



# Standard Guide for Specifying and Evaluating Performance of Single Family Attached and Detached Dwellings—Indoor Air Quality<sup>1</sup>

This standard is issued under the fixed designation E2267; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## INTRODUCTION

This guide is part of a set which together presents a complete performance standard guide for specifying and evaluating single family attached and detached dwellings. The complete set in the series, when finished, is to include the attributes given in [Table 1](#).

The series provides a framework for specifying and evaluating qualities of building products and systems to meet user needs without limiting ways and means. The format for this guide includes performance statements that consist of four components, Objectives-Criteria-Evaluation-Commentary (O-C-E-C), which together provide a systematic performance based approach for the intended purpose. These performance statements are presented in [Section 8](#) against a Hierarchy of Building Elements as tabulated in [Table 2](#).

The purpose of these standard guides is to provide a standardized system for describing performance parameters of single-family attached or detached dwellings. This system standardizes the descriptions of performance of a single-family dwelling, attached or detached, that can be expressed as performance statements (O-C-E-C) for a particular attribute, agent, and user need.

These standard guides are intended for use by those who need to prescribe required levels of performance and those who need to rate a product which forms a single-family dwelling or part thereof. The standard guides include examples of performance statements that may be used for the specification and evaluation of design, materials, products, components, subsystems, and systems.

## 1. Scope

1.1 This guide contains suggested performance statements for single family residential buildings (attached and detached) that address indoor air quality performance including indoor air pollution and thermal comfort. These performance statements are not presented as proposed requirements, but are written in permissive language as suggestions that can be used in developing specifications to satisfy user needs.

1.2 This guide does not address other aspects of the indoor environment such as lighting and acoustics.

1.3 Performance statements addressing building ventilation and ventilation rates are also included in the standard, since it is premature to base performance only on indoor air pollution, that is, airborne contaminant concentrations. When health authorities have established contaminant concentration limits for residential environments, it may be possible to define indoor air quality performance in terms of contaminant concentrations rather than ventilation.

1.4 This guide is one in a series of guides containing performance statements for residential buildings that are intended for use in the procurement, specification and evaluation of one- and two-family dwellings. These companion standard guides include those noted in the Introduction above.

1.5 This guide also addresses a number of residential indoor air quality issues that can not be expressed as performance statements at this time. However, they are important enough to include in this guide to at least raise the awareness of those

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**TABLE 1 Attributes Addressed in the Series of Performance Standards for Single Family Attached and Detached Dwellings**

A	Structural Safety and Serviceability
B	Fire Safety
C	Accident Safety
D	Health and Hygiene
E	Indoor Air Quality
F	Light
G	Acoustics
H	Durability
I	Accessibility
J	Security
K	Economics
L	Functionality
M	Aesthetics
N	Adaptability
O	Maintainability
P	Sustainability

**TABLE 2 Hierarchy of Building Elements Included in the Series of Performance Standards for Single Family Attached and Detached Dwellings**

