



**BSR/ASHRAE/IES Addendum s  
to ANSI/ASHRAE/IES Standard 90.1-2019**

**Public Review Draft**

# **Proposed Addendum s to Standard 90.1-2019, Energy Standard for Buildings Except Low-Rise Residential Buildings**

**First Public Review (November 2020)  
(Draft Shows Proposed Changes to Current Standard)**

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## FOREWORD

This proposal removes the use of solar reflectance index (SRI) for walls and replaces it with the more accurate and relevant term--solar reflectance (SRI is still used when referring to roofs). The proposal also adds requirements for south-, east-, and west-facing walls to have a minimum solar reflectance of 0.30 in climate zone 0.

1. Thermal emittance values do not vary much for opaque, non-metallic surfaces. A minimum value of 0.75 is sufficient and can be demonstrated by published values or testing. The default value in Appendix G is 0.90. The main reason to have 0.75 back stop is to avoid shiny bare metal, which can get hot.
2. For solar reflectance, three options have been provided for measurement: (a) ASTM C1549 with air mass 1.5 global vertical (AM1.5GV) output (labelled “1.590”, for air mass 1.5, 90° tilt, in a upgrade to the Devices & Services Solar Spectrum Reflectometer version 6 available from its manufacturer); (b) ASTM E903, using the AM1.5GV solar spectral irradiance to weight near normal-hemispherical solar spectral reflectance; or (c) the “G197GT90” output of the Surface Optics 410-Solar-i Hemispherical Reflectometer, operated following Appendix 9 of the CRRC-1 Program Manual ([https://coolroofs.org/documents/CRRC-1\\_Program\\_Manual.pdf](https://coolroofs.org/documents/CRRC-1_Program_Manual.pdf)). All three options are based on the global solar spectral irradiance for a 90° sun-facing tilted surface specified in ASTM G197.
3. For emittance, ASTM C1371 is the simplest and least expensive measurement method but other options have been provided.
4. Initial reflectance is specified because there isn't a fully developed measurement technique for measuring aged wall reflectance. Preliminary testing shows that walls get much less dirty than roofs because they are vertical surfaces.
5. We have removed planted material as a shading option as plants are not considered durable or guaranteed to last the life of the building.
6. This proposal removes reflectance as a defined term within the Standard. The ESC agreed that the current definition is inaccurate and that there is no question about what the term reflectance means. In an effort to simplify the standard it was decided to remove the definition rather than amend it.
7. Cost-effectiveness: There is no increase in stringency as part of this proposal and therefore cost-effectiveness need not be shown.

*[Note to Reviewers: This addendum makes proposed changes to the current standard. These changes are indicated in the text by underlining (for additions) and ~~striketrough~~ (for deletions) except where the reviewer instructions specifically describe some other means of showing the changes. Only these changes to the current standard are open for review and comment at this time. Additional material is provided for context only and is not open for comment except as it relates to the proposed changes.]*

## Addendum s to 90.1-2019

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*Modify the standard as follows (IP and SI Units)*

### 3.2 Definitions

...

**north-oriented:** facing within ~~45~~67.5 degrees of true north in the northern hemisphere; ~~(however, facing within 67.5 degrees of true south in the southern hemisphere.)~~

**south-oriented:** facing within 45 degrees of true south in the northern hemisphere; facing within 45 degrees of true north in the southern hemisphere.

**east-oriented:** facing within 45 degrees of true east to the south and within less than 22.5 degrees of true east to the north in the northern hemisphere; facing within 45 degrees of true east to the north and within less than 22.5 degrees of true east to the south in the southern hemisphere.

**west-oriented:** facing within 45 degrees of true west to the south and within less than 22.5 degrees of true west to the north in the northern hemisphere; facing within 45 degrees of true west to the north and within less than 22.5 degrees of true west to the south in the southern hemisphere.

**reflectance:** the ratio of the light reflected by a surface to the light incident upon it.

...

#### 5.5.3.1.1 Roof Solar Reflectance and Thermal Emittance

Roofs in Climate Zones 0 through 3 shall have one of the following:

- A minimum three-year-aged solar ~~reflectance~~reflectance of 0.55 and a minimum three-year-aged thermal *emittance* of 0.75 when tested in accordance with CRRC S100.
- A minimum Solar Reflectance Index of 64 when determined in accordance with the Solar Reflectance Index method in ASTM E1980 using a convection coefficient of 2.1 Btu/h·ft<sup>2</sup>·°F (12 W/m<sup>2</sup>·K), based on three-year-aged solar ~~reflectance~~reflectance and three-year-aged thermal *emittance* tested in accordance with CRRC S100.
- Increased *roof* insulation levels found in Table 5.5.3.1.1.

