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STANDARD

ANSI/ASHRAE/IES Addendum ay to
ANSI/ASHRAE/IES Standard 90.1-2022

Energy Standard for Sites and Buildings Except Low-Rise Residential Buildings

Approved by ASHRAE and the American National Standards Institute on October 31, 2024, and by the Illuminating Engineering Society on October 15, 2024.

This addendum was approved by a Standing Standard Project Committee (SSPC) for which the Standards Committee has established a documented program for regular publication of addenda or revisions, including procedures for timely, documented, consensus action on requests for change to any part of the standard. Instructions for how to submit a change can be found on the ASHRAE® website (https://www.ashrae.org/continuous-maintenance).

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FOREWORD

Addendum ay clarifies the mass, steel frame, and wood frame wall base assemblies in Normative Appendix A and provides a means to determine the U-factor of a base wall assembly with an added layer of framing or furring with thermally-bridged cavity insulation. This assembly is a common application that does not comply with the definition of "continuous insulation." But, the standard does not currently provide a means to determine an assembly U-factor for this condition (including the impact of the thermally-bridged exterior insulation). A method already exists for similar purpose in Section A3.1.3.2(b) for mass walls. It is updated in this addendum and applied similarly to steel-frame and wood-frame walls. The method involves simply determining the effective R-value of the base wall assembly and the effective R-value of the added insulation and framing/furring layer, summing the two effective R-values, and then taking the inverse to determine the overall assembly U-factor.

The added wood framing/furring layer with insulation between framing members is characterized with an effective R-value determined in a manner consistent with the parallel-path-calculation method for U-factors of wood frame wall assemblies. The added steel framing/furring layer with insulation between framing members has an effective R-value determined in a manner consistent with the cavity insulation correction factors implicit to Table A9.2-2 in Appendix A (but implemented in the form of a Psi-factor).

This addendum serves as a correction and update to the precalculated U-factors and calculation methodology for steel-frame wall assemblies in Appendix A. It does not change the R-value and U-factor criteria in Tables 5.5-0 through 5.5-8 of the standard. Therefore, the proposal does not have a cost impact and cost-effectiveness was not evaluated.

Note: In this addendum, changes to the current standard are indicated in the text by underlining (for additions) and ~~strikethrough~~ (for deletions) unless the instructions specifically mention some other means of indicating the changes.

Addendum ay to Standard 90.1-2022

Revise Section 5.5.5.3 as shown (I-P and SI).

5.5.5.3 Exterior Cladding Supports~~.~~

5.5.5.3.1 Shelf Angles. Shelf angles ~~that~~ supporting anchored masonry or other heavyweight veneer ~~exterior cladding~~ shall be offset from the *floor* edge or primary structural frame using point connections to accommodate not less than one-half of the thickness ~~the full depth~~ of any exterior *continuous insulation* between the support and *floor* or structure, exclusive of the point connections. The cross-sectional area of point connections shall not exceed 1.5 in.^{2}/lin ft (3200 mm) for carbon steel connections or 2.3 in.^{2}/lin ft (4900 mm) for stainless steel.

5.5.5.3.2 Linear Cladding Supports. Linear cladding supports, such as furring or rails, shall be offset from the base construction using point connections to accommodate the full depth of any exterior *continuous insulation,* where present, exclusive of the point connections.

Exceptions to 5.5.5.3.2:

1. Where linear cladding supports cannot be point-supported, and insulation is placed between such linear supports, the U-factor for the overall assembly shall be determined in accordance with Normative Appendix A, Section A.1 and used to demonstrate compliance with Section 5.2.2.
2. Linear cladding supports applied outboard of the exterior *continuous insulation* on an exterior *wall* assembly installed only with fasteners penetrating the *continuous insulation*.

5.5.5.3.3 Other Cladding Supports. Other cladding supports that penetrate the insulation layers on or in the assembly ~~exterior *continuous insulation*~~ shall be subject to the provisions of Section 5.5.5.5.~~ and be mounted away from the backup construction using point connections to accommodate the full depth of any exterior *continuous insulation* exclusive of the point connections.~~

Exception to 5.5.5.3: Girts in *metal building walls* as described in Normative Appendix A provided such girts do not penetrate or compress *continuous insulation* used to comply with Section 5.2.2.

