CONTENTS

ANSI/ASHRAE Standard 215-2018 (RA 2021)
Method of Test to Determine Leakage of Operating HVAC Air Distribution Systems

SECTION **PAGE**

NOTE

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

(This foreword is not part of this standard. It is merely informative and does not contain requirements necessary for conformance to the standard. It has not been processed according to the ANSI requirements for a standard and may contain material that has not been subject to public review or a consensus process. Unresolved objectors on informative material are not offered the right to appeal at ASHRAE or ANSI.)

FOREWORD

As discussed in the 2016 and 2017 ASHRAE Handbook chapters "Duct Construction" (Chapter 19) and "Duct Design," (Chapter 21), heating, ventilating, and air-conditioning (HVAC) system air leakage significantly increases building energy consumption. For example, a leaky VAV system (e.g., 10% leakage upstream and 10% downstream of terminal box inlet dampers at operating conditions) can use 25% to 35% more fan energy than a tight system (e.g., 2.5% upstream and 2.5% downstream at operating conditions). For an exhaust system with 20% leakage, the fan has to move 25% more air to meet the specified flows at the grilles, which causes fan power to increase up to 95%. Leakage also reduces the system's ability to control and deliver intended flows and pressures and to manage the spread of contaminants. As such, there is a need to minimize leakage airflows during air-handling system operation.

Leakage test procedures currently used by industry focus on determining component airtightness (e.g., for ductwork located upstream of terminal box inlet dampers). Airtightness alone, however, is insufficient to determine leakage airflows. One must also then estimate system pressures during system operation to determine these flows. Determining the location of every leak and the pressure difference across each leak is practically impossible for most systems and can cause significant uncertainty in leakage airflow estimates using this approach.

To eliminate the uncertainty associated with estimating pressure differences across leaks, this standard provides a method of test for determining leakage airflows, either for the whole system or for selected parts. Flows into and out of the section being tested are measured at a repeatable reference operating condition: the difference is the leakage flow. The operating condition is not necessarily the design operating condition but corresponds to the greatest system inlet flow (outlet flow for exhaust systems) possible without being detrimental to the occupants of the building, the building structure, or the HVAC mechanical components, while maintaining the duct static pressure set point (where applicable) specified in design documents.

This standard does not mandate a calibration method for any instrument, nor does it dictate that the user employ a specific flow measurement technique. Informative Appendix A provides a general discussion of airflow measuring instrument technologies and their capabilities. Informative Appendix B provides recommended airflow measuring instrument calibration and verification procedures.

A simplified methodology for estimating leakage airflows downstream of terminal-box inlet dampers (Informative Appendix G) is also provided in this standard. This methodology can be used to distinguish leakage downstream of terminal-box inlet dampers from total leakage determined by this standard so that the user can determine where to focus potential sealing activities.

This is a reaffirmation of Standard 215-2018. This standard was prepared under the auspices of ASHRAE. It may be used in whole or in part by an association or government agency with due credit to ASHRAE. Adherence is strictly on a voluntary basis and merely in the interest of obtaining uniform guidelines throughout the industry. This version of the reaffirmation includes a clarification of the citation of ASHRAE Handbook—Fundamentals *in Section A1.1 and an update to Appendix H, "Informative References and Bibliography."*

1. PURPOSE

This standard specifies a method of test to determine leakage airflow and fractional leakage of operating HVAC air distribution systems and determines the uncertainty of the test results.

2. SCOPE

2.1 This standard is for field application in both new and existing buildings.

2.2 This standard can be applied to determine whole-system or sectional leakage airflow.

2.3 This standard provides

a. test procedures and requirements for measuring inlet and outlet airflows during system operation,
b. methods for calculating leakage airflows to/from system surroundings,

c. methods for calculating leakage test uncertainties,
d. methods for documenting the test plan, and
e. methods for reporting test results.

2.4 The test procedures in this standard are limited to single-duct supply and independent exhaust air systems.

2.5 This standard is not for determining return air leakage.

2.6 This standard is not for determining leakage involving ceiling and floor plenums, systems serving pressure-controlled spaces, or air dispersion systems.

