

ANSI/ASHRAE Standard 111-2008
(Supersedes ANSI/ASHRAE Standard 111-1988)



ASHRAE STANDARD

Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems

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NOTE

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FOREWORD

ANSI/ASHRAE Standard 111 was first published in 1988 with the title Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems. At the time of publication, the cognizant Technical Committee was TC 9.7, Testing and Balancing, which is now designated as Technical Committee 7.7. In 1992 the TC recommended that the standard be rewritten for testing and balancing in order to update procedures for the industry and to aid design engineers in writing a testing and balancing specification that would encompass the design ramifications of present-day HVAC systems.

Field test results are considered essential to designers, manufacturers, and installers to better enable them to evaluate the results of their design, equipment performance, and installation techniques under actual operating conditions. This revised standard updates the testing procedures for air, hydronics, and control verification; identifies new instrumentation used in today's testing; and incorporates the findings of several research projects that have established new means for testing. The standard also suggests how the Test and Balance Agency can interface with the Commissioning team.

This standard covers causes affecting a system's performance. Its intent is to convey the message that field testing can be repeated but will not necessarily provide the accuracy of factory testing. However, when the proper conditions exist—good engineering practices, realistic ratings, and good craftsmanship installation—adequate results can be obtained to satisfy a given set of design conditions within a reasonable set of limitations. Testing and balancing provides the means to determine and monitor system performance and may be utilized repeatedly long after the project is completed.

Testing and balancing reports provide many benefits that can be used

- a. to assist personnel responsible for the efficient operation of HVAC systems;*
- b. to provide a record of existing conditions;*
- c. to compare periodic tests to original conditions as a way to determine possible system deterioration or reduced efficiency;*
- d. to establish operating conditions whenever modifications or changes are made in the HVAC system;*
- e. to determine existing conditions for base energy-level calculations used in energy conservation programs;*
- f. to create procedures and reports that can be used to verify energy conservation results; and*
- g. to provide a comparison of design versus actual field performance.*

1. PURPOSE

To provide uniform procedures for measurement, testing, adjusting, balancing, evaluating, and reporting the performance of building heating, ventilating, and air-conditioning systems in the field.

2. SCOPE

2.1 This standard applies to building heating, ventilating, and air-conditioning (HVAC) systems of the air-moving and hydronic types and their associated heat transfer, distribution, refrigeration, electrical power, and control subsystems.

2.2 This standard includes

- a. methods for determining thermodynamic, hydraulic, hydronic, mechanical, and electrical conditions;
- b. methods for determining room air-change rates, room pressurization, and cross contamination of spaces;
- c. procedures for measuring and adjusting outdoor ventilation rates to meet specified requirements; and
- d. methods for validating collected data while considering system effects.

2.3 This standard establishes

- a. minimum system configuration requirements to ensure that the system can be field tested and balanced;
- b. minimum instrumentation required for field measurements;
- c. procedures for obtaining field measurements in HVAC testing and balancing and equipment testing; and
- d. formats for recording and reporting results.

2.4 The field data collected and reported under this standard are intended for use by building designers, operators, and users, and by manufacturers and installers of HVAC systems.

3. DEFINITIONS AND SYMBOLS

The following terms are used in this standard as they are defined below. For definitions of other technical terms, refer to the *ASHRAE Terminology of Heating, Ventilation, Air Conditioning, and Refrigeration*.

A_e factor: the effective area of an air terminal, which is equal to the measured airflow rate divided by the velocity reading of a particular instrument used in a prescribed manner.

fan velocity pressure: the velocity pressure corresponding to the average velocity through the fan outlet; the kinetic energy per unit volume of air exiting the fan.

(PD): abbreviation for pressure difference and ΔP .

sensitivity (instrument): a measure of the smallest incremental change to which an instrument can respond.

static discharge head: the static pressure of a fluid at the outlet of the pumping device, expressed in terms of the height of a column of the fluid or of the height of some manometric fluid that it would support.