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Modify Section A3.1.3.2 as shown (I-P and SI).

A3.1.3.2 Determination of Mass Wall U-Factors. ~~If~~ Where not taken from Table A3.1-1, *mass wall U-factors* shall be determined from Tables A3.1-2, A3.1-3, or A3.1-4 using the following procedure:

a. ~~If~~ Where the *mass wall* is uninsulated or only the cells are insulated:
   1. For concrete *walls*, determine the *U-factor* from Table A3.1-2 based on the concrete density and *wall* thickness.
   2. For concrete block *walls*, determine the *U-factor* from Table A3.1-3 based on the block size, concrete density, degree of grouting in the cells, and whether the cells are insulated.

b. ~~If~~ Where the *mass wall* has additional insulation:
   1. For concrete *walls*, determine the R_u from Table A3.1-2 based on the concrete density and *wall* thickness. Next, determine the effective *R-value* for the insulation/framing layer from Table A3.1-4 based on the *rated R-value of insulation* installed~~, the thickness of the insulation, and whether it is installed~~ in the cavity between wood or *metal framing* or linear cladding supports, or as *continuous insulation* with no framing or linear cladding supports penetrating or compressing the insulation. Then, determine the *U-factor* by adding the R_u and the effective *R-value* together and taking the inverse of the total.
   2. For concrete block *walls*, determine the R_u from Table A3.1-3 based on the block size, concrete density, degree of grouting in the cells, and whether the cells are insulated. Next, determine the effective *R-value* for the insulation/framing layer from Table A3.1-4 based on the *rated R-value of insulation* installed~~, the thickness of the insulation, and whether it is installed~~ in the cavity between wood or *metal framing* or linear cladding supports, or as *continuous insulation* with no framing or linear cladding supports penetrating or compressing the insulation. Then, determine the *U-factor* by adding the R_u and the effective *R-value* together and taking the inverse of the total.

Revise one subheading in Table A3.1-1 as shown (I-P and SI).

Table A3.1-1 Assembly U-Factors for Above-Grade Concrete Walls and Masonry Walls

[. . .]
Continuous Metal Framing or Linear Cladding Supports at 24 in. on Center Horizontally or Vertically
[. . .]

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Delete existing Table A3.1-4 and replace it with new Table A3.1-4 as shown (I-P and SI, respectively).

Table A3.1-4 Effective R-Values for Continuous Insulation or Cavity Insulation between Framing or Linear Cladding Supports Added to Mass Walls

Framing/Linear Cladding Type[a]	Rated R-value of Insulation																									
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Effective R-Value for Continuous Insulation Uninterrupted by Framing/Furring—includes R-0.5 for gypsum board or equivalent material layer																										
None	0.5	1.5	2.5	3.5	4.5	5.5	6.5	7.5	8.5	9.5	10.5	11.5	12.5	13.5	14.5	15.5	16.5	17.5	18.5	19.5	20.5	21.5	22.5	23.5	24.5	25.5
Effective R-Value for Insulation is Installed in Cavity between Framing/Furring—includes R-0.5 for gypsum board or equivalent material layer																										
Wood (16 in. o.c.)	1.3	1.4	2.2	3.1	3.9	4.8	5.6	6.5	7.3	8.2	9.0	9.9	10.7	11.6	12.4	13.2	14.1	15.0	15.8	16.7	17.5	18.4	19.2	20.1	20.9	21.8
Wood (24 in. o.c.)	1.3	1.4	2.2	3.2	4.0	4.8	5.7	6.7	7.5	8.4	9.3	10.2	11.1	11.9	12.8	13.7	14.6	15.5	16.3	17.2	18.1	19.0	19.9	20.7	21.6	22.5
Steel (16 in. o.c.)	1.3	1.4	2.2	2.9	3.5	4.1	4.5	5.0	5.4	5.7	6.0	6.3	6.6	6.9	7.1	7.3	7.5	7.7	7.8	8.0	8.2	8.3	8.4	8.6	8.7	8.8
Steel (24 in. o.c.)	1.4	1.5	2.3	3.1	3.8	4.4	5.0	5.5	6.0	6.4	6.9	7.2	7.6	7.9	8.3	8.6	8.8	9.1	9.3	9.6	9.8	10.0	10.2	10.4	10.6	10.8

a. o.c. = on center

Table A3.1-4 Effective R-Values for Continuous Insulation or Cavity Insulation between Framing or Linear Cladding Supports Added to Mass Walls

