



STANDARD

ANSI/ASHRAE Standard 41.3-2014
(Supersedes ASHRAE Standard 41.3-1989)

Standard Methods for Pressure Measurement

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NOTE

Approved addenda, errata, or interpretations for this standard can be downloaded free of charge from the ASHRAE Web site at www.ashrae.org/technology.

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FOREWORD

First published in 1989, Standard 41.3 is intended to help users select and apply suitable pressure measurement instruments. This revision of the standard updates the descriptions of pressure measurement instruments and provides tables of information to help users quickly identify the specific types of instruments that best suit their applications. New sections have been added regarding the test requirements, measurement uncertainty calculations, and test report. Additionally, this revision meets ASHRAE's mandatory language requirements.

1. PURPOSE

The purpose of this standard is to prescribe methods for measuring pressure.

2. SCOPE

The pressure measurement methods described herein are intended for use in testing heating, refrigerating, and air-conditioning equipment and components.

3. DEFINITIONS

The following definitions apply to terms used in this standard:

absolute pressure: normal force per unit area exerted by a fluid on a containing wall with respect to zero absolute pressure (a perfect vacuum). Absolute pressure can be positive only (see Figure 3-1).

accuracy: the degree of conformity of an indicated value to an accepted standard value, or true value. The degree of inaccuracy is known as the total measurement error and is the sum of bias error and precision error.

ambient pressure: the pressure in which a device operates.

barometric pressure: the pressure of the atmosphere relative to zero absolute pressure (a perfect vacuum). Standard atmospheric reference pressure (assumed at sea level) is defined by the International Civil Aeronautics Organization (ICAO) as 101.325 kPa, 1013.25 millibars, 14.696 psia, 29.921 in. Hg at 0°C (32°F).

bias, fixed, or systematic error: a persistent difference between the true or actual value to be measured and the indicated value from the measuring system, usually due to the particular instrument or technique of measurement. An error of this type can be corrected by calibration.

calibration: correcting or determining the error of an existing scale, or of evaluating one quantity in terms of readings from another.

differential pressure: difference in pressure between any two points in a system (see Figure 3-1).

error: the difference between the true value of the quantity measured and the measured value. All errors in experimental data can be classified as one of two types: systematic (fixed) errors or random (precision) errors. The terms *accuracy* and *precision* are often used to distinguish between systematic and random errors. A measurement with small systematic errors is said to be unbiased. A measurement with small random errors is said to have high precision. A measurement that is unbiased and precise is said to be accurate.

fixed error: same as *systematic error*.

gage (or gauge) pressure: pressure above or below ambient pressure (see Figure 3-1).

hysteresis: in control systems, the difference between the response of a system to increasing and decreasing signals.

precision: the closeness of agreement among repeated measurements of the same characteristic by the same method under the same conditions. Compare to *accuracy*.

precision error: same as *random error*.

pressure: normal force per unit area exerted by a fluid on a containing wall with respect to a reference.

pressure transducer or pressure sensor: a device that converts mechanical energy into an electrical output that is proportional to the mechanical stimulus.

pressure transmitter: a device that translates low-level electrical outputs from sensors into high-level electrical signals for transmission and processing.

pulsating pressure: random or oscillating pressure variations that are more frequent than 1 Hz. Pulsations less than or equal to 1 Hz are considered to be steady state.

random error: a statistical error that is caused by chance and is not recurring. Random errors cannot be corrected through calibration. There are two types of random errors: (a) additive errors that are independent of the magnitude of the observations and (b) multiplicative errors that are dependent on the magnitude of the observations.

resolution: the smallest change a sensor is able to detect in the quantity that it is measuring.

sensitivity: the ratio of the change in indicated value to the change in measured variable.

snubber: a device used to suppress pressure pulsations or fluctuations, or to protect internal gage mechanisms.

static pressure: pressure at a point where the fluid element is in equilibrium. Static pressure would be indicated by a pressure-sensing instrument at rest with respect to the fluid.

surroundings pressure: same as *ambient pressure*.

total pressure: the pressure on a plane normal to the local flow direction. It is the maximum value of pressure as a function of direction at a point, and it is equal to the summation of static pressure and velocity pressure: $p_t = p_s + p_v$. Total pres-