Society of Automotive Engineers, Inc.
TWO PENNSYLVANIA PLAZA, NEW YORK, N.Y. 10001

AEROSPACE INFORMATION REPORT

AIR 818B

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AIRCRAFT INSTRUMENT STANDARDS: WORDING, TERMINOLOGY, PHRASEOLOGY, ENVIRONMENT AND DESIGN STANDARDS FOR

INTRODUCTION

This AIR is intended to provide the sponsors of Minimum Performance Instrument Standards with standard wording and with minimum environmental and design requirements for use in the preparation of their document.

The individual sponsor shall use only those parts of this AIR which apply to his particular document.

The individual sponsor shall expand the standard wording, especially section 4 of part I and section 6 of part II as required for his particular document.

The paragraphs of this AIR shall be used verbatim wherever possible.

Unless otherwise directed by the Committee, cross-referenced documents shall be called out by specific revision letter, e.g. ". . . shall be in accordance with AS XXXA." In addition, non-SAE document callouts shall include the document title. However, every effort shall be made to keep cross-referencing to an absolute minimum.

TITLE

(Reciprocating Engine Powered Aircraft)

OR

TITLE

(Turbine Powered Aircraft)

Unless otherwise directed by the committee, the balance of the document shall be broken up into two sub parts:

PART I

MINIMUM PERFORMANCE STANDARD FOR EQUIPMENT

1. PURPOSE

This Aerospace Standard establishes the essential minimum safe operational performance requirements for _____ instruments primarily for use with (reciprocating engine (turbine)) powered aircraft certificated under part 25 of the Federal Aviation regulations.

2. SCOPE

This Aerospace Standard covers _____ or

SCOPE

This Aerospace Standard covers _____ basic types of (no capitals) instruments as follows:

Type I: _____

Type II: _____

NOTE: Each type number to be followed by a brief description. As many types as required may be used.

2.1 Applicable Documents: The following documents shall form a part of this specification to the extent specified herein. In event of conflict between these documents and this standard, the contents of this standard shall govern.

2.1.1 Federal Air Regulations: List all appropriate documents identifying them with the date of issue.

2.1.2 Military Specifications: List all appropriate documents.

2.1.3 SAE Documents: List all appropriate documents.

2.1.4 Other: List all other appropriate documents (i.e., RTCA, ATA, AIA, etc.).

3. GENERAL REQUIREMENTS

3.1 Materials 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 legible and permanently marked on the instrument or nameplate attached thereto:

(a) Name of instrument.

(b) FAA TSO number (or SAE AS number or equivalent approval identification).

(c) Manufacturer's part number.

(d) Manufacturer's serial number or date of manufacture.

(e) Manufacturer's name and/or trademark.

(f) Range (if applicable).

(g) Rating (electrical, pneumatic, vacuum, etc.) if applicable.

(h) Environmental catagories.

(i) Aircraft identification (if applicable).

3.3 Compatibility of Components: If components are individually acceptable, but require matching for proper operation, they shall be identified in a manner that will assure proper matching.

3.4 Environmental Conditions: The minimum safe operational performance requirements specified in section 4 shall apply over the entire range of environmental conditions to which the instrument may be subjected as further specified in part II hereto.

3.5 Power Variation: The instrument shall properly function with plus or minus 15% variation in dc voltage and/or plus or minus 10% variation in ac voltage and plus or minus 5% variation in frequency or hydraulic pressure limits of plus or minus 30% of rated value.

3.6 Explosion Proof: The instrument, when intended for installation either in uninhabited areas of non-pressurized aircraft or non-pressurized areas of pressurized aircraft shall not cause an explosion when operated in an explosive atmosphere. The instrument shall meet the requirements of section 4 hereof.

3.7 Fire Hazard: The instrument shall be so designed as to safeguard against hazards to the aircraft in the event of malfunction or failure, and the maximum operating temperature of surfaces of any instrument component contacted by combustible fuel or vapor shall not exceed 200 C due to self heating.

All materials shall be noncombustible and shall not liberate gases or fumes which will result in such corrosion as to cause malfunction of equipment or discoloration of dials or indicia, nor shall toxic gases or fumes that are detrimental to performance of the aircraft or health of personnel be liberated under the operating conditions specified herein.

3.8 Radio Interference: The instruments shall not be a source of objectionable interference under operating conditions at any frequencies used on the aircraft, either by radiation, conduction, or feedback in any electronic equipment installed in the same aircraft as the instruments, in accordance with RTCA report DO-138, latest revision.

3.9 Magnetic Effect: The magnetic effect of the instruments shall not adversely affect the performance of other instruments installed in the same aircraft.