Framing/Linear Cladding Type[a]	Rated R-Value of Insulation																									
	0	0.2	0.4	0.5	0.7	0.9	1.1	1.2	1.4	1.6	1.8	1.9	2.1	2.3	2.5	2.6	2.8	3.0	3.2	3.3	3.5	3.7	3.9	4.1	4.2	4.4
Effective R-Value for Continuous Insulation Uninterrupted by Framing/Furring—includes R-0.09 for gypsum board or equivalent material layer																										
None	0.1	0.3	0.4	0.6	0.8	1.0	1.1	1.3	1.5	1.7	1.8	2.0	2.2	2.4	2.6	2.7	2.9	3.1	3.3	3.4	3.6	3.8	4.0	4.1	4.3	4.5
Effective R-Value for Insulation is Installed in Cavity between Framing/Furring—includes R-0.09 for gypsum board or equivalent material layer)																										
Wood (400 mm o.c.)	0.2	0.2	0.4	0.5	0.7	0.8	1.0	1.1	1.3	1.4	1.6	1.7	1.9	2.0	2.2	2.3	2.5	2.6	2.8	2.9	3.1	3.2	3.4	3.5	3.7	3.8
Wood (600 mm o.c.)	0.2	0.2	0.4	0.6	0.7	0.8	1.0	1.2	1.3	1.5	1.6	1.8	2.0	2.1	2.3	2.4	2.6	2.7	2.9	3.0	3.2	3.3	3.5	3.6	3.8	4.0
Steel (400 mm o.c.)	0.2	0.2	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.0	1.1	1.1	1.2	1.2	1.3	1.3	1.3	1.4	1.4	1.4	1.4	1.5	1.5	1.5	1.5	1.6
Steel (600 mm o.c.)	0.2	0.3	0.4	0.5	0.7	0.8	0.9	1.0	1.1	1.1	1.2	1.3	1.3	1.4	1.5	1.5	1.6	1.6	1.6	1.7	1.7	1.8	1.8	1.8	1.9	1.9

a. o.c. = on center

Modify Section A3.3 as shown (I-P and SI).

A3.3 Steel-Framed Walls

A3.3.1 General. For the purpose of Section A1.2, the base assembly is a wall where the insulation is installed within the cavity of the cold-formed steel stud framing. The steel stud framing thickness is up to 54 mils (0.0538 in. minimum base steel thickness). The U-factors include R-0.17 for exterior air film, R-0.08 for stucco, R-0.56 for 0.625 in. gypsum board on the exterior, R-0.56 for 0.625 in. gypsum board on the interior, and R-0.68 for interior vertical surfaces air film. The performance of the insulation/framing layer is calculated using the values in Table A9.2-2. Additional assemblies include *continuous insulation* uncompressed and uninterrupted by framing. Precalculated U-factors are provided in Table A3.3.3.1. For assemblies where added exterior insulation is interrupted by framing or furring members, refer to Section A3.3.3.1(c).

A3.3.2 Rated R-Value of Insulation for Steel-Framed Walls

A3.3.2.1 Steel stud framing spaced at 16 in. on-center with cavities filled with 16 in. wide insulation for both 3.5 in. deep and 6.0 in. deep wall cavities serve as the basis for the *R-value* compliance values in Tables 5.5-0 through 5.5-8.

A3.3.2.2 The first *rated R-value of insulation* is for uncompressed insulation installed in the cavity between steel studs. ~~It is acceptable for this insulation to also be *continuous insulation* uninterrupted by framing.~~

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A3.3.2.3 ~~If~~ Where there are two values, the second *rated R-value of insulation* is for *continuous insulation* uninterrupted by framing~~,~~ or linear cladding supports~~, etc.,~~ to be installed in addition to the first insulation value to be installed in the cavity between steel studs.

