



**BSR/ASHRAE Addendum c to
ANSI/ASHRAE Standard 140-2023**

First Public Review Draft

Proposed Addendum c to Standard 140-2023, Method of Test for Evaluating Building Performance Simulation Software

**First Public Review Draft (March 2026)
(Draft shows Proposed Changes to Current Standard)**

This draft has been recommended for public review by the responsible project committee. To submit a comment on this proposed standard, go to the ASHRAE website at www.ashrae.org/standards-research-technology/public-review-drafts and access the online comment database. The draft is subject to modification until it is approved for publication by the Board of Directors and ANSI. Until this time, the current edition of the standard (as modified by any published addenda on the ASHRAE website) remains in effect. The current edition of any standard may be purchased from the ASHRAE Online Store at www.ashrae.org/bookstore or by calling 404-636-8400 or 1-800-727-4723 (for orders in the U.S. or Canada).

The appearance of any technical data or editorial material in this public review document does not constitute endorsement, warranty, or guaranty by ASHRAE of any product, service, process, procedure, or design, and ASHRAE expressly disclaims such.

© 2026 ASHRAE. This draft is covered under ASHRAE copyright. Permission to reproduce or redistribute all or any part of this document must be obtained from the ASHRAE Manager of Standards, 180 Technology Parkway, Peachtree Corners, GA 30092. Phone: 404-636-8400, Ext. 1125. Fax: 404-321-5478. E-mail: standards.section@ashrae.org.

ASHRAE, 180 Technology Parkway, Peachtree Corners GA 30092

Proposed BSR/ASHRAE/IBPSA Addendum c to ANSI/ASHRAE Standard 140-2023, *Method of Test for Evaluating Building Performance Simulation Software*

(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 to Addendum c

This addendum updates the Standard 140 acceptance criteria based on updated results from Building Energy Modeling software. The same procedure that was used for the existing ranges was used with the new results to calculate the updated ranges. One software, the Modelica Buildings Library, was added to the reference set of software for the calculations.

[Note to Reviewers: This addendum makes proposed changes to the current standard. These changes are indicated in the text by underlining (for additions) and strikethrough (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.]

[Note to Reviewers: Revisions proposed for this addendum begin with Normative Annex A3.]

NORMATIVE ANNEX A3 SOFTWARE ACCEPTANCE CRITERIA

Table A3-1 Low Mass Building—Single-Value Ranges

Range Case	Annual Heating Load (MWh/yr)*		Annual Sensible Cooling Load (MWh/yr)*	
	Lower Limit	Upper Limit	Lower Limit	Upper Limit
Case 600	3.75 <u>3.98</u>	4.98 <u>4.85</u>	5.00 <u>5.35</u>	6.83 <u>6.52</u>
Case 610 – Case 600	-0.14	0.29 <u>0.30</u>	-2.26 <u>-2.11</u>	-0.80 <u>-1.01</u>
Case 620 – Case 600	-0.08 <u>-0.05</u>	0.40	-2.24 <u>-2.23</u>	-1.64 <u>-1.63</u>
Case 630 – Case 620	0.02 <u>-0.05</u>	0.74 <u>0.81</u>	-1.68 <u>-1.93</u>	-0.77 <u>-0.56</u>
Case 640 – Case 600	-2.17 <u>-2.04</u>	-1.22 <u>-1.4</u>	-0.56	0.03
Case 650 – Case 600	n/a	n/a	-1.54 <u>-1.51</u>	-0.95 <u>-0.91</u>
Case 660 – Case 600	-1.07 <u>-1.08</u>	-0.16 <u>-0.25</u>	-3.09 <u>-3.11</u>	-2.50 <u>-2.38</u>
Case 670 – Case 600	0.25 <u>0.77</u>	2.98 <u>2.48</u>	0.05 <u>0.13</u>	0.84
Case 680 – Case 600	-2.54 <u>-2.44</u>	-1.90 <u>-2.0</u>	0.13 <u>0.09</u>	0.87 <u>0.82</u>
Case 685 – Case 600	0.33	0.77	2.70 <u>2.72</u>	3.31 <u>3.32</u>
Case 695 – Case 685	-2.38	-1.94	-0.21 <u>-0.29</u>	0.44 <u>0.46</u>

* For output specified in Section 7.3.1.1 and 7.3.1.2 for heating and cooling loads, respectively.