3.10 Decompression: When installed in accordance with the instrument manufacturer's instructions, the instrument shall function and not be adversely affected following exposure to a pressure decrease from 22 to 0.64 in. of mercury in 5 seconds.

3.11 Outgassing: The instrument shall be so designed as to safeguard against hazards to the aircraft and crew, and/or malfunction of the instrument due to outgassing of organic compounds when subjected to a vacuum equivalent to 0.50 in. of mercury for a period of two hours.

3.12 Interchangeability: Instruments and components which are identified in accordance with 3.2 shall be directly and completely interchangeable.

3.13 Definitions: Definitions shall be in accordance with AS 425, Flight Control Compartment Nomenclature and Abbreviations, and as noted in the glossary of terms defined in paragraph 9 of Part II.

4. DETAIL REQUIREMENTS

4.1 Equipment Functions:

4.1.1 Required Functions: The following functions shall be required of equipment identified as conforming to this Aerospace Standard:

(Use subsequent subparagraphs to identify the required functional operation of the equipment.)

4.1.2 Optional Functions: The equipment identified as conforming to this Aerospace Standard may also perform additional optional functions which may include, but not be limited to, the following:

(Use subsequent subparagraphs to identify any optional equipment functions.)

4.2 Instrument Markings:

4.2.1 Finish: Unless otherwise specified by the user, matte white material shall be applied to all graduations, numerals and indication means. Non-functional surfaces, knobs and markings shall be durable dull black or gray.

4.2.2 Graduation: The graduations shall be arranged to provide the maximum degree of readability consistent with the accuracy of the instrument.

4.2.3 Numerals: The display shall include sufficient numerals to permit quick and positive identification of each significant graduation.

4.2.4 Instrument Title: The instrument title, when used, shall be of the same approximate size but no larger than the numerals. The title may be of the same finish as the numerals. The units of measure ("PSI x 100," "Degrees C," "In. Hg. Abs," as applicable) shall appear on the dial in lettering noticeably smaller than either the numerals or the title. All letters and numerals shall conform to military standard drawing MS33558.

4.2.5 Instrument Function: Where more than one function is displayed on a single instrument, the function name, when used, shall be of the same approximate size but no larger than the numerals and/or instrument title.

4.2.6 Visibility: The indicating means (indicia, pointers, counters, etc.) shall be completely visible from all points within a space defined by a surface generated by lines making angles of at least 30 degrees with a perpendicular to the display surface and diverging from the perimeter of the instrument window aperture. The distance between the dial and the cover glass shall be a practical minimum.

4.3 Function, Indicating Means: The function shall be indicated by means of one or more pointers, dials, tapes, drums or any compatible combination thereof. Unless otherwise specified, relative motion of the index with respect to the scale (either the index or the scale may be the moving element) shall be clockwise, up or to the right for increasing function.

4.4 Internal Lighting: Red internal lighting shall be in accordance with ARP 582 Lighting, Integral, for Aircraft Instruments; Criteria for Design. White internal lighting shall be in accordance with ARP 798, Design Criteria for White Incandescent Lighted Aerospace Instruments.

4.5 Ambiguity: Appropriate means shall be provided to prevent ambiguous indications within the extremes of operating range of the instrument.

4.6 Power Failure and Malfunction Monitoring:

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

4.6.2 Fail-Safe Provisions: No single failure or malfunction of the instrument shall introduce unsafe transients to associated interconnected instruments.

4.6.3 Malfunction Indication: Means shall be incorporated in the instrument to permit electrical and/or mechanical malfunctions, other than power failure, to be monitored by some appropriate means. Such monitoring means shall indicate malfunctions in a positive manner.

4.7 Hermetic Sealing: When hermetically sealed, the case shall be filled with an inert gas, free of dust particles, and sufficiently dry so that fogging of the indicator glass does not occur during the low temperature and fogging tests of this Aerospace Standard.

4.8 Synchro Requirements: The synchro requirements shall be in accordance with the characteristics specified in ARP 461B, Synchros.

4.9 Gyro Caging: If a gyro caging means is provided, it shall not be capable of locking the gyro in a caged position. Any malfunction which causes the gyro to remain caged shall be indicated in a positive manner on the face of the instrument affected.

4.10 Altitude and Differential Pressures: Altitude pressure values shall be in accordance with those specified in "US Standard Atmosphere, 1962." Differential pressure values shall be per NASA Technical Note D-822, "Table of Airspeed, Altitude, and MACH Number based on latest International Values for Atmospheric Properties."

PART II

PERFORMANCE TEST PROCEDURES

5. TEST CONDITIONS

Unless otherwise specified below, equipment meeting the requirements of this standard shall be tested under the conditions specified in Section 3.0 of RTCA Report DO-138.

5.1 Atmospheric Conditions: Unless otherwise specified herein, all tests required by the Aerospace Standard shall be made at an atmospheric pressure of approximately 29.92 in. of mercury, an ambient temperature of approximately 25 C and a relative humidity of not greater than 85 percent. When tests are conducted with the atmospheric pressure of temperature substantially different from these values, allowance shall be made for the variation from the specified conditions, per RTCA Report DO-138.

5.2 Power Conditions: Except as otherwise specified herein, all tests shall be conducted at the power rating recommended by the manufacturer.

5.3 Position: All tests shall be conducted with the instrument mounted in its normal operating position except as otherwise specified herein.

5.4 Supplemental Heating/Cooling: Should supplemental heating or cooling be required by the equipment to assure conformance with this standard, it shall be the responsibility of the manufacturer to specify such requirements in the detailed equipment specification.

6. INSTRUMENTATION FOR PERFORMANCE TESTS

6.1 Vibration Equipment: Vibration equipment shall be such as to allow vibration to be applied along each of three mutually perpendicular axes of the instrument at frequencies and amplitudes consistent with the requirements of 3.4.3 (Part I).

6.2 Test Synchros: Synchro transmitters used to provide test input and/or output functions to the instrument shall be in accordance with the requirements specified in ARP 461B, Synchros.

6.3 Test Potentiometers: Potentiometers used to provide test input functions to the instrument shall be precision potentiometers with an impedance of _____OHMS ± _____%, a resolution of 0.01%, and a linearity of at least 0.005 percent.

6.4 Other Instrumentation: All other instrumentation used in the tests in this ARP should have an accuracy of at least ten times better than the tolerances specified for the instrument under test.

7. PERFORMANCE TESTS

All instruments shall be subjected to tests by the instrument manufacturer to demonstrate specific compliance with this Aerospace Standard, including the following requirements where applicable.

7.1 Dielectric: Ungrounded instruments, or internally grounded instruments with the internal grounds disconnected, shall be tested by the method of inspection listed in 3.1.1 and 3.1.2.

7.1.1 Insulation Resistance: The insulation resistance measured at 200 volts DC for five seconds between all electrical circuits and the metallic case shall not be less than 5 megohms. Insulation resistance measurements shall not be made to circuits where the potential will appear across elements such as windings, resistors, capacitors, etc., since this measurement is intended only to determine adequacy of insulation.

7.1.2 Overpotential Tests: The instruments shall not be damaged by the application of a test potential between electrical circuits, and between electrical circuits and the metallic case. The test potential shall be a sinusoidal voltage of a commercial frequency with an R.M.S. value of five times the maximum circuit voltage or per 3.1.2.1 or 3.1.2.2, whichever applies. The potential shall start from zero and be increased at a uniform rate to its test value. It shall be maintained at this value for five seconds, and then reduced at a uniform rate to zero.

Since these tests are intended to insure proper electrical isolation of the circuit components in question, these tests shall not be applied to circuits where the potential will appear across elements such as windings, resistors, capacitors, etc.

7.1.2.1 Hermetically sealed instruments shall be tested at five times the maximum circuit voltage up to a maximum test voltage of 200 volts R.M.S.

7.1.2.2 Circuits that operate at potentials below 15 volts are not to be subjected to overpotential tests.

7.2 Sealing: Hermetically sealed components containing helium shall be tested for leaks by means of a mass spectrometer type of helium leak detector or equivalent. The leak rate shall not exceed 0.0434 micron cubic feet per hour per cubic inch of filling gas at a pressure differential of one atmosphere.

Note: A micron cubic foot per hour leak rate is defined as that gas leakage which would change the pressure of one cubic foot of volume by the amount of one micron (one millionth of a meter of mercury) in one hour.

7.2.1 Hermetically sealed components filled with an inert gas other than helium shall be tested for leaks by being immersed in a suitable liquid such as water. The absolute pressure of the air above the liquid shall then be reduced approximately 1 in. Hg and maintained for 1 minute, or until air bubbles substantially cease to be given off by the liquid, whichever is longer. The absolute pressure shall then be increased to 2-1/2 in. Hg. Any bubbles coming from within the component case shall be considered as leakage and shall be cause for rejection. Bubbles which are the result of entrapped air on the various exterior parts of the case shall not be considered as a leak.

8. QUALIFICATION TESTS

As many instruments or components deemed necessary by the manufacturer to demonstrate that all instruments will comply with the requirements of this section shall be tested in accordance with the manufacturer's recommendations.

8.1 Environmental Tests: The equipment shall be tested in accordance with the procedures specified in RTCA Report DO-138 for the appropriate environmental catagories. As a minimum, the following tests shall be conducted:

a. Temperature and altitude tests, including decompression and overpressure tests.