A3.3.2.4 *Opaque* mullions in spandrel glass shall be insulated in accordance ~~covered with insulation complying~~ with the *steel framed wall* requirements of Tables 5.5-0 through 5.5-8.

A3.3.2.5 Where *steel framed wall* assemblies contain no cavity insulation, and where the *building envelope* assembly uses *continuous insulation* to satisfy the minimum *R-value* for the relevant climate zone in Tables 5.5-0 through 5.5-8, the on-center framing spacing is permitted to be at any dimension.

A3.3.3 U-Factors for Steel-Framed Walls

A3.3.3.1 *U-factors* for *steel-framed walls* shall be determined from one of the following methods:

a. Table A3.3.3.1-1 for assemblies complying with the base assembly and insulation conditions described in Section A3.3.1,

b. Testing or calculation methods listed in Section A9.2(b)(3), or

c. Use Table A3.3.3.1-1 to determine an effective R-value (1/*U*) from the inverse of the *U-factor* for the base *wall* assembly complying with Section A3.3.1. Use Table A3.3.3.1-2 to determine an effective R-value for an added cavity insulation layer interrupted by wood or metal framing or linear cladding supports. Sum the two effective R-values for a total effective R-value and then determine the *U-factor* for the total assembly as the inverse of the total effective R-value.

A3.3.3.2 Where *steel-framed wall* framing is spaced greater than 24 in. on center, the *U-factor* shall be permitted to be determined based on the 24 in. on-center spacing options from Section A3.3.3.1-1 or based on ASTM C1363 testing at the actual frame spacing used.

~~**A3.3.3.3** Where *steel framed wall* assemblies contain no cavity insulation, and where the *building envelope* assembly uses *continuous insulation* to satisfy the minimum *R-value* for the relevant climate zone in Tables 5.5-0 through 5.5-8, the on-center framing spacing is permitted to be at any dimension.~~

Renumber Table A3.3.3.1 as shown (I-P and SI).

Table A3.3.3.1-1 Assembly U-Factors for Steel-Frame Walls

Add new table A3.3.3.1-2 as shown (I-P and SI, respectively).

Table A3.3.3.1-2 Effective R-Values for Cavity Insulation Between Linear Cladding Supports Added to Base Wall Assembly

	Rated R-value of Cavity Insulation between Furring Added to Base Wall Assembly																								
Type[a]	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Wood (16 in. o.c.)	0.8	0.9	1.7	2.6	3.4	4.3	5.1	6.0	6.8	7.7	8.5	9.4	10.2	11.1	11.9	12.7	13.6	14.5	15.3	16.2	17.0	17.9	18.7	19.6	20.4	21.3
Wood (24 in. o.c)	0.9	1.0	1.8	2.7	3.5	4.4	5.2	6.2	7.0	7.9	8.8	9.7	10.6	11.3	12.3	13.2	14.1	15.0	15.8	16.7	17.6	18.5	19.4	20.2	21.1	22.0
Steel (16 in. o.c)	0.8	0.9	1.7	2.4	3.0	3.6	4.0	4.5	4.9	5.2	5.5	5.8	6.1	6.4	6.6	6.8	7.0	7.2	7.3	7.5	7.7	7.8	7.9	8.1	8.2	8.3
Steel (24 in. o.c)	0.9	1.0	1.8	2.6	3.3	3.9	4.5	5.0	5.5	5.9	6.4	6.7	7.1	7.4	7.8	8.1	8.3	8.6	8.8	9.1	9.3	9.5	9.7	9.9	10.1	10.3

a. o.c. = on center

Table A3.3.3.1-2 Effective R-Values for Cavity Insulation Between Linear Cladding Supports Added to Base Wall Assembly

