STANDARD

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

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

Approved by the ASHRAE Standards Committee on February 8, 2025; by the American National Standards Institute on March 11, 2025; and by the Illuminating Engineering Society on January 28, 2025.

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FOREWORD

The 2023 edition of ASHRAE Standard 140 added software acceptance criteria to the standard, allowing codes citing Standard 140, such as ANSI/ASHRAE/IES Standard 90.1, to require the results from software to provide results within the ranges included in Standard 140. This provides Standard 90.1 with a measure of the acceptability of a building performance simulation software program based on the tests included in Standard 140. Prior to the 2023 edition, Standard 140 had test cases with example results to evaluate building performance software, but it did not include any information on when a software's results would be considered acceptable for the test cases. This meant that organizations that cited Standard 140 would only require that software ran the tests and not that their results had to be within a specific range of results. Historically, this caused confusion for jurisdictions adopting IECC when determining if software passed or failed Standard 140 testing when simply running the tests was all that was required.

All major building energy modeling software developers were invited to participate in the process to determine the acceptance ranges that appear in Standard 140-2023, and many software developers participated. The acceptance ranges were set so that commonly used software programs are within the ranges, and additional software is expected to be within the ranges as software developers address outlying results. Overall, this approach will encourage building performance simulation software to be more accurate and consistent. No comments were provided during the public review of the addendum that added this to Standard 140, which reflects the consensus reached within the software and modeling community.

Addendum at adds the necessary referencing language to utilize ASHRAE Standard 140-2023, including the acceptance ranges to be met, reporting requirements, and details necessary for testing to Standard 90.1 in the four sections that referenced it. This addendum also reduces redundancy in Standard 90.1 by citing Standard 140 only in Appendix G, which includes all the necessary details, and letting Section 12, Appendix C, and Appendix L simply reference the section in Appendix G related to Standard 140. The use of a simulation engine and a simplified interface for programs that comply with Appendices C and L have traditionally meant that only the simulation engine and not the entire program including user interface were tested according to Standard 140; this addendum makes that explicit.

This addendum impacts an optional performance path in the standard designed to provide increased flexibility, which was not subjected to a cost-effectiveness analysis.

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 at to Standard 90.1-2022

Revise Section 3.2 as shown below.

3.2 Definitions

[. . .]

simulation engine: the component of the *simulation program* that performs the *building* performance simulation calculations.

simulation program: a computer ~~program~~ software application, including the ~~simulation engine~~ *simulation engine* and the corresponding ~~user interface~~ *simulation user interface*, that is capable of simulating the *energy* performance of *building systems*.

simulation user interface: the component of the *simulation program* for users to specify inputs that are communicated to the *simulation engine* and to display outputs to the user generated by the *simulation engine*.

[. . .]

Revise Section 12.4.1.4 as shown below.

12.4.1.4 Simulation Program Testing Requirements. The *simulation program* used to model *design energy cost* and *energy cost budget* shall meet the testing requirements in Section G2.2.4.2.

~~**12.4.1.4.1** The simulation program shall be tested according to ASHRAE Standard 140, except for Sections 7 and 8 of Standard 140. The required tests shall include building thermal envelope and fabric load tests (Sections 5.2.1, 5.2.2, and 5.2.3), ground coupled slab-on-grade analytical verification tests (Section 5.2.4), space-cooling equipment performance tests (Section 5.3), space-heating equipment performance tests (Section 5.4), and air-side HVAC equipment analytical verification tests (Section 5.5), along with the associated reporting (Section 6).~~

~~**12.4.1.4.2** The test results and modeler reports shall be posted on a publicly available website and shall include the test results of the simulation program and input files used for generating results along with the results of the other simulation programs included in ASHRAE Standard 140, Annexes B8 and B16. The modeler report in Standard 140, Annex A2, Attachment A2.7, shall be completed for results exceeding the maximum or falling below the minimum of the reference values and for omitted results.~~

~~**12.4.1.4.3** The testing shall be performed for the version of the simulation program used to calculate the design energy cost and energy cost budget.~~

Informative Notes~~:~~

~~1.~~ ~~There are no pass/fail criteria established by this requirement.~~

~~2.~~ ~~Based on the Section 3.2 definition, simulation program includes the simulation engine and the corresponding user interface.~~ The testing of a *simulation program* only meets the requirements of Section 12.4.1.4 for that *simulation program* and ~~cannot~~ should not be used as proxy for documenting compliance of another *simulation program* that uses the same ~~simulation engine~~ *simulation engine*.