The values for three-year-aged solar ~~reflectance~~reflectance and three-year-aged thermal *emittance* shall be determined by a laboratory accredited by a nationally recognized accreditation organization and shall be *labeled* and certified by the *manufacturer*.

...

#### 5.5.3.2 Above-Grade Wall Insulation

All *above-grade walls* shall comply with the insulation values specified in Tables 5.5-0 through 5.5-8.

##### Exception to 5.5.3.2

Alternatively, for *mass walls*...

##### 5.5.3.2.1 Walls that are both Above and Below Grade.

When a *wall* consists of both *above-grade* and *below-grade* portions ...

##### 5.5.3.2.2 Wall Solar Reflectance and Thermal Emittance

~~In addition, f~~For Climate Zone 0, *above-grade east-oriented, south-oriented, and west-oriented walls* ~~above-grade walls~~ shall comply with ~~one of the following~~ subparagraph (a) or (b):

- ~~For east and west walls, a~~ A minimum of 75% of the *opaque wall* area shall have a minimum ~~SRI of 29~~ area-weighted initial solar reflectance of 0.30 when tested in accordance with ASTM C1549 with AM1.5GV output or ASTM E903 with the AM1.5GV output or determined in accordance with generally accepted engineering standards; and a minimum *emittance* or emissivity of 0.75 when tested in accordance with ASTM C835, C1371, E408, or determined in accordance with generally accepted engineering standards. For the portion of the *opaque wall* that is glass spandrel area, a minimum solar ~~reflectance~~ reflectance of 0.29 determined in accordance with NFRC 300 or ISO 9050 shall be permitted. ~~Each wall is allowed to be considered separately.~~ Area-weighting is permitted only between the south-, east-, and west-oriented walls and only between walls of the same space-conditioning category.
- ~~For east and west walls, a~~ A minimum of 30% of the *above-grade wall* area shall be shaded through the use of ~~shade providing plants~~, manmade structures, *existing buildings*, hillsides,

permanent *building* projections, *on-site renewable energy systems*, or a combination of these. Shade coverage shall be calculated by projecting the shading surface downward on the wall at an angle of 45 degrees, at 10 a.m. for the east-oriented walls and 3 p.m. for the west-oriented walls on the summer solstice.

~~The *building* is allowed to be rotated up to 45 degrees to the nearest cardinal orientation for purposes of calculations and showing compliance.~~

**Exception to 5.5.3.2.2:**

*Exterior walls of semiheated spaces.*

...

**5.5.4.5 Fenestration Orientation**

...

where

$A_w$  = west-oriented *vertical fenestration area* (~~oriented within 45 degrees of true west to the south and within 22.5 degrees of true west to the north in the northern hemisphere; oriented within 45 degrees of true west to the north and within 22.5 degrees of true west to the south in the southern hemisphere~~)

$A_e$  = east-oriented *vertical fenestration area* (~~oriented within 45 degrees of true east to the south and within 22.5 degrees of true east to the north in the northern hemisphere; oriented within 45 degrees of true east to the north and within 22.5 degrees of true east to the south in the southern hemisphere~~)

...

*Changes in Section 11*

**Table 11.5.1, Part 5: Building Envelope**

*Modify Column A as follows:*

**Exceptions:**

...

3. The exterior *roof* surface shall be modeled using the aged solar ~~reflectance~~ reflectance and thermal *emittance* determined in accordance with Section 5.5.3.1.1(a). Where aged test data are unavailable, the *roof* surface shall be modeled with a solar ~~reflectance~~ reflectance of 0.30 and a thermal *emittance* of 0.90. The above-grade wall surfaces of buildings shall be modeled with an initial solar reflectance and thermal *emittance* determined in accordance with the test methods identified in Section 5.5.3.2.2(a). Where initial test data is unavailable, the above-grade wall surfaces shall be modeled with a solar reflectance of 0.25 and a thermal *emittance* of 0.90.