	Rated R-value of Insulation																								
Type	0	0.2	0.4	0.5	0.7	0.9	1.1	1.2	1.4	1.6	1.8	1.9	2.1	2.3	2.5	2.6	2.8	3.0	3.2	3.3	3.5	3.7	3.9	4.1	4.2	4.4
Wood (400 mm o.c.)	0.1	0.2	0.3	0.5	0.6	0.8	0.9	1.1	1.2	1.4	1.5	1.7	1.8	2.0	2.1	2.2	2.4	2.6	2.7	2.9	3.0	3.2	3.3	3.5	3.6	3.8
Wood (600 mm o.c.)	0.2	0.2	0.3	0.5	0.6	0.8	0.9	1.1	1.2	1.4	1.5	1.7	1.9	2.0	2.2	2.3	2.5	2.6	2.8	2.9	3.1	3.3	3.4	3.6	3.7	3.9
Steel (400 mm o.c.)	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	0.9	1.0	1.0	1.1	1.1	1.2	1.2	1.2	1.3	1.3	1.3	1.4	1.4	1.4	1.4	1.4	1.5
Steel (600 mm o.c.)	0.2	0.2	0.3	0.5	0.6	0.7	0.8	0.9	1.0	1.0	1.1	1.2	1.3	1.3	1.4	1.4	1.5	1.5	1.5	1.6	1.6	1.7	1.7	1.7	1.8	1.8

a. o.c. = on center

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Revise Section A3.4 as shown (I-P and SI).

A3.4 Wood-Framed Walls

A3.4.1 A3.4.1 General. For the purpose of Section A1.2, the base assembly is a wall where the insulation is installed between 2 in. nominal wood framing. Cavity insulation is full depth, but values are taken from Table A9.4.3 for R-19 insulation, which is compressed when installed in a 5.5 in. cavity. Headers are double 2 in. nominal wood framing. The U-factors include R-0.17 for exterior air film, R-0.08 for stucco, R-0.56 for 0.625 in. gypsum board on the exterior, R-0.56 for 0.625 in. gypsum board on the interior, and R-0.68 for interior air film, vertical surfaces. Additional assemblies include continuous insulation uncompressed and uninterrupted by framing. U-factors are provided for the following configurations:

a. Standard framing: Wood framing at 16 in. on center with cavities filled with 14.5 in. wide insulation for both 3.5 in. deep and 5.5 in. deep *wall* cavities. Double headers leave no cavity. Weighting factors are 75% insulated cavity, 21% studs, plates, and sills, and 4% headers.
b. Advanced framing: Wood framing at 24 in. on center with cavities filled with 22.5 in. wide insulation for both 3.5 in. deep and 5.5 in. deep *wall* cavities. Double headers leave uninsulated cavities. Weighting factors are 78% insulated cavity, 18% studs, plates, and sills, and 4% headers.
c. Advanced framing with insulated headers: Wood framing at 24 in. on center with cavities filled with 22.5 in. wide insulation for both 3.5 in. deep and 5.5 in. deep *wall* cavities. Double header cavities are insulated. Weighting factors are 78% insulated cavity, 18% studs, plates, and sills, and 4% headers.

A3.4.2 Rated R-Value of Insulation for Wood-Framed and Other Walls

A3.4.2.1 The first *rated R-value of insulation* is for uncompressed insulation installed in the cavity between wood studs. ~~It is acceptable for this insulation to also be *continuous insulation* uninterrupted by framing.~~

A3.4.2.2 ~~If~~ Where there are two values, the second *rated R-value of insulation* is for *continuous insulation* uninterrupted by framing, etc., to be installed in addition to the first insulation.

A3.4.3 U-Factors for Wood-Framed Walls

A3.4.3.1 *U-factors* for wood-framed *walls* shall be determined by one of the following methods:~~taken from~~

a. Table A3.4.3.1-1 for assemblies complying with the base assembly and insulation conditions described in Section A3.4.1.~~,~~
b. b. Testing or calculation methods listed in Section 9.2(b)(4), or
c. Use Table A3.4.3.1-1 to determine an effective R-value (1/U) from the inverse of the *U-factor* for the base *wall* assembly complying with Section A3.3.1. Use Table A3.4.3.2-2 to determine an effective R-value for an added cavity insulation layer interrupted by wood or steel framing or linear cladding supports. Sum the two effective R-values for a total effective R-value and then determine the *U-factor* for the total assembly as the inverse of the total effective R-value.

