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Standard Test Methods for Determining Airtightness of Buildings Using an Orifice Blower Door[1]

This standard is issued under the fixed designation E1827; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 These test methods describe two techniques for measuring air leakage rates through a building envelope in buildings that may be configured to a single zone. Both techniques use an orifice blower door to induce pressure differences across the building envelope and to measure those pressure differences and the resulting airflows. The measurements of pressure differences and airflows are used to determine airtightness and other leakage characteristics of the envelope.

1.2 These test methods allow testing under depressurization and pressurization.

1.3 These test methods are applicable to small indoor-outdoor temperature differentials and low wind pressure conditions; the uncertainty in the measured results increases with increasing wind speeds and temperature differentials.

1.4 These test methods do not measure air change rate under normal conditions of weather and building operation. To measure air change rate directly, use Test Methods E741.

1.5 The text of these test methods reference notes and footnotes that provide explanatory material. These notes and footnotes, excluding those in tables and figures, shall not be considered as requirements of the standard.

1.6 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.* For specific hazard statements see Section 7.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

E456 Terminology Relating to Quality and Statistics

E631 Terminology of Building Constructions

E741 Test Method for Determining Air Change in a Single Zone by Means of a Tracer Gas Dilution

E779 Test Method for Determining Air Leakage Rate by Fan Pressurization

E1186 Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems

E1258 Test Method for Airflow Calibration of Fan Pressurization Devices

2.2 *ISO International Standard:*[3]

ISO 9972 Thermal Insulation—Determination of Building Airtightness—Fan Pressurization Method

2.3 *Other Standard:*[3]

ANSI/ASME PTC 19.1—Part 1, Measurement Uncertainty, Instruments, and Apparatus

3. Terminology

3.1 *Definitions*—Refer to Terminology E456 for definitions of accuracy, bias, precision, and uncertainty.

3.1.1 ACH_{50}, *n*—the ratio of the air leakage rate at 50 Pa (0.2 in. H_2O), corrected for a standard air density, to the volume of the test zone (1/h).

3.1.2 *air leakage rate,* Q_{env}, *n*—the total volume of air passing through the test zone envelope per unit of time (m^3/s, ft^3/min).

3.1.3 *airtightness*, *n*—the degree to which a test zone envelope resists the flow of air.

NOTE 1—ACH_{50}, air leakage rate, and effective leakage area are examples of measures of building airtightness.

3.1.4 *blower door*, *n*—a fan pressurization device incorporating a controllable fan and instruments for airflow measurement and building pressure difference measurement that mounts securely in a door or other opening.

3.1.5 *building pressure difference, P*, *n*—the pressure difference across the test zone envelope (Pa, in. H_2O).

3.1.6 *fan airflow rate,* Q_{fan}, *n*—the volume of airflow through the blower door per unit of time (m^3/s, ft^3/min).

3.1.7 *nominal airflow rate,* Q_{nom}, *n*—the flow rate indicated by the blower door using the manufacturer's calibration coefficients (m^3/s, ft^3/min).

[1] These test methods are under the jurisdiction of ASTM Committee E06 on Performance of Buildings and are the direct responsibility of Subcommittee E06.41 on Air Leakage and Ventilation Performance.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

3.1.8 *orifice blower door*, *n*—a blower door in which airflow rate is determined by means of the pressure drop across an orifice or nozzle.

3.1.9 *precision index of the average*, *n*—the sample standard deviation divided by the square root of the number of samples.[3]

3.1.10 *pressure station*, *n*—a specified induced change in the building pressure difference from the initial zero-flow building pressure difference (Pa, in. H_2O).

3.1.11 *single zone*, *n*—a space in which the pressure differences between any two places, as indicated on a manometer, differ by no more than 2.5 Pa (0.01 in. H_2O) during fan pressurization at a building pressure difference of 50 Pa (0.2 in. H_2O) and by no more than 5 % of the highest building pressure difference achieved.

NOTE 2—A multiroom space that is interconnected within itself with door-sized openings through any partitions or floors is likely to satisfy this criterion if the fan airflow rate is less than 3 m^3/s ($6 \times 10^3 ft^3/min$) and the test zone envelope is not extremely leaky.