2.7 This standard does not replace ductwork pressurization leakage testing.

2.8 This standard does not specify leakage acceptance criteria.

2.9 This standard shall not be used to override any safety, health, or critical process requirements.

3. DEFINITIONS

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

air dispersion systems: any diffuser system designed to both convey air within a room, space, or area and diffuse air into that space while operating under positive pressure. These systems are commonly, but not exclusively, constructed of fabric, sheet metal, or plastic film.

air terminal: device other than an air valve that modulates the volume of air delivered to or removed from a conditioned space in response to an external demand.

bias error: the difference or offset between the true or actual value to be measured and the mean indicated value from the measuring system that persists and is usually due to the particular instrument or technique of measurement. This error is determined and minimized through calibration.

confidence level: the probability that a stated interval will include the true value. In analyzing measured data, a confidence level of 95% (approximately two standard deviations) is often used. The level used in this standard for error analyses is one standard deviation (approximately 68%).

error: the difference between the true value of the quantity measured and an observed value. All experimental errors can be classified as one of two types: bias error or precision error.

exhaust system, independent: air discharged from a space to the outdoors by a system not coupled to supply or return air systems.

fractional leakage: leakage airflow for the system or a section, whichever is applicable, divided by the associated inlet airflow at the reference operating condition.

independent exhaust system: see *exhaust system, independent*.

leakage airflow: the aggregate sum of all airflows through leaks either to or from an air-handling system or a section, whichever is applicable and regardless of whether the leaks are unintentional or not, due to pressure differences applied across the leaks during system operation at the reference operating condition. Calculated leakage airflows are referenced to standard air density.

mechanical room plenum: plenum between the air-handling unit (AHU) and the return or relief fan that make up the economizer cycle.

outlet: for a single-duct supply system, a grille or diffuser. For an independent exhaust system, the system discharge.

precision error: a statistical error that is caused by chance or by stochastic temporal or spatial variations of factors affecting the measurement process and that is not necessarily recurring. It causes readings to take varying values on either side of the mean value. This error can often be reduced by increasing the number of observations.

pressure-controlled space: an enclosed space within a building, such as a laboratory space or hospital isolation space, that has automatically controlled pressure relationships. Whole-building pressure control is not defined as a pressure-controlled space within this standard.

reference flow: airflow at which an HVAC system operates during a leakage test.

reference operating condition: configuration, as applicable, of system fans and all other system components and commands necessary to achieve the desired operating condition. It corresponds to the greatest system inlet flow (outlet flow for exhaust systems) possible without being detrimental to the occupants of the building, the building structure, or the HVAC mechanical components, while maintaining the duct static pressure set point (where applicable) specified in design documents.

reference static pressure: static pressure at which a system operates during a leakage test.

relative humidity: the ratio of the vapor pressure of a moist air sample to the saturation vapor pressure at the same mixture temperature and pressure.

single-duct supply air distribution system: system in which the air, having been conditioned, is distributed to various zones through a single-duct system, in some cases through an air terminal, but not through air valves.

surroundings: where applicable, system surroundings include outdoors and conditioned or unconditioned spaces within the building.

system: in this standard, (a) portions of HVAC systems or (b) independent exhaust systems.

The portions of the HVAC system covered by this standard are

a. the supply air distribution ductwork between the air-handling unit (AHU) discharge and the conditioned space, including variable-air-volume (VAV) terminal units, coils, dampers, and sound attenuators, or
b. a portion of that supply air distribution ductwork.

Exhaust air systems, independent of the HVAC system, are also covered by this standard. The AHU, return ductwork, return or exhaust/relief fan, and outdoor air and exhaust air plenums are not covered by this standard.

test plan: a document or other written form of communication that specifies the requirements for conducting the test procedure and reporting the test results.

test section: see *system*.

uncertainty: a measure of the dispersion of potential error relative to the true value. Uncertainty reflects doubt in a measurement to a specified confidence level. Although uncertainty is the result of both bias and precision errors, only precision errors are treated by statistical methods. Bias errors correspond to a mean error and can be minimized through calibration. In this standard, instrument readings are corrected by subtracting mean bias errors, and uncertainty is analyzed only as a precision error.

[. . .]