0.	Whole Building System
0.1	All Building Subsystems
0.2	Groups of Building Subsystems
1.	Spaces
1.1	Entries
1.2	Living Spaces
1.3	Dining Spaces
1.4	Kitchens
1.5	Sleeping Spaces
1.6	Bathrooms
1.7	Water Closets
1.8	Outdoor Living Spaces
1.9	Storage Spaces
1.10	Other
2.	Structure
2.1	Foundation
2.2	Superstructure
3.	Exterior Enclosure
3.1	Grade Enclosure
3.1.1	Floor on Grade
3.1.2	Floor over Air Space
3.1.3	Other
3.2	Vertical and Sloped Enclosure
3.2.1	Walls
3.2.2	Windows
3.2.3	Doors
3.2.4	Other (e.g., railings, louvers, screens, etc.)
3.3	Roofs
3.3.1	Roof Coverings
3.3.2	Skylights
3.3.3	Other Roof Openings
3.4	Joint Sealants
4.	Interior Space Division
4.1	Vertical Space Dividers
4.1.1	Partitions
4.1.2	Doors
4.1.3	Other
4.2	Horizontal Space Dividers
4.2.1	Floors
4.2.2	Ceilings
4.2.3	Floor/Ceiling Openings
4.2.4	Other
4.3	Stairs and Ramps
5.	Plumbing
5.1	Plumbing Fixtures
5.2	Domestic Water Distribution
5.3	Sanitary Waste
5.4	Rain Water Drainage
6.	HVAC
6.1	Heating
6.1.1	Heating Generation
6.1.2	Heating Distribution
6.1.3	Heating Terminal and Package Units
6.1.4	Heating Controls and Instrumentation
6.2	Cooling
6.2.1	Cooling Generation
6.2.2	Cooling Distribution
6.2.3	Cooling Terminal and Package Units
6.2.4	Cooling Controls and Instrumentation
6.3	Ventilation
6.3.1	Ventilation Distribution
6.3.2	Ventilation Terminal and Package Units
6.3.4	Ventilation Controls and Instrumentation
7.	Fire Protection Subsystems
7.1	Suppression Systems
7.2	Detection Systems
7.3	Notification Systems
7.4	Fire Protection Specialties
8.	Electrical Network
8.1	Electrical Service and Distribution
8.2	Lighting and Branch Wiring

involved in the process of procurement, specification and evaluation. These issues are addressed in 8.3.

1.6 This guide does not include site planning objectives. However, certain issues addressing the relationship of building to site have been covered, and it is important that these few objectives not be construed as a comprehensive site specification.

1.7 *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 requirements prior to use.*

**2. Referenced Documents**

2.1 *ASTM Standards:*<sup>2</sup>

- [D1356 Terminology Relating to Sampling and Analysis of Atmospheres](#)
- [D5116 Guide for Small-Scale Environmental Chamber Determinations of Organic Emissions from Indoor Materials/Products](#)
- [E241 Guide for Limiting Water-Induced Damage to Buildings](#)
- [E631 Terminology of Building Constructions](#)
- [E779 Test Method for Determining Air Leakage Rate by Fan Pressurization](#)
- [E1465 Practice for Radon Control Options for the Design and Construction of New Low-Rise Residential Buildings](#)
- [E1554 Test Methods for Determining Air Leakage of Air Distribution Systems by Fan Pressurization](#)
- [E1998 Guide for Assessing Depressurization-Induced Backdrafting and Spillage from Vented Combustion Appliances](#)
- [E2151 Terminology of Guides for Specifying and Evaluating Performance of Single Family Attached and Detached Dwellings](#)
- [E2156 Guide for Evaluating Economic Performance of Alternative Designs, Systems, and Materials in Compliance](#)

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

**TABLE 2** (continued)

9.	Communication and Security Networks
9.1	Telephone
9.2	Intercom
9.3	Television
9.4	Security
9.5	Other
10.	Fuel Networks
10.1	Gas
10.2	Oil
10.3	Other
11.	Fittings, Furnishings and Equipment

### Attached and Detached Dwellings

#### 2.2 ASHRAE Standards:<sup>3</sup>

ASHRAE Fundamentals Handbook 2001

ASHRAE Standard 52.2 Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size

ASHRAE Standard 55 Thermal Environmental Conditions for Human Occupancy

ASHRAE Standard 62 Ventilation for Acceptable Indoor Air Quality

ASHRAE Standard 111 Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems

ASHRAE Standard 129 Measuring Air Change Effectiveness

ASHRAE Standard 136 A Method of Determining Air Change Rates in Detached Dwellings

#### 2.3 Other Standards:

ICC International Fuel Gas Code<sup>4</sup>

ISO 7730 Moderate Thermal Environments, Determination of the PMV and PPD Indices and Specification of the Conditions for Thermal Comfort<sup>5</sup>