*Modify Column B as follows:*

- a. ...
- b. The exterior *roof* surfaces shall be modeled with a solar ~~reflectance~~ reflectance and thermal *emittance* as required in Section 5.5.3.1.1(a). All other *roofs*, including *roofs* exempted from the requirements in Section 5.5.3.1.1, shall be modeled the same as the *proposed design*. The above-grade wall surfaces of buildings shall be modeled with a solar reflectance and thermal *emittance* as required in Section 5.5.3.2.2 and 5.5.3.2.2(a). All other above-grade walls, including those exempt from the requirements in Section 5.5.3.2.2, shall be modeled the same as the *proposed design*.
- c. ...

...

*Revisions to Chapter 12 as follows:*

## 12 Normative References

Reference	Title
...	
ASTM C835-06 (2013) e1	Standard Test Method for Total Hemispherical Emittance of Surfaces up to 1400°C
<u>ASTM C1371-15</u>	<u>Standard Test Method for Determination of Emittance of Materials Near Room Temperature using Portable Emissometers.</u>
<u>ASTM C1549-16</u>	<u>Standard Test Method for Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer</u>
<u>ASTM E408-13</u>	<u>Standard Test Methods for Total Normal Emittance of Surfaces Using Inspection-Meter Techniques</u>

...

### Changes in Appendix C

#### C1.2.1 For Roofs

The *class of construction*, *opaque area*, *U-factor*, *HC*, and insulation position shall be specified. Where three-year-aged test data for the solar ~~reflectance~~reflectance and three-year-aged thermal *emittance* of the exterior *roof* surface are available, the three-year-aged solar ~~reflectance~~reflectance and three-year-aged thermal *emittance* shall be specified.

...

#### C3.5.5 Building Envelope

The *building envelope* shall reflect the information specified in Section C1.

##### Exception to C3.5.5

Where three-year-aged test data for the solar ~~reflectance~~reflectance and three-year-aged thermal *emittance* of the exterior *roof* surface are unavailable, the exterior *roof* surface shall be modeled with a solar ~~reflectance~~reflectance of 0.30 and a thermal *emittance* of 0.90.

#### C3.5.5.1 Shading

Manually operated interior shades shall be modeled on all *vertical fenestration*. Shades shall be modeled to be in the lowered position when either the transmitted luminance is greater than 200 cd/ft<sup>2</sup> (2000 cd/m<sup>2</sup>) or the direct solar transmitted *energy* exceeds 30 Btu/h·ft<sup>2</sup> (95 W/m<sup>2</sup>) and then remain lowered for rest of the day. Shades shall be modeled with visible light transmittance of 0.10, visible light ~~reflectance~~reflectance of 0.40, solar transmittance of 0.21, and solar ~~reflectance~~reflectance of 0.23. Permanent shading devices such as fins and overhangs shall be modeled.

...

#### C3.6 Calculation of Base Envelope Performance Factor

a. ...

- b. The exterior *roof* surfaces shall be modeled with a solar ~~reflectance~~reflectance and thermal *emittance* as required in Section 5.5.3.1.1(a). All other *roofs*, including *roofs* exempted from the requirements in Section 5.5.3.1.1, shall be modeled the same as in the *proposed design*. The above-grade wall surfaces of buildings shall be modeled with a solar reflectance and thermal emittance as required in Section 5.5.3.2.2 and Section 5.5.3.2.2(a). All other above-grade walls, including those exempt from the requirements in Section 5.5.3.2.2, shall be modeled the same as the proposed design.

...

Changes in Appendix G Table G3.1 Part 5 Building Envelope Change Column A as follows

**Exceptions: ...**

4. The exterior *roof* surface shall be modeled using the aged solar ~~reflectance~~reflectance and thermal *emittance* determined in accordance with Section 5.5.3.1.1(a). Where aged test data are unavailable, the *roof* surface shall be modeled with a solar ~~reflectance~~reflectance of 0.30 and a thermal *emittance* of 0.90
5. ...
6. The above-grade wall surface shall be modeled using the initial solar reflectance and thermal emittance determined in accordance with the test methods identified in Section 5.5.3.2.2(a). Where initial test data are unavailable, the wall surface may be modeled with a solar reflectance of 0.25 and a thermal emittance of 0.90.

*Changes in Section G Table G3.1 Part 5 Building Envelope Change Column B as follows*

- g. **Roof Solar ~~Reflectance~~Reflectance and Thermal Emittance.** The exterior *roof* surfaces shall be modeled using a solar ~~reflectance~~reflectance of 0.30 and a thermal *emittance* of 0.90.
- h. ...
- i. **Wall Solar Reflectance and Thermal Emittance.** Above-grade wall surfaces shall be modeled with a solar reflectance of 0.25 and a thermal *emittance* of 0.90.