Revise Section 13 as shown below.

13. NORMATIVE REFERENCES

Revise Section C3.1.4 as shown below.

C3.1.4 Simulation ~~Program~~ Engine Testing Requirements. The *simulation engine* used to model *base envelope performance factor* and *proposed envelope performance factor* shall meet the testing requirements in Section G2.2.4.2.

~~**C3.1.4.1** The simulation program shall be tested according to ASHRAE Standard 140, except for Sections 7 and 8, of Standard 140. The required tests shall include building thermal envelope and fabric load tests (Sections 5.2.1, 5.2.2, and 5.2.3), ground coupled slab-on-grade analytical verification tests (Section 5.2.4), space-cooling equipment performance tests (Section 5.3), space-heating equipment performance tests (Section 5.4), and air-side HVAC equipment analytical verification tests (Section 5.5), along with the associated reporting (Section 6).~~

~~**C3.1.4.2** The test results and modeler reports shall be posted on a publicly available website and shall include the test results of the simulation program and input files used for generating the results along with the results of the other simulation programs included in ASHRAE Standard 140, Annexes B8 and B16. The modeler report in Standard 140, Annex A2, Attachment A2.7 shall be completed for results exceeding the maximum or falling below the minimum of the reference values and for omitted results.~~

~~**C3.1.4.3** The testing shall be performed for the version of the simulation program used to calculate the proposed envelope performance factor and base envelope performance factor.~~

~~***Informative Notes:***~~

~~1.~~ ~~There are no pass/fail criteria established by this requirement.~~

~~2.~~ ~~Based on the Section 3 definition, simulation program includes the simulation engine and the corresponding user interface. The testing of a simulation program only meets the requirements of Section C3.1.4 for that simulation program and cannot be used as proxy for documenting compliance of another simulation program that uses the same simulation engine.~~

Revise Section G2.2.4 as shown below.

G2.2.4 Simulation Program Testing Requirements

G2.2.4.1 Modeling Requirements Related to Testing. The *simulation program* used to model *proposed building performance* and *baseline building performance* shall meet the testing requirements in Section G2.2.4.2.

Informative Note: The testing of a *simulation program* only meets the requirements of Section G2.2.4 for that *simulation program* and should not be used as proxy for documenting compliance of another *simulation program* that uses the same *simulation engine*.

~~The simulation program shall be tested according to ASHRAE Standard 140, except for Sections 7 and 8 of Standard 140. The required tests shall include building thermal envelope and fabric load tests (Sections 5.2.1, 5.2.2, and 5.2.3), ground coupled slab-on-grade analytical verification tests (Section 5.2.4), space-cooling equipment performance tests (Section 5.3), space-heating equipment performance tests (Section 5.4), and air-side HVAC equipment analytical verification tests (Section 5.5), along with the associated reporting (Section 6).~~

G2.2.4.2 Required Software Testing. When this section is referenced from Appendices C or L, all uses of the term "*simulation program*" are replaced with "*simulation engine*."

~~The test results and modeler reports shall be posted on a publicly available website and shall include the test results of the simulation program and input files used for generating the results along with the results of the other simulation programs included in ASHRAE Standard 140, Annexes B8 and B16. The modeler report in Standard 140, Annex A2, Attachment A2.7 shall be completed for results exceeding the maximum or falling below the minimum of the reference values and for omitted results.~~

G2.2.4.2.1 The *simulation program* shall be tested according to ASHRAE Standard 140, except for Section 12 of Standard 140. The required tests shall include Weather Drivers Tests (Section 6), Building Thermal Envelope and Fabric Load Tests (Section 7), Ground Coupled Slab-On-Grade Tests (Section 8), Space-Cooling Equipment Performance Tests (Section 9), Space-Heating Equipment Performance Tests (Section 10), and Air-Side HVAC Equipment Performance Tests (Section 11), along with the associated reporting.

