



**BSR/ASHRAE/IES Addendum aw
to ANSI/ASHRAE/IES Standard 90.1-2016**

Public Review Draft

Proposed Addendum aw to Standard 90.1-2016, Energy Standard for Buildings Except Low-Rise Residential Buildings

**Second Public Review (November 2018)
(Draft Shows Proposed Independent Substantive
Changes to Previous Public Review Draft)**

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(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

Addendum AW is a comprehensive revision to the fenestration prescriptive criteria in Tables 5.5-0 through 5.5-8. This 2nd public review ISC to Addendum AW makes corrections in response to comments received on the first public review.

Specifically, the fixed SHGC in zone 5 for nonresidential and residential spaces is adjusted from the initially proposed 0.36 back to 0.38, to account for the different frame ratio used in NFRC calculations for curtain wall products compared to the window wall products used in the analysis. Second, the residential skylight U-factor in zone 6 is adjusted from 0.47 back to 0.50 to account for limitations in curb-mounted unit skylights, especially in zone 6 with significant snow loads. These corrections restore values currently in the 2016 edition and therefore do not impact cost effectiveness. Finally, the skylight U-factors in semiheated spaces in zones 2-8 were adjusted upwards following review to include more product options. The cost effectiveness for fenestration products in semiheated spaces in the initial proposed addendum were indirectly derived from the detailed analysis for products in conditioned spaces, but shifted less stringent by two climate zones, based on an analysis of HDD in fully conditioned and partially conditioned spaces. The skylight U-factors in this ISC will include more product options and increased cost effectiveness, and also line up with the U-factors determined from a prior analysis for plastic dome skylights in retail spaces.

[Note to Reviewers: This public review draft makes proposed independent substantive changes to the previous public review draft. 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 previous draft 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 substantive changes.]

Addendum AW to 90.1-2016

Modify the standard as follows (IP and SI Units)

Table 5.5-2 Building Envelope Requirements for Climate Zone 2 (A,B)* [I-P]
 (Portions of table not shown are unchanged.)

Fenestration	Nonresidential			Residential			Semiheated		
	Assembly Max. U	Assembly Max. SHGC	Assembly Min. VT/SHGC	Assembly Max. U	Assembly Max. SHGC	Assembly Min. VT/SHGC	Assembly Max. U	Assembly Max. SHGC	Assembly Min. VT/SHGC
Vertical Fenestration, 0% to 40% of Wall									
fixed	0.45	0.25	1.10 (for all types)	0.45	0.25	1.10 (for all types)	0.50	NR (for all types)	NR (for all types)
operable	0.60	0.23		0.60	0.23		0.65		
entrance door	0.77	0.23		0.77	0.23		0.77		
Skylight, 0% to 3% of Roof									
All types	0.65	0.30	NR	0.65	0.30	NR	0.70 0.90	NR	NR

* The following definitions apply: c.i. = continuous insulation (see Section 3.2), FC = filled cavity (see Section A2.3.2.5), NR = no (insulation) requirement.

Table 5.5-2 Building Envelope Requirements for Climate Zone 2 (A,B)* [SI]
 (Portions of table not shown are unchanged.)

Fenestration	Nonresidential			Residential			Semiheated		
	Assembly Max. U	Assembly Max. SHGC	Assembly Min. VT/SHGC	Assembly Max. U	Assembly Max. SHGC	Assembly Min. VT/SHGC	Assembly Max. U	Assembly Max. SHGC	Assembly Min. VT/SHGC
Vertical Fenestration, 0% to 40% of Wall									
fixed	2.56	0.25	1.10 (for all types)	2.56	0.25	1.10 (for all types)	2.84	NR (for all types)	NR (for all types)
operable	3.41	0.23		3.41	0.23		3.69		
entrance door	4.37	0.23		4.37	0.23		4.37		
Skylight, 0% to 3% of Roof									
All types	3.69	0.30	NR	3.69	0.30	NR	3.97 5.11	NR	NR

*The following definitions apply: c.i. = continuous insulation (see Section 3.2), FC = filled cavity (see Section A2.3.2.5), NR = no (insulation) requirement.

Table 5.5-3 Building Envelope Requirements for Climate Zone 3 (A,B,C)* [I-P]
 (Portions of table not shown are unchanged.)

