

1. **PURPOSE:** To specify minimum requirements for Flight Directors for use in aircraft, the operation of which may subject the equipment to the environmental conditions specified in Section 3.3.
2. **SCOPE:** This Aeronautical Standard covers Flight Directors for use on aircraft to indicate to the Pilot, by visual means, the correct control application for the operation of an aircraft in accordance with a pre-selected flight plan.
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 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 each of the major components or attached thereto:
 - a. Name of the unit and type of Flight Director.
 - b. SAE Aeronautical Standard AS-420.
 - c. Manufacturer's part number.
 - d. Manufacturer's serial number or date of manufacture.
 - e. Manufacturer's name and/or trade mark.
 - f. Rating (electrical power supply - if required).
 - 3.3 **Environmental Conditions:** The following conditions have been established as design criteria only. Tests shall be conducted as specified in Sections 5, 6 and 7.
 - 3.3.1 **Temperature:** When installed in accordance with the instrument manufacturer's instructions, the instruments 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:

Instrument Location	A	B
Powerplant Accessory Compartment	-30 to 130 C	-65 to 130 C
Heated Areas (Temperature Controlled)	-30 to 50 C	-65 to 70 C
Unheated Areas (Temperature Uncontrolled)	-55 to 70 C	-65 to 70 C

Section 7C of the SAE Technical Board rules provides that: "All technical reports, including those approved and practices recommended, are advisory only. Their use by anyone engaged in industry or trade is entirely voluntary. There is no agreement to adhere to any SAE standard or recommended practice, and no commitment to conform 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 liability for infringement of patents."

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3.3.2 Humidity: All units 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 Altitude: All units shall function and shall not be adversely affected when subjected to a pressure and temperature range equivalent to -1000 feet to +40,000 feet standard altitude, except as limited by application of Section 3.3.1.

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

<u>Type of Component Mounting</u>	<u>Cycles Per Minute</u>	<u>Max. Double Amplitude</u>	<u>Maximum Acceleration</u>
Airframe Structure-Mounted	300-30,000	.050"	10 g.
Shock-Mounted Panel	300-3000	.020"	1.5 g.
Powerplant-Mounted	300-30,000	.100"	20 g.

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 electronic equipment installed in the same aircraft as the instrument.

4. DETAIL REQUIREMENTS:

4.1 Indication:

4.1.1 Flight Director Indicator:

4.1.1.1 Steering Control Indication: A steering pointer shall be provided which moves right and left of a zero reference. Departure of the steering pointer from the zero reference shall result from any one, or any combination, of the following signals required to indicate correct control application;

- a. Displacement of the aircraft heading to the right of the pre-set heading shall deflect the pointer to the left of the zero reference.
- b. Displacement of the aircraft in roll to the right shall deflect the pointer to the left of the zero reference.
- c. Displacement of the aircraft to the right of a radio course line shall deflect the pointer to the left of the zero reference.

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4.1.1.2 Pitch Control Indication: A pitch control pointer shall be provided which moves above and below a zero reference. Displacement of the aircraft about the pitch axis shall deflect the pointer with respect to the zero reference to indicate pitch angle displacement.

Provisions shall be made for combining the aircraft pitch displacement signal and the glide slope displacement signal in such a manner that a direct indication of correct control application is provided to seek and maintain flight along the glide path. When altitude control is provided in the equipment, pitch displacement and altitude displacement shall be combined in such a manner that a direct indication of correct control application is provided for constant altitude flight.

4.2 Heading Selector: Means shall be provided to permit setting the desired magnetic heading into the Flight Director System. Indication of the heading selected shall be continuously provided.

4.3 Manual Pitch Knob: Means shall be provided for manually setting the pitch control pointer to zero reference during climbs and descent such that a true indication is thus provided of correct control application to seek and maintain flight at the desired pitch angle. This manual setting feature may be ineffective during approach and constant altitude modes of operation.

4.4 Function Selector(s): Means shall be provided for selecting the operational mode (as applicable) for the Flight Director such as:

- a. Flight Instrument
- b. Radio Course
- c. Approach (ILS)
- d. Altitude Control

4.5 Attitude Limiter: Provision shall be made to limit the control indications so that pre-set maximum values of bank and pitch shall not be exceeded.

4.6 Safety Provisions:

4.6.1 Interlock Provisions: Provisions shall be made to prevent simultaneous application of approach and constant altitude control.

4.6.2 Power Indication: Unless incorporated in the instrument, means shall be provided to permit the use of a device to indicate whether the Flight Director is receiving power. The indication shall be readily visible under currently accepted aircraft lighting.

4.6.3 Reliability: The Flight Director design shall be such as to preclude (insofar as possible) any hazardous maneuver resulting from malfunction unless an indicating means is provided to warn against such malfunction.

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4.7 Power Variations: All units shall function with +15% variation in DC voltage and/or +10% variation in AC voltage and frequency, provided the AC voltage and frequency vary in the same direction.

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. When tests are conducted 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:

5.2.1 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 Section 3.3.4 with the following characteristics:

5.3.1 Linear Motion Vibration: Vibration equipment for airframe structure-mounted or powerplant-mounted instruments or equipment shall be such as to allow vibration to be applied along each of three mutually perpendicular axes of the test specimen.

5.3.2 Circular Motion Vibration: Vibration equipment for shock mounted panel instruments shall be such that a point on the instrument case will describe, in a plane inclined 45° to the horizontal plane, a circle, 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 conducted with the units mounted in their normal operating position.

6. INDIVIDUAL PERFORMANCE TESTS: All of the various units or complete system shall be tested in accordance with the manufacturer's recommendations. The manufacturer shall conduct sufficient tests to prove compliance with this Aeronautical Standard, including the following requirements, where applicable:

6.1 Dielectric: The insulation resistance shall not be less than 5 megohms.