ERRATA SHEET FOR
ANSI/ASHRAE STANDARD 140-2007
Standard Method of Test for the Evaluation of
Building Energy Analysis Computer Programs

December 4, 2008

The corrections listed in this errata sheet apply to the first printing of ANSI/ASHRAE Standard 140-2007. The outside back cover marking identifying the first printing is "86471 PC 12/07".

FOREWORD to this Errata Sheet

These errata apply primarily to informative material included with the space heating equipment model test cases of Section 5.4, along with a few editorial revisions to relevant normative sections. The errata were developed because a comment by a user of Standard 140 led to the discovery that the DOE-2 simulation program input files and processed DOE-2 weather data files provided in support of informative Annex B16, Section B16.6 (Results for Space-Heating Equipment Cases) are inconsistent with normative material in the test specification (Sections 5.4 and A1.3). This errata includes updates to:

- *The following files within the accompanying electronic files folder "Sec5-4Files" (these files are included in new folder "Sec5-4Files+ERRATA-Dec2008", which replaces folder "Sec5-4Files"):*
  - *RESULTS5-4+Errata-Dec2008.xls (includes updates to DOE-2 results)*
  - *Updates to DOE-2 input files, processed weather data files, and output files, which comprise the contents of the subfolder "DOE-2_ERRATA-Dec2008 (located within subfolder "InputFiles5-4+ERRATA-Dec2008)*
- *Printed DOE-2 results in tables and figures of informative Annex B16, Section B16.6.*

In the process of developing the errata, other editorial revisions are provided, including:

- *Editorial clarifications or corrections to normative Sections 5.4.1.4.3, 6.4, and A1.3*
- *An editorial update to informative Annex B17, Section B17.2 (Production of Quasi-Analytical Solution Results and Example Simulation Results for HVAC Equipment Performance Tests) to add Table B17-3, which gives further information about example simulation results that were developed for the space heating equipment model test cases; SSPC-140 recommended to include this informative material at their June 2008 meeting.*

Page(s) **Erratum**

61 **Section 5.4.1.4.3.** Revise Section 5.4.1.4.3 as follows:
Note: Additions are shown in underline and deletions are shown in ~~strikethrough~~.

5.4.1.4.3. Air density at 115 m altitude is 1.185 kg/m^3. For software that automatically calculates air density, the air density may have a different value.

67 **Section 6.4 Output Requirements for Space-Heating Equipment Performance Tests of Section 5.4.** Revise Section 6.4 as follows:
Note: Additions are shown in underline and deletions are shown in ~~strikethrough~~.

6.4 Output Requirements for Space-Heating Equipment Performance Tests of Section 5.4. All these values shall be entered into the appropriate standard output report (see Annex A2).

The outputs listed immediately below shall include cumulative consumptions or average loads (as appropriate) for the ~~entire~~ three-month simulation period: January 1 through March 31. Sections 6.4.1-6.4.3 detail the required outputs for each test case.

68 **A1.3 Weather Data for Space-Heating Equipment Performance Tests.** Revise Section A1.3 as follows:
Note: Additions are shown in underline and deletions are shown in ~~strikethrough~~.

A1.3 Weather Data for Space-Heating Equipment Performance Tests. Weather data listed in Table A1-5 shall be used as specified in Section 5.4. These data are presented in WYEC2 format.[10] See Section A1.6 for a detailed description of the WYEC2 format. Site characteristics are summarized in Table A1-6.

Five ~~three-month-long (January 1 - March 31)~~full-year weather data files are used in the test suite:

- weather file HE100W.WY2 has a constant outdoor temperature of –30°C;
- weather files HE120W.WY2 and HE130W.WY2 have constant outdoor temperatures of 0°C and +20°C, respectively;
- weather file HE140W.WY2 features the outdoor temperature varying sinusoidally over each 24-hour period from -20°C to +20°C; and
- weather file HE210W.WY2 represents a more realistic weather set from a heating climate.

Many simulation programs use TMY or WYