

MANIFOLD PRESSURE INSTRUMENTS

1. **PURPOSE:** This Aerospace Standard establishes the minimum safe performance standards for manifold pressure instruments, primarily for use with aircraft reciprocating engines.
2. **SCOPE:** This Standard covers two basic types of manifold pressure instruments:

Type I - Direct Indicating

Type II - Remote Indicating; comprised of separate transmitter and indicator
3. **GENERAL STANDARDS:**
 - 3.1 **Material:** Materials shall be of a quality which experience and/or tests have demonstrated to be suitable and dependable for use in aircraft instruments.
 - 3.2 **Workmanship:** Workmanship shall be consistent with high grade instrument manufacturing practice.
 - 3.3 **Interchangeability:** Instruments and instrument systems which are identified with the same manufacturer's part or model number shall be completely interchangeable.
 - 3.4 **Compatibility:** If components of Type II instruments are individually acceptable but require matching for proper operation, they shall be identified in a manner that will insure performance to the requirements of this Standard.
 - 3.5 **Accessibility of Controls:** Controls, if provided, which are not normally adjustable in flight shall not be readily accessible to flight personnel when the instrument is installed in accordance with the manufacturer's instructions.

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- 3.6 **Self-Test Provisions:** Self-test provisions, if included, shall be spring-loaded or otherwise arranged to automatically return to the normal operating mode following self-testing.
- 3.6.1 **In-Flight Testing:** In-flight, self-test activation controls, if included, must provide a means to warn the pilot or appropriate flight crew member of this mode of operation.
- 3.6.2 **Combined Systems:** If the equipment contains integral arrangements to permit pre-flight and/or in-flight self-test checks on the operation of the equipment in combination with other aircraft subsystems, a means shall be provided to deactivate any subsystem which might be adversely affected during the self-test cycle.
- 3.6.3 **Effect of Tests:** The application of the specified tests shall not produce a condition which would be detrimental to the continued performance of the aircraft or the instrument.
- 3.7 **Malfunction Indication:** Means shall be provided to indicate malfunctions or failures of Type II instruments in a positive manner.
- 3.7.1 **Power Failure Indication:** Means shall be incorporated in the instrument to indicate when adequate electrical power (voltage and/or current of all required phases) is not being made available for proper operation of the instruments. Dial lights are considered to be self-indicating.
- 3.7.2 **Remote Indicator:** Means shall be incorporated to detect an internal malfunction or loss of information-valid signal from the remote source providing the information to be indicated.
- 3.8 **Fail-Safe Provisions:** No failure or malfunction of the instrument system shall introduce unsafe signal or power effects to associated equipment.
- 3.9 **Multiple Mode:** When an instrument has more than one mode of operation, each mode shall be identified and means shall be provided to indicate the mode.
- 3.10 **Display:**
- 3.10.1 **Indicating Means:** The functions shall be indicated by means of one or more pointers, dials, tapes, drums, digital displays or other devices. Unless otherwise specified, relative motion of the index with respect to the scale when moving elements are employed (either the index or the scale may be the moving element) shall be clockwise, up or to the right for increasing values. In a dual indicator, the pointers or other indicating means shall be clearly identified as 1 and 2 or as 3 and 4.
- 3.10.2 **Graduations:** The graduations shall be arranged to provide the maximum degree of readability consistent with the accuracy of the instrument.

- 3.10.3 **Numerals:** The display shall include sufficient numerals to permit quick and positive identification of each significant graduation.
- 3.10.4 **Ambiguity:** Appropriate means shall be provided to prevent ambiguous indications within the extremes of the operating range of the instrument.
- 3.10.5 **Instrument Title:** The instrument title, MANIFOLD PRESSURE or MANIF PRESS, shall be of the same approximate size but no larger than the numerals. The title may be of the same finish as the numerals.
- 3.10.6 **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.
- 3.10.7 **Units of Measure:** The units of measure (in Hg abs or cm Hg abs) shall appear on the display in lettering noticeably smaller than either the numerals or the title.
- 3.10.8 **Dial Finish:** Where applicable, unless otherwise specified by the user, matte white material shall be applied to graduations, numerals and pointers. Non-functional surfaces shall be dull black. The manufacturer's trademark shall not appear on the dial unless in black-on-black.
- 3.10.9 **Visibility:** Pointer(s) and dial markings shall be visible from any point within the frustrum of a cone, the side of which makes an angle of 30° with the perpendicular to the dial and the small diameter of which is the aperture of the instrument case. The distance between the dial and the cover glass shall be a practical minimum and shall not exceed .12 in (3.0 mm) for a single indicator and .19 in (4.8 mm) for a dual indicator.
- 3.11 **Cover Glass:** The cover glass of the instrument shall be clear, flat, colorless and free from flaws which would adversely affect the readability of the instrument. The total reflectance of the glass, including the integral lighting wedge, if applicable, shall not exceed 10% of the incident light. This reflectance applies over the visible light spectrum from 450 to 600 millimicrons and over an incident solid angle of 60° perpendicular to the viewing plane.
- 3.12 **Integral Lighting:** When integral lighting is provided, it must under normal cockpit lighting conditions make all markings within the required visibility angle easily readable. No direct light shall radiate from the instrument within an angle of 45° either side of the vertical center line of the instrument face in the horizontal plane, not above 30° to the longitudinal axis in the vertical plane.

- 3.13 **Temperature:** When installed in accordance with the manufacturer's instructions, the instrument shall function over the range of ambient temperatures shown in Column A, and shall not be adversely affected by exposure to the range of temperatures shown in Column B below:

<u>Instrument Location</u>	<u>A</u>	<u>B</u>
Engine or Engine Accessory Compartment	-30° to 100°C	-65° to 100°C
Heated Areas (Temperature Controlled)	-30° to 70°C	-65° to 70°C
Unheated Areas	-55° to 70°C	-65° to 70°C

- 3.14 **Altitude:** When installed in accordance with the instrument manufacturer's instructions, the instrument shall function and shall not be adversely affected following exposure to a pressure range equivalent to -1,000 to 40,000 feet of standard altitude. The instrument shall not be adversely affected when subjected to an ambient pressure of 50 in (127 cm) of Hg absolute.

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

<u>Instrument Location</u>	<u>Hz</u>	<u>Max. Double Amplitude</u>	<u>Maximum Accel.</u>
Engine Mounted	5-150	.100 in / 2.54 mm	20 g
Wing or Empennage	5-500	.036 in / .91 mm	10
Fuselage	5-500	.036 in / .91 mm	5

- 3.16 **Humidity:** The instruments shall function and shall not be adversely affected following exposure to any relative humidity in the range from 0 to 95% at a temperature of approximately 70°C.

- 3.17 **Operation:** The transmitter of a Type II instrument shall be capable of operating in either the horizontal or the vertical position.

- 3.18 **Pressure Stops:** Underpressure and overpressure stops shall be provided and shall be designed to restrain the prime mover. The stops shall allow the pointer or other indicating means to travel beyond full scale, but there shall be no overlap of low and high stopped positions.

- 3.19 **Noncorrosive Sealing:** Where applicable, the instrument mechanism shall be sealed from the pressure compartment by a metal diaphragm or bellows to prevent corrosive or explosive vapors from coming in contact with the mechanism.