Table A3-4 High Mass Building—Single-Value Ranges

Range Case	Annual Heating Load (MWh/yr)*		Annual Sensible Cooling Load (MWh/yr)*	
	Lower Limit	Upper Limit	Lower Limit	Upper Limit
Case 900	1.04 <u>1.2</u>	2.28 <u>2.17</u>	2.35 <u>2.23</u>	2.60
Case 900 – Case 910	-0.52 <u>-0.42</u>	-0.02 <u>-0.14</u>	0.35 <u>0.61</u>	1.74 <u>1.49</u>
Case 920 – Case 900	1.51 <u>1.45</u>	1.92 <u>1.93</u>	0.08 <u>0.04</u>	0.48 <u>0.50</u>
Case 930 – Case 920	0.20 <u>0.22</u>	1.15 <u>1.17</u>	-1.19 <u>-1.22</u>	-0.44 <u>-0.46</u>
Case 940 – Case 900	-0.82 <u>-0.87</u>	-0.37 <u>-0.29</u>	-0.19 <u>-0.18</u>	0.06
Case 950 – Case 900	n/a	n/a	-2.00 <u>-2.05</u>	-1.56 <u>-1.45</u>
Case 960 – Case 900	0.96 <u>0.78</u>	1.12 <u>1.3</u>	-1.81 <u>-1.79</u>	-1.27 <u>-1.29</u>
Case 980 – Case 900	-1.65 <u>-1.55</u>	-1.00 <u>-1.05</u>	1.09 <u>0.67</u>	1.41 <u>1.82</u>
Case 985 – Case 900	0.64 <u>0.62</u>	0.81 <u>0.79</u>	3.52 <u>3.56</u>	4.18 <u>4.06</u>
Case 995 – Case 985	-1.83 <u>-1.61</u>	-1.07 <u>-1.22</u>	0.63 <u>0.48</u>	1.15 <u>1.26</u>

* For output specified in Section 7.3.1.1 and 7.3.1.2 for heating and cooling loads, respectively.

Table A3-7 Cooling Equipment Single-Value Ranges

Range Case	Annual Total Cooling Energy Consumption (kWh/yr)*	
	Lower Limit	Upper Limit
CE300	33497 <u>33452</u>	37023 <u>36973</u>
CE310 – CE300	2671 <u>2706</u>	6197 <u>6227</u>
CE320 – CE300	2610 <u>2652</u>	6136 <u>6173</u>
CE330 – CE320	-766 <u>-733</u>	2760 <u>2789</u>
CE330 – CE300	3697 <u>3711</u>	7223 <u>7232</u>
CE340 – CE300	3172 <u>3277</u>	6698 <u>6798</u>
CE330 – CE340	-1393 <u>-1429</u>	2133 <u>2092</u>
CE350 – CE300	-5354 <u>-5293</u>	-1828 <u>-1771</u>
CE360 – CE300	18084 <u>18094</u>	21610 <u>21616</u>
CE400 – CE300	-5783 <u>-5711</u>	-2179 <u>-2190</u>
CE410 – CE300	-5929	-371
CE420 – CE300	-3945 <u>-3855</u>	-419 <u>-334</u>
CE430 – CE300	-4762 <u>-4728</u>	-1236 <u>-1206</u>
CE440 – CE300	-3694 <u>-3611</u>	-168 <u>-90</u>

* For output specified in Section 9.3.2.1.1.1(a)

Table A3-8 Heating Equipment Single-Value Ranges

Range Case	Furnace Input Energy (GJ)*		Cumulative Fan Energy (kWh)*	
	Lower Limit	Upper Limit	Lower Limit	Upper Limit
HE210	49.86 <u>49.84</u>	55.11 <u>55.08</u>	279.55 <u>278.67</u>	308.98 <u>308.0</u>
HE220 – HE210	-5.48	-0.23 <u>-0.24</u>	-30.21 <u>-30.14</u>	-0.78 <u>-0.80</u>
HE230 – HE220	-9.10 <u>-9.07</u>	-3.86 <u>-3.83</u>	186.29 <u>186.99</u>	216.78 <u>216.32</u>

* For output specified in Section 10.3.1.2 and 10.3.2.1 for furnace input energy and cumulative fan energy, respectively.