NFPA 54 National Fuel Gas Code<sup>6</sup>

NFPA 5000 Building Construction and Safety Code<sup>6</sup>

#### 2.4 Other References:

Building for Environmental and Economic Sustainability (BEES) 3.0<sup>7</sup>

EPA, 1992, Indoor Radon and Radon Decay Product Measurement Device Protocols EPA 402-R-92-004<sup>8</sup>

International Residential Code 2003<sup>4</sup>

Moisture Control in Buildings ASTM Manual Series, MNL 18, 1994<sup>2</sup>

MOIST A PC Program for Predicting Heat and Moisture Transfer in Building Envelopes. Version 3.0. NIST SP 917<sup>7</sup>

ORNL/CON-295 Builder's Foundation Handbook, 1991<sup>9</sup>

### 3. Terminology

3.1 *Definitions*—For definitions of terms used in this guide refer to Terminologies E631, D1356, and E2151.

#### 3.2 Definitions of Terms Specific to This Standard:

3.2.1 *commentary, n*—the fourth part of a performance statement, consisting of an informative narrative explaining aspects of the performance statement.

3.2.1.1 *Discussion*—A commentary may include one or more of the following: an explanation of how the objective relates to user needs in fields such as physiology, psychology, and culture or tradition; an explanation of how the criteria are established including guides for setting different levels of performance to meet various user needs; a discussion of the reliability of the evaluation method; and example solutions that may be deemed by the specifier to comply with the performance statement.

3.2.2 *criteria, n*—the second part of a performance statement, consisting of quantitative statements defining the level or range of performance necessary to meet an objective or, where such a level or range cannot be established, the units of measurement of the performance.

3.2.3 *evaluation, n*—the third part of a performance statement, consisting of the method(s) of assessing conformance of the element being addressed to the criteria.

3.2.3.1 *Discussion*—The evaluation states standards, inspection methods, review procedures, historical documentation, test methods, in-use performance, engineering analyses, models, or other means that may be used in assessing whether or not a criterion has been satisfied.

3.2.4 *indoor air pollution, n*—the level of air pollution in an enclosed environment.

3.2.4.1 *Discussion*—Based on the definition of air pollution in Terminology D1356, indoor air pollution relates to the concentrations of unwanted material in the air.

3.2.5 *indoor air quality, n*—the composition and characteristics of the air in an enclosed space that affect the occupants of that space.

3.2.5.1 *Discussion*—The indoor air quality of a space is determined by the level of indoor air pollution and other characteristics of the air, including those that impact thermal comfort such as air temperature, relative humidity, and air speed.

3.2.6 *specifier, n*—the individual or organization using the standard guides to create specifications and ultimately accept dwelling designs, materials, products, components, subsystems, or buildings to be provided by providers.

3.2.7 *thermal comfort, n*—the condition of mind that expresses satisfaction with the thermal environment; it requires subjective evaluation.

<sup>9</sup> Available from Oak Ridge National Laboratory (ORNL), Bethel Valley Rd., Oak Ridge, TN 37831, <http://www.ornl.gov>.

<sup>3</sup> Available from American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. (ASHRAE), 1791 Tullie Circle, NE, Atlanta, GA 30329, <http://www.ashrae.org>.

<sup>4</sup> Available from International Code Council (ICC), 500 New Jersey Ave., NW, 6th Floor, Washington, DC 20001, <http://www.iccsafe.org>.

<sup>5</sup> Available from International Organization for Standardization (ISO), 1, ch. de la Voie-Creuse, CP 56, CH-1211 Geneva 20, Switzerland, <http://www.iso.org>.

<sup>6</sup> Available from National Fire Protection Association (NFPA), 1 Batterymarch Park, Quincy, MA 02169-7471, <http://www.nfpa.org>.

<sup>7</sup> Available from National Institute of Standards and Technology (NIST), 100 Bureau Dr., Stop 1070, Gaithersburg, MD 20899-1070, <http://www.nist.gov>.

<sup>8</sup> Available from United States Environmental Protection Agency (EPA), Ariel Rios Bldg., 1200 Pennsylvania Ave., NW, Washington, DC 20004, <http://www.epa.gov>.