessary to ensure safe and accurate operation (calibration, alignment to aircraft, maintenance, etc.).

4.4 *User's Manual*—The manufacturer of the AoA system shall provide a user's manual that specifies:

- 4.4.1 The functional operation of the system (including items in Section 5, Functional Requirements).

4.5 The operating instruction shall be a separate document or clearly stated section of the User's Manual rather than part of the Installation Manual.

5. Functional Requirements

5.1 *Basic Operation*—The manufacturer shall clearly specify the functional characteristics of the system including:

5.1.1 The resolution of the AoA indication over the specified range. The resolution may vary over the range. The stated resolution need not be in degrees but may be in units consistent with the indication (for example, percent of green band, number of LEDs, degrees, percent of full scale, etc.).

5.1.2 The minimum accuracy of the AoA indication over the specified range. The following accuracies should be used for the AoA range between the zero-lift angle of attack ($\alpha_{\text{Zero Lift}}$), and the stall angle of attack ($\alpha_{\text{CL Max}}$):

$$\alpha\% = \alpha - \alpha_{\text{Zero Lift}} \\ (\alpha_{\text{CL Max}}) - (\alpha_{\text{Zero Lift}}) \\ \alpha\% > 0.50 + 4.0^\circ \\ \alpha\% < 0.50 + 2.0^\circ$$

The zero-lift angle of attack is not required to be defined for multiple aircraft configurations (for example, flaps, gear, etc.).

5.1.3 The range of sideslip angles for which specifications above are valid. The range should be a minimum of $+5^\circ$ of sideslip.

5.1.4 These characteristics shall be verified by test of a representative system. This test need not consider the effects of installation on an aircraft and may be done in a wind tunnel, on an aircraft, or other testing device.

5.2 *Stall Indication*—If the system indicates a stall, the system shall clearly and intuitively indicate the approach, or trend, to critical AoA considering use of at least two different types of attention-getting cues (that is, visual, aural, tactile).

5.3 *Startup of Electronically Driven Systems*—If an AoA system is electronically driven, it shall meet all performance requirements within 3 min of power application unless the system suppresses the indication, or clearly indicates an invalid indication, until performance requirements are met.

5.4 *Accessibility of Controls*—Adjustments not normally made during flight (for example, setup, calibration, etc.) shall not be accessible from the top-level user interface (that is, there must be a menu or special entry that requires a deliberate action to enter setup mode).

5.5 *Software*—If the system uses software, it shall function as described in the system's user manual. The software configuration shall be controlled by the manufacturer. The revision level shall reside on, or in, the product such that a user can view it.

6. Environmental Requirements

6.1 The system shall meet the following parameters specified by the manufacturer:

6.1.1 *Operating Temperature Range*—The temperature range that the system correctly functions and is not adversely affected at standard pressure.

6.1.2 *Storage/Survival Temperature Range*—The temperature range across which the system is exposed and not permanently damaged.

6.1.3 *Operating Humidity Range*—The non-condensing humidity range at standard temperature and pressure that the system correctly functions, and is not adversely affected.

6.1.4 *Operating Altitude Range*—The altitude range that the system correctly functions and is not adversely affected at standard temperature.

6.1.5 *Operating Airspeed Range*—The airspeed range that the system correctly functions and is not adversely affected.

6.1.6 *Precipitation*—The precipitation conditions for which the system properly functions and is not adversely affected. At a minimum, the system shall correctly function and not be adversely affected during flight through rain.

6.2 *Icing*—The system shall not be permanently damaged when icing occurs on system components that are designed to be exposed to environments external to the aircraft.

6.3 *Deicing Fluids*—If deicing fluids are permitted by the manufacturer, the system shall not be negatively affected by the use of deicing fluids or the application of these fluids from pressure sprayers.

6.4 *Emissions of RF Energy*—The system shall not be the source of objectionable interference, under operating conditions at any frequencies used on aircraft.

6.4.1 The performance levels in DO-160G (or later released version), Section 21.0, Category M, for conducted and radiated RF emissions meet the requirements above.

6.5 *Electrical Power Input*—If the system uses electrical power from the aircraft, it shall function throughout the entire voltage operating range specified by the manufacturer.

6.6 *Power Input Abnormal Surge Voltage*—If the system uses direct current (dc) electrical power from the aircraft, it shall pass the following:

6.6.1 With the equipment operating at its maximum operating voltage, apply to the positive (dc) input lead voltage surges of two times maximum operating voltage $-0/+5\%$ Vdc for 100 ms. The rise time shall be less than or equal to 1 ms and the fall time shall be less than or equal to within 5 ms. Apply each voltage surge three times at 10-s, or less, intervals. Following this test, the system shall operate normally.

6.6.2 The required surge voltages as measured at the input terminals of the unit under test (UUT) shall be achieved regardless of the required surge current.

7. Keywords

7.1 aircraft; angle-of-attack system; AoA