A3.4.3.2 For wood-framed *walls* with framing at less than 24 in. on center, use the standard framing values as described in Section A3.4.1(a).

A3.4.3.3 For wood-framed *walls* with framing from 24 to 32 in. on center, use the advanced framing values as described in Section A3.4.1(b) ~~if~~ where the headers are uninsulated, or the advanced framing with insulated header values as described in Section A3.4.1(c) ~~if~~ where the headers are insulated.

A3.4.3.4 For wood-framed *walls* with framing greater than 32 in. on center, *U-factors* shall be determined in accordance with Section A9.

Renumber Table A3.3.3.1 as shown (I-P and SI).

Table A3.4.3.1-1 Assembly U-Factors for Wood-Frame Walls

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Add new Table A3.4.3.1-2 as shown (I-P and SI, respectively).

Table A3.4.3.1-2 Effecti\ve R-Values for Cavity Insulation Between Linear Cladding Supports Added to Base Wall Assembly

	Rated R-value of Cavity Insulation between Furring Added to Base Wall Assembly																								
Type	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
Wood (16 in. o.c.)	0.8	0.9	1.7	2.6	3.4	4.3	5.1	6.0	6.8	7.7	8.5	9.4	10.2	11.1	11.9	12.7	13.6	14.5	15.3	16.2	17.0	17.9	18.7	19.6	20.4	21.3
Wood (24 in. o.c)	0.9	1.0	1.8	2.7	3.5	4.4	5.2	6.2	7.0	7.9	8.8	9.7	10.6	11.3	12.3	13.2	14.1	15.0	15.8	16.7	17.6	18.5	19.4	20.2	21.1	22.0
Steel (16 in. o.c)	0.8	0.9	1.7	2.4	3.0	3.6	4.0	4.5	4.9	5.2	5.5	5.8	6.1	6.4	6.6	6.8	7.0	7.2	7.3	7.5	7.7	7.8	7.9	8.1	8.2	8.3
Steel (24 in. o.c)	0.9	1.0	1.8	2.6	3.3	3.9	4.5	5.0	5.5	5.9	6.4	6.7	7.1	7.4	7.8	8.1	8.3	8.6	8.8	9.1	9.3	9.5	9.7	9.9	10.1	10.3

a. o.c. = on center

Table A3.4.3.1-2 Effecti\ve R-Values for Cavity Insulation Between Linear Cladding Supports Added to Base Wall Assembly

	Rated R-value of Insulation																								
Type	**0**	**0.2**	**0.4**	**0.5**	**0.7**	**0.9**	**1.1**	**1.2**	**1.4**	**1.6**	**1.8**	**1.9**	**2.1**	**2.3**	**2.5**	**2.6**	**2.8**	**3.0**	**3.2**	**3.3**	**3.5**	**3.7**	**3.9**	**4.1**	**4.2**	**4.4**
Wood (400 mm o.c.)	0.1	0.2	0.3	0.5	0.6	0.8	0.9	1.1	1.2	1.4	1.5	1.7	1.8	2.0	2.1	2.2	2.4	2.6	2.7	2.9	3.0	3.2	3.3	3.5	3.6	3.8
Wood (600 mm o.c.)	0.2	0.2	0.3	0.5	0.6	0.8	0.9	1.1	1.2	1.4	1.5	1.7	1.9	2.0	2.2	2.3	2.5	2.6	2.8	2.9	3.1	3.3	3.4	3.6	3.7	3.9
Steel (400 mm o.c.)	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	0.9	1.0	1.0	1.1	1.1	1.2	1.2	1.2	1.3	1.3	1.3	1.4	1.4	1.4	1.4	1.4	1.5
Steel (600 mm o.c.)	0.2	0.2	0.3	0.5	0.6	0.7	0.8	0.9	1.0	1.0	1.1	1.2	1.3	1.3	1.4	1.4	1.5	1.5	1.5	1.6	1.6	1.7	1.7	1.7	1.8	1.8

a. o.c. = on center

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