Table A3-9 Air-Side Equipment Single-Value Ranges

Range Case	Preheat-Coil Load (kWh/h)*		Heating-Coil Load (kWh/h)*		Cooling-Coil Total Load (kWh/h)*		Cooling-Coil Sensible Load (kWh/h)*		Zone 1 Reheat-Coil Load (kWh/h)*		Zone 2 Reheat-Coil Load (kWh/h)*	
	Lower Limit	Upper Limit	Lower Limit	Upper Limit	Lower Limit	Upper Limit	Lower Limit	Upper Limit	Lower Limit	Upper Limit	Lower Limit	Upper Limit
AE201	n/a	n/a	7.94	8.78	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
AE205	n/a	n/a	n/a	n/a	1.82	2.01	1.82	2.01	n/a	n/a	n/a	n/a
AE245 – AE205	n/a	n/a	n/a	n/a	0.20	0.39	0.20	0.39	n/a	n/a	n/a	n/a
AE206	n/a	n/a	n/a	n/a	2.54	2.85 2.81	1.62	1.79	n/a	n/a	n/a	n/a
AE226 – AE206	n/a	n/a	n/a	n/a	0.55	0.82	-0.23	-0.06	n/a	n/a	n/a	n/a
AE301	2.80 2.64	4.20 4.52	n/a	n/a	n/a	n/a	n/a	n/a	7.23 7.33	8.10	7.77 7.97	8.81
AE301 – AE401	-7.67 -8.21	-6.16 -5.85	n/a	n/a	n/a	n/a	n/a	n/a	2.70 2.68	3.60	2.87 2.69	3.93 4.03
AE305	n/a	n/a	n/a	n/a	8.77 8.45	9.85 9.94	8.77 8.45	9.85 9.94	1.92 1.91	2.46 2.47	2.02 1.99	2.71 2.75
AE305 – AE405	n/a	n/a	n/a	n/a	4.55 4.35	5.75 5.84	4.55 4.35	5.75 5.84	n/a	n/a	n/a	n/a
AE345 – AE305	n/a	n/a	n/a	n/a	-0.15	0.79	-0.15	0.79	-0.11	0.11	-0.12	0.12
AE345 – AE445	n/a	n/a	n/a	n/a	4.76 4.59	6.01 6.15	4.76 4.59	6.01 6.15	n/a	n/a	n/a	n/a
AE306	n/a	n/a	n/a	n/a	13.65	15.08	8.30 8.16	9.37	1.92 1.99	2.48 2.43	2.02 2.11	2.74 2.69
AE306 – AE406	n/a	n/a	n/a	n/a	5.42	6.86	4.64 4.62	5.73	n/a	n/a	n/a	n/a
AE326 – AE306	n/a	n/a	n/a	n/a	5.68	7.12	-0.91	-0.01	-0.11	0.11	-0.12	0.12
AE326 – AE426	n/a	n/a	n/a	n/a	11.21	12.65	4.27 4.17	5.31	n/a	n/a	n/a	n/a
AE401	9.75	10.77	n/a	n/a	n/a	n/a	n/a	n/a	4.27	4.72	4.63	5.12
AE405	n/a	n/a	n/a	n/a	3.90	4.31	3.90	4.31	0.00	0.00	0.00	0.00
AE445 – AE405	n/a	n/a	n/a	n/a	-0.15	0.26	-0.15	0.26	n/a	n/a	n/a	n/a
AE406	n/a	n/a	n/a	n/a	7.81 7.78	8.82 8.85	3.45	3.82	0.00	0.00	0.00	0.00
AE426 – AE406	n/a	n/a	n/a	n/a	0.20	1.02	-0.22	0.14	n/a	n/a	n/a	n/a

BSR/ASHRAE Addendum c to ANSI/ASHRAE Standard 140-2023, *Method of Test for Evaluating Building Performance Simulation Software*
First Public Review Draft

For output specified in Sections as follows. Preheat coil, 11.3.3.2(a),11.3.4.2; heating coil, 11.3.1.2(a), 11.3.2.2; cooling coil total, 11.3.1.2(d), 11.3.2.2, 11.3.3.2(d), 11.3.4.2; cooling coil sensible load 11.3.1.2(b), 11.3.2.2, 11.3.3.2(b), 11.3.4.2; zone 1 reheat coil, 11.3.3.2(f), 11.3.4.2; zone 2 reheat coil, 11.3.3.2(g), 11.3.4.2.

INFORMATIVE ANNEX B12 DEVELOPMENT OF ACCEPTANCE CRITERIA

B12.1 Acceptance Criteria Bounds Calculations. The results from a reference set of software programs (see Section B12.1.2), also called “reference results” here, are used to calculate the upper and lower limits for the acceptance criteria.

B12.1.1 Equations for Setting Bound Limits. There are two different types of results included in the acceptance criteria: single-value results (e.g., annual totals) and time series results (e.g., hourly zone loads for a specific day). There are different calculation methodologies for each of these types of results.