G2.2.4.2.2 During testing, hidden inputs that are not normally accessible to the user shall be permitted.

Informative Note: The hidden inputs are permitted to avoid introducing source code changes strictly used for testing.

G2.2.4.2.3 The software vendor or third party, authorized by either the software vendor or the *authority having jurisdiction*, shall publish on a publicly available website the following ASHRAE Standard 140 test results, input files, and modeler reports for each tested version of a *simulation program*:

a. Test results demonstrating the *simulation program* was tested in accordance with ASHRAE Standard 140, Annex A3, and that meet or exceed the values for "Minimum Number of Range Cases within the Test Group to Pass" for all test groups in ASHRAE Standard 140, Table A3-14.
b. Test results of the *simulation program* and input files used for generating the ASHRAE Standard 140 test cases along with the results of the other *simulation programs* included in ASHRAE Standard 140, Annexes B8 and B16.
c. The modeler report in ASHRAE Standard 140, Annex A2, Attachment A2.8,.Report blocks A and G shall be completed for results exceeding the maximum or falling below the minimum of the reference values shown in ASHRAE Standard 140, Tables A3-1 through A3-13, and Report blocks A and E shall be completed for any omitted results.

A software vendor of the *simulation user interface* or third party, authorized by the software vendor or the *authority having jurisdiction*, shall also be permitted to meet the requirements of this section.

G2.2.4.2.4 If a certification program exists for *simulation programs* tested to ASHRAE Standard 140, the *simulation program* shall be listed in the certification program.

~~**G2.2.4.3** The testing shall be performed for the version of the simulation program used to calculate the proposed building performance and baseline building performance.~~

Informative Notes~~ to G2.2.4: See Standard 140, Informative Section 4.5, "Citing Standard 140," for further guidance.

~~1. There are no pass/fail criteria established by this requirement.~~
~~2. Based on the Section 3 definition, *simulation program* includes the simulation engine and the corresponding user interface. The testing of a simulation program only meets the requirements of Section G2.2.4 for that simulation program and cannot be used as proxy for documenting compliance of another simulation program that uses the same simulation engine.~~

Revise Section L3.2.4 as shown below.

L3.2.4 Testing. The *simulation engine* used to model *total system performance ratio* of the proposed design and reference design shall meet the testing requirements in Section G2.2.4.2.

L3.2.4.1 L3.2.4.1 The simulation program shall be tested according to ASHRAE Standard 140, except for Sections 7 and 8 of Standard 140. The required tests shall include building thermal envelope and fabric load tests (Sections 5.2.1, 5.2.2, and 5.2.3), ground coupled slab-on-grade analytical verification tests (Section 5.2.4), space-cooling equipment performance tests (Section 5.3), space-heating equipment performance tests (Section 5.4), and air-side HVAC equipment analytical verification tests (Section 5.5) along with the associated reporting (Section 6).

L3.2.4.2 L3.2.4.2 The test results and modeler reports shall be posted on a publicly available website and shall include the test results of the simulation program and input files used for generating the results along with the results of the other simulation programs included in ASHRAE Standard 140, Annexes B8 and B16. The modeler report in Standard 140, Annex A2, Attachment A2.7 shall be completed for results exceeding the maximum or falling below the minimum of the reference values and for omitted results.

Informative Notes:

1. There are no pass/fail criteria established by this testing requirement.
2. Based on the Section 3.2 definition, simulation program includes the simulation engine and the corresponding user interface. The testing of a simulation program only meets the requirements of Section L1 for that simulation program and cannot be used as proxy for documenting compliance of another simulation program that uses the same simulation engine.

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