Fenestration	Nonresidential			Residential			Semiheated		
	Assembly Max. U	Assembly Max. SHGC	Assembly Min. VT/SHGC	Assembly Max. U	Assembly Max. SHGC	Assembly Min. VT/SHGC	Assembly Max. U	Assembly Max. SHGC	Assembly Min. VT/SHGC
Vertical Fenestration, 0% to 40% of Wall									
fixed	0.42	0.25	1.10 (for all types)	0.42	0.25	1.10 (for all types)	0.50	NR (for all types)	NR (for all types)
operable	0.54	0.23		0.54	0.23		0.65		
entrance door	0.68	0.23		0.68	0.23		0.77		
Skylight, 0% to 3% of Roof									
All types	0.55	0.30	NR	0.55	0.30	NR	0.70 <u>0.90</u>	NR	NR

*The following definitions apply: c.i. = continuous insulation (see Section 3.2), FC = filled cavity (see Section A2.3.2.5), NR = no (insulation) requirement.
 a. When using the R-value compliance method for metal building roofs, a thermal spacer block is required (see Section A2.3.2).

Table 5.5-3 Building Envelope Requirements for Climate Zone 3 (A,B,C)* [SI]
 (Portions of table not shown are unchanged.)

Fenestration	Nonresidential			Residential			Semiheated		
	Assembly Max. U	Assembly Max. SHGC	Assembly Min. VT/SHGC	Assembly Max. U	Assembly Max. SHGC	Assembly Min. VT/SHGC	Assembly Max. U	Assembly Max. SHGC	Assembly Min. VT/SHGC
Vertical Fenestration, 0% to 40% of Wall									
fixed	2.38	0.25	1.10 (for all types)	2.38	0.25	1.10 (for all types)	2.84	NR (for all types)	NR (for all types)
operable	3.07	0.23		3.07	0.23		3.69		
entrance door	3.86	0.23		3.86	0.23		4.37		
Skylight, 0% to 3% of Roof									
All types	3.12	0.30	NR	3.12	0.30	NR	3.97 <u>5.11</u>	NR	NR

*The following definitions apply: c.i. = continuous insulation (see Section 3.2), FC = filled cavity (see Section A2.3.2.5), NR = no (insulation) requirement.

Table 5.5-4 Building Envelope Requirements for Climate Zone 4 (A,B,C)* [I-P]
 (Portions of table not shown are unchanged.)

Fenestration	Nonresidential			Residential			Semiheated		
	Assembly Max. U	Assembly Max. SHGC	Assembly Min. VT/SHGC	Assembly Max. U	Assembly Max. SHGC	Assembly Min. VT/SHGC	Assembly Max. U	Assembly Max. SHGC	Assembly Min. VT/SHGC
<i>Vertical Fenestration, 0% to 40% of Wall</i>									
<i>fixed</i>	0.36	0.36	1.10 (for all types)	0.36	0.36	1.10 (for all types)	0.50	NR (for all types)	NR (for all types)
<i>operable</i>	0.45	0.33		0.45	0.33		0.65		
<i>entrance door</i>	0.63	0.33		0.63	0.33		0.77		
<i>Skylight, 0% to 3% of Roof</i>									
All types	0.50	0.40	NR	0.50	0.40	NR	0.70 <u>0.75</u>	NR	NR

*The following definitions apply: c.i. = *continuous insulation* (see Section 3.2), FC = *filled cavity* (see Section A2.3.2.5), Ls = *liner system* (see Section A2.3.2.4), NR = no (insulation) requirement.

Table 5.5-4 Building Envelope Requirements for Climate Zone 4 (A,B,C)* [SI]
 (Portions of table not shown are unchanged.)

Fenestration	Nonresidential			Residential			Semiheated		
	Assembly Max. U	Assembly Max. SHGC	Assembly Min. VT/SHGC	Assembly Max. U	Assembly Max. SHGC	Assembly Min. VT/SHGC	Assembly Max. U	Assembly Max. SHGC	Assembly Min. VT/SHGC
<i>Vertical Fenestration, 0% to 40% of Wall</i>									
<i>fixed</i>	2.04	0.36	1.10 (for all types)	2.04	0.36	1.10 (for all types)	2.84	NR (for all types)	NR (for all types)
<i>operable</i>	2.56	0.33		2.56	0.33		3.69		
<i>entrance door</i>	3.58	0.33		3.58	0.33		4.37		
<i>Skylight, 0% to 3% of Roof</i>									
All types	2.84	0.40	NR	2.84	0.40	NR	3.97 <u>4.26</u>	NR	NR

*The following definitions apply: c.i. = *continuous insulation* (see Section 3.2), FC = *filled cavity* (see Section A2.3.2.5), Ls = *liner system* (see Section A2.3.2.4), NR = no (insulation) requirement.

Table 5.5-5 Building Envelope Requirements for Climate Zone 5 (A,B,C)* [I-P]
 (Portions of table not shown are unchanged.)