B12.1.1.1 Equations for Single-Value Results. The upper and lower limits for each range case applied for acceptance criteria are set by selecting the lower minimum value and higher maximum value of the following:

a. Statistical Bounds (SB):

$$\text{Minimum: MinSB} = \text{Median}_{\text{case}} - \text{MAD}_{3\text{sigma}}$$

$$\text{Maximum: MaxSB} = \text{Median}_{\text{case}} + \text{MAD}_{3\text{sigma}}$$

where

$\text{Median}_{\text{case}} \equiv$ median value of reference results for a given case

$\text{MAD}_{3\text{sigma}} \equiv$ median absolute deviation (MAD) with 99.73% (3 sigma) confidence interval for the reference results of a given case

and

$$\text{MAD}(X) = \text{Median}[|X - \text{Median}(X)|]$$

for a normal distribution, we can relate MAD to the standard deviation as

$$\text{MAD} = \sigma \Phi^{-1}\left(\frac{3}{4}\right) = \sigma \sqrt{2} \text{erf}^{-1}\left(\frac{1}{2}\right) \approx 0.6745\sigma$$

where

$\sigma \equiv$ standard deviation

$\Phi \equiv$ quantile function

$\text{erf} \equiv$ error function

The bounds of the confidence interval can be set in terms of \pm standard deviation from the average or \pm MAD from the median. In this case, a 99.73% confidence interval results from three standard deviations (or 3 sigma), which leads to a MAD multiplier ($\text{MAD}_{3\text{sigma}}$) of ~~2.024~~ 4.64.

b. Nonstatistical Bounds (NSB):

1. Where no quasi-analytical solution results exist for an acceptance criteria test group:

$$\text{Minimum: MinNSB} = \text{Median}_{\text{case}} - \text{Median}_{\text{BC}} \times 0.05$$

$$\text{Maximum: MaxNSB} = \text{Median}_{\text{case}} + \text{Median}_{\text{BC}} \times 0.05$$

where

$\text{Median}_{\text{BC}} \equiv$ median value of reference results of base case (BC) for a given case

2. Where quasi-analytical solution results (QAS) exist for an acceptance criteria test group:

$$\text{Minimum: MinNSB} = \text{QAS}_{\text{case}} - \text{QAS}_{\text{BC}} \times 0.05$$

$$\text{Maximum: MaxNSB} = \text{QAS}_{\text{case}} + \text{QAS}_{\text{BC}} \times 0.05$$

where

$\text{QAS}_{\text{case}} \equiv$ QAS value for a given case

$QAS_{BC} \equiv$ QAS value of the base case (BC) for a given case

B12.1.2 Reference Software for Setting Bound Limits. The reference set of software for setting the bound limits is selected based on the following criteria:

- A single set of results per calculation engine is included (multiple user interfaces for the same calculation engine are not included).
- Results are submitted by the calculation engine copyright holder(s) or by a modeler designated by the calculation engine copyright holder(s), applying a user interface specified by the calculation engine copyright holder(s) if appropriate.
- The set of selected software should represent a diversity of modeling methods, such as control-based and load-based.
- The calculation engine should be actively, reasonably, and widely used and actively maintained.
- Software satisfies the following:
 - Able to run at a time step of an hour or less
 - Able to include hourly variations in occupancy, lighting power, miscellaneous equipment power, thermostat set points, and HVAC system operation
 - Include thermal mass effects
- If a software did not participate in the simulation trials for the initial development of a test suite, then prior to the submittal, its results are reviewed and undergo iterative rounds of review and revisions as determined during the submission review process. The reviewer comments and submitter responses are documented from each round, with a logical basis for corrections to programs or inputs included in the documentation. This review process only applies to the initial submittal of a software and not subsequent submittals of that software for version updates.

The results from a reference software

- include justification via Normative Annex A2, Attachment A2.8, Item G (“Report Block for Anomalous Results”) if they fall outside of the established bounds and
- pass the minimum number of tests indicated for each test group in Table A3.2-1 for which a given reference software provided results.

The results from a reference software may be updated for each new public release of the calculation engine. For future continuous maintenance revisions of Standard 140, SSPC 140 may

- include any additional software in the acceptance criteria-bounds reference set that apply and meet the criteria for inclusion;
- remove any software from the reference set that no longer meet the criteria for inclusion; and
- update the acceptance criteria with the most recent results from the reference set of software.

The current reference set of software used to determine the acceptance criteria are (in alphabetical order): CSE, DeST, DOE-2.2, EnergyPlus, ESP-r, IDA ICE, IES-VE, Modelica Buildings Library, TAS, and TRNSYS. Not all software are applied for all test groups.