3.1.12 *test zone*, *n*—a building or a portion of a building that is configured as a single zone for the purpose of this standard.

NOTE 3—For detached dwellings, the test zone envelope normally comprises the thermal envelope.

3.1.13 *test zone envelope*, *n*—the barrier or series of barriers between a test zone and the outdoors.

NOTE 4—The user establishes the test zone envelope at such places as basements or neighboring rooms by choosing the level of resistance to airflow between the test zone and outdoors with such measures as opening or closing windows and doors to, from, and within the adjacent spaces.

3.1.14 *zero-flow building pressure difference*, *n*—the natural building pressure difference measured when there is no flow through the blower door.

3.2 *Symbols*—The following is a summary of the principal symbols used in these test methods:

Alt = altitude at site, m (ft),
C = flow coefficient at standard conditions, m^3/s (Pa^n) ft^3/min (in. H_2O^n),[4]
L = effective leakage area at standard conditions, m^2($in.^2$),
n = envelope flow exponent (dimensionless),
P = building pressure difference (see 3.1.5),
P_1 = average pressure, $\bar{P}_{sta}$, at the primary pressure station, Pa (in. H_2O),
P_2 = average pressure, $\bar{P}_{sta}$, at the secondary pressure station, Pa (in. H_2O),
P_{ref} = the reference pressure differential across the building envelope, Pa (in. H_2O),
P_{sta} = station pressure, Pa (in. H_2O),
P_{test} = test pressure, Pa (in. H_2O),
P_{zero1} = zero-airflow pressure before test, Pa (in. H_2O),
P_{zero2} = zero-airflow pressure after test, Pa (in. H_2O),
Q_{env} = the air leakage rate, m^3/s (ft^3/min),
Q_{env1} = average air leakage rate, $\bar{Q}_{env}$, at the primary pressure station, m^3/s (ft^3/min),
Q_{env2} = average air leakage rate, $\bar{Q}_{env}$, at the secondary pressure station, m^3/s (ft^3/min),
Q_{fan} = fan airflow rate (see 3.1.6),
Q_{nom} = nominal airflow rate (see 3.1.7),
T = temperature,° C (°F),
t = value from a two-tailed student t table for the 95 % confidence level,
δn = measurement uncertainty of the envelope flow exponent (dimensionless),
V_{zone} = volume of the test zone, m^3(ft^3),
δQ_{env} = measurement uncertainty of the average air leakage rate, m^3/s (ft^3/min),
δQ_{50} = the measurement uncertainty of Q_{50}, m^3/s (ft^3/min),
δQ_{bias} = estimated bias of the flow rate, m^3/s (ft^3/min),
δQ_{bias1} = estimated bias of the flow rate at the primary pressure station, m^3/s (ft^3/min),
δQ_{bias2} = estimated bias of the flow rate at the secondary pressure station, m^3/s (ft^3/min),
$\delta Q_{precision}$ = precision index of the average measured flow rate, m^3/s (ft^3/min),
δQ_{prec1} = precision index of the average measured flow rate at the primary pressure station, m^3/s (ft^3/min),
δQ_{prec2} = precision index of the average measured flow rate at the secondary pressure station, m^3/s (ft^3/min),
δP = measurement uncertainty of the average measured pressure differential across the building envelope, Pa (in. H_2O),
δP_{bias} = estimated bias of the pressure differential across the building envelope, Pa (in. H_2O),
δP_{bias1} = estimated bias of the pressure differential across the building envelope at the primary pressure station, Pa (in. H_2O),
δP_{bias2} = estimated bias of the pressure differential across the building envelope at the secondary pressure station, Pa (in. H_2O),
$\delta P_{precision}$ = precision index of the average measured pressure differential across the building envelope, Pa (in. H_2O),
δP_{prec1} = precision index of the average measured pressure differential across the building envelope at the primary pressure station, Pa (in. H_2O),
δP_{prec2} = precision index of the average measured pressure differential across the building envelope at the secondary pressure station, Pa (in. H_2O),
δV_{zone} = measurement uncertainty of the zone volume, m^3(ft^3),
μ = dynamic viscosity, kg/m·s (lbm/ft·hr),
ρ = air density, kg/m^3(lbm/ft^3), and