Fenestration	Nonresidential			Residential			Semiheated		
	Assembly Max. U	Assembly Max. SHGC	Assembly Min. VT/SHGC	Assembly Max. U	Assembly Max. SHGC	Assembly Min. VT/SHGC	Assembly Max. U	Assembly Max. SHGC	Assembly Min. VT/SHGC
<i>Vertical Fenestration, 0% to 40% of Wall</i>									
<i>fixed</i>	0.36	0.36 0.38	1.10 (for all types)	0.36	0.36 0.38	1.10 (for all types)	0.50	NR (for all types)	NR (for all types)
<i>operable</i>	0.45	0.33		0.45	0.33		0.65		
<i>entrance door</i>	0.63	0.33		0.63	0.33		0.77		
<i>Skylight, 0% to 3% of Roof</i>									
All types	0.50	0.40	NR	0.50	0.40	NR	0.70 0.75	NR	NR

*The following definitions apply: c.i. = *continuous insulation* (see Section 3.2), FC = *filled cavity* (see Section A2.3.2.5), Ls = *liner system* (see Section A2.3.2.4), NR = no (insulation) requirement.

Table 5.5-5 Building Envelope Requirements for Climate Zone 5 (A,B,C)* [SI]
 (Portions of table not shown are unchanged.)

Fenestration	Nonresidential			Residential			Semiheated		
	Assembly Max. U	Assembly Max. SHGC	Assembly Min. VT/SHGC	Assembly Max. U	Assembly Max. SHGC	Assembly Min. VT/SHGC	Assembly Max. U	Assembly Max. SHGC	Assembly Min. VT/SHGC
<i>Vertical Fenestration, 0% to 40% of Wall</i>									
<i>fixed</i>	2.04	0.36 0.38	1.10 (for all types)	2.04	0.36 0.38	1.10 (for all types)	2.84	NR (for all types)	NR (for all types)
<i>operable</i>	2.56	0.33		2.56	0.33		3.69		
<i>entrance door</i>	3.58	0.33		3.58	0.33		4.37		
<i>Skylight, 0% to 3% of Roof</i>									
All types	2.84	0.40	NR	2.84	0.40	NR	3.97 4.26	NR	NR

*The following definitions apply: c.i. = *continuous insulation* (see Section 3.2), FC = *filled cavity* (see Section A2.3.2.5), Ls = *liner system* (see Section A2.3.2.4), NR = no (insulation) requirement.

Table 5.5-6 Building Envelope Requirements for Climate Zone 6 (A,B)* [I-P]
 (Portions of table not shown are unchanged.)

Opaque Elements	Nonresidential			Residential			Semiheated		
	Assembly Max. U	Assembly Max. SHGC	Assembly Min. VT/SHGC	Assembly Max. U	Assembly Max. SHGC	Assembly Min. VT/SHGC	Assembly Max. U	Assembly Max. SHGC	Assembly Min. VT/SHGC
<i>Vertical Fenestration, 0% to 40% of Wall</i>									
<i>fixed</i>	0.34	0.38	1.10 (for all types)	0.34	0.38	1.10 (for all types)	0.39	NR (for all types)	NR (for all types)
<i>operable</i>	0.42	0.34		0.42	0.34		0.48		
<i>entrance door</i>	0.63	0.34		0.63	0.34		0.68		
<i>Skylight, 0% to 3% of Roof</i>									
All types	0.47	0.40	NR	0.47 <u>0.50</u>	0.40	NR	0.55 <u>0.75</u>	NR	NR

*The following definitions apply: c.i. = *continuous insulation* (see Section 3.2), FC = *filled cavity* (see Section A2.3.2.5), Ls = *liner system* (see Section A2.3.2.4), NR = no (insulation) requirement.

Table 5.5-6 Building Envelope Requirements for Climate Zone 6 (A,B)* [SI]
 (Portions of table not shown are unchanged.)

Opaque Elements	Nonresidential			Residential			Semiheated		
	Assembly Max. U	Assembly Max. SHGC	Assembly Min. VT/SHGC	Assembly Max. U	Assembly Max. SHGC	Assembly Min. VT/SHGC	Assembly Max. U	Assembly Max. SHGC	Assembly Min. VT/SHGC
<i>Vertical Fenestration, 0% to 40% of Wall</i>									
<i>fixed</i>	1.93	0.38	1.10 (for all types)	1.93	0.38	1.10 (for all types)	2.21	NR (for all types)	NR (for all types)
<i>operable</i>	2.38	0.34		2.38	0.34		2.73		
<i>entrance door</i>	3.58	0.34		3.58	0.34		3.86		
<i>Skylight, 0% to 3% of Roof</i>									
All types	2.67	0.40	NR	2.67 <u>2.84</u>	0.40	NR	3.12 <u>4.26</u>	NR	NR

*The following definitions apply: c.i. = *continuous insulation* (see Section 3.2), FC = *filled cavity* (see Section A2.3.2.5), Ls = *liner system* (see Section A2.3.2.4), NR = no (insulation) requirement.

Table 5.5-7 Building Envelope Requirements for Climate Zone 7* [I-P]
 (Portions of table not shown are unchanged.)

