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#### NOTE

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## FOREWORD

*This Standard Method of Test can be used for identifying and diagnosing predictive differences from whole building energy simulation software that may possibly be caused by algorithmic differences, modeling limitations, input differences, or coding errors. The current set of tests included herein consists of*

- *comparative tests that focus on building thermal envelope and fabric loads and mechanical equipment performance*
- and
- *analytical verification tests that focus on mechanical equipment performance.*

*These tests are part of an overall validation methodology described in Annex B18.*

*This procedure tests software over a broad range of parametric interactions and for a number of different output types, thus minimizing the concealment of algorithmic differences by compensating errors. Different building energy simulation programs, representing different degrees of modeling complexity, can be tested. However, some of the tests may be incompatible with some building energy simulation programs.*

*The tests are a subset of all the possible tests that could occur. A large amount of effort has gone into establishing a sequence of tests that examine many of the thermal models relevant to simulating the energy performance of a building and its mechanical equipment. However, because building energy simulation software operates in an immense parameter space, it is not practical to test every combination of parameters over every possible range of function.*

*The tests consist of a series of carefully described test case building plans and mechanical equipment specifications. Output values for the cases are compared and used in conjunction with diagnostic logic to determine the sources of predictive differences. For the building thermal envelope and fabric load cases of Section 5.2, the “basic” cases (Sections 5.2.1 and 5.2.2) test the ability of the programs to model such combined effects as thermal mass, direct solar gain windows, window-shading devices, internally generated heat, infiltration, sunspaces, and deadband and setback thermostat control. The “in-depth” cases (Section 5.2.3) facilitate diagnosis by allowing excitation of specific heat transfer mechanisms. The space-cooling equipment cases of Section 5.3 test the ability of programs to model the performance of unitary space-cooling equipment using manufacturer design data presented as empirically derived performance maps. In the steady-state analytical verification cases of Sections 5.3.1 and 5.3.2, which utilize a typical range of performance data, the following parameters are varied: sensible internal gains,*

*latent internal gains, zone thermostat setpoint (entering dry-bulb temperature), and outdoor dry-bulb temperature. Parametric variations isolate the effects of the parameters singly and in various combinations and isolate the influence of part-loading of equipment, varying sensible heat ratio, “dry” coil (no latent load) versus “wet” coil (with dehumidification) operation, and operation at typical Air-Conditioning and Refrigeration Institute (ARI) rating conditions. Quasi-analytical solution results are presented for the test cases in this section. The comparative test cases of Sections 5.3.3 and 5.3.4 utilize an expanded range of performance data, an outside air mixing system and hourly varying weather data and internal gains. These cases cannot be solved analytically. In these cases the following parameters are varied: sensible internal gains, latent internal gains, infiltration rate, outside air fraction, thermostat setpoints, and economizer control settings. Through analysis of results, the influence of part loading of equipment, ODB sensitivity, and “dry” coil (no latent load) versus “wet” coil (with dehumidification) operation can also be isolated. These cases help to scale the significance of simulation results disagreements in a realistic context, which is less obvious in the steady-state analytical verification cases of Sections 5.3.1 and 5.3.2. The space heating equipment cases of Section 5.4 test the ability of programs to model the performance of residential fuel-fired furnaces. These tests are divided into two tiers. The Tier 1 cases (Sections 5.4.1 and 5.4.2—Analytical Verification Tests) employ simplified boundary conditions and test the basic functionality of furnace models. Boundary conditions that are more realistic are used in the Tier 2 cases (Section 5.4.3—Comparative Tests), where specific aspects of furnace models are examined. The full set of space heating test cases is designed to test the implementation of specific algorithms for modeling the following aspects of furnace performance: furnace steady-state efficiency, furnace part-load ratio, furnace fuel consumption, circulating fan operation, and draft fan operation. These cases also test the effects of thermostat setback and undersized capacity.*

*For consistent numbering of test cases within the standard, case numbers used for the mechanical equipment tests in Sections 5.3 and 5.4 have been changed from the numbering used in the original research reports where the test specifications were developed. For example, in Section 5.3.1, Case CE100 was named Case E100 in the original research.*

*The tests have a variety of uses, including:*

- a. *comparing the predictions from other building energy programs to the example results provided in the informative Annexes B8 and B16 and/or to other results that were generated using this SMOT;*
- b. *checking a program against a previous version of itself after internal code modifications to ensure that only the intended changes actually resulted;*
- c. *checking a program against itself after a single algorithmic change to understand the sensitivity between algorithms; and*
- d. *diagnosing the algorithmic sources and other sources of prediction differences (diagnostic logic flow diagrams are included in the informative Annex B9).*

*Regarding the comparative test results of Annex B8 and selected parts of Annex B16, the building energy simulation*