Fenestration	Nonresidential			Residential			Semiheated		
	Assembly Max. U	Assembly Max. SHGC	Assembly Min. VT/SHGC	Assembly Max. U	Assembly Max. SHGC	Assembly Min. VT/SHGC	Assembly Max. U	Assembly Max. SHGC	Assembly Min. VT/SHGC
Vertical Fenestration, 0% to 40% of Wall									
fixed	0.29	0.40	1.10 (for all types)	0.29	0.40	1.10 (for all types)	0.36	NR (for all types)	NR (for all types)
operable	0.36	0.36		0.36	0.36		0.44		
entrance door	0.63	0.36		0.63	0.36		0.63		
Skylight, 0% to 3% of Roof									
All types	0.44	NR	NR	0.44	NR	NR	0.50 <u>0.75</u>	NR	NR

*The following definitions apply: c.i. = continuous insulation (see Section 3.2), FC = filled cavity (see Section A2.3.2.5), Ls = liner system (see Section A2.3.2.4), NR = no (insulation) requirement.

Table 5.5-7 Building Envelope Requirements for Climate Zone 7* [SI]
 (Portions of table not shown are unchanged.)

Fenestration	Nonresidential			Residential			Semiheated		
	Assembly Max. U	Assembly Max. SHGC	Assembly Min. VT/SHGC	Assembly Max. U	Assembly Max. SHGC	Assembly Min. VT/SHGC	Assembly Max. U	Assembly Max. SHGC	Assembly Min. VT/SHGC
Vertical Fenestration, 0% to 40% of Wall									
fixed	1.65	0.40	1.10 (for all types)	1.65	0.40	1.10 (for all types)	2.04	NR (for all types)	NR (for all types)
operable	2.04	0.36		2.04	0.36		2.50		
entrance door	3.58	0.36		3.58	0.36		3.58		
Skylight, 0% to 3% of Roof									
All types	2.50	NR	NR	2.50	NR	NR	2.84 <u>4.26</u>	NR	NR

*The following definitions apply: c.i. = continuous insulation (see Section 3.2), FC = filled cavity (see Section A2.3.2.5), Ls = liner system (see Section A2.3.2.4), NR = no (insulation) requirement.

Table 5.5-8 Building Envelope Requirements for Climate Zone 8* [I-P]
 (Portions of table not shown are unchanged.)

Fenestration	Nonresidential			Residential			Semiheated		
	Assembly Max. U	Assembly Max. SHGC	Assembly Min. VT/SHGC	Assembly Max. U	Assembly Max. SHGC	Assembly Min. VT/SHGC	Assembly Max. U	Assembly Max. SHGC	Assembly Min. VT/SHGC
<i>Vertical Fenestration, 0% to 40% of Wall</i>									
<i>fixed</i>	0.26	0.40	1.10 (for all types)	0.26	0.40	1.10 (for all types)	0.36	NR (for all types)	NR (for all types)
<i>operable</i>	0.32	0.36		0.32	0.36		0.44		
<i>entrance door</i>	0.63	0.36		0.63	0.36		0.63		
<i>Skylight, 0% to 3% of Roof</i>									
All types	0.41	NR	NR	0.41	NR	NR	0.50 <u>0.75</u>	NR	NR

*The following definitions apply: c.i. = *continuous insulation* (see Section 3.2), FC = *filled cavity* (see Section A2.3.2.5), Ls = *liner system* (see Section A2.3.2.4), NR = no (insulation) requirement.

Table 5.5-8 Building Envelope Requirements for Climate Zone 8* [SI]
 (Portions of table not shown are unchanged.)

Fenestration	Nonresidential			Residential			Semiheated		
	Assembly Max. U	Assembly Max. SHGC	Assembly Min. VT/SHGC	Assembly Max. U	Assembly Max. SHGC	Assembly Min. VT/SHGC	Assembly Max. U	Assembly Max. SHGC	Assembly Min. VT/SHGC
<i>Vertical Fenestration, 0% to 40% of Wall</i>									
<i>fixed</i>	1.48	0.40	1.10 (for all types)	1.48	0.40	1.10 (for all types)	2.04	NR (for all types)	NR (for all types)
<i>operable</i>	1.82	0.36		1.82	0.36		2.50		
<i>entrance door</i>	3.58	0.36		3.58	0.36		3.58		
<i>Skylight, 0% to 3% of Roof</i>									
All types	2.33	NR	NR	2.33	NR	NR	2.84 <u>4.26</u>	NR	NR

*The following definitions apply: c.i. = *continuous insulation* (see Section 3.2), FC = *filled cavity* (see Section A2.3.2.5), Ls = *liner system* (see Section A2.3.2.4), NR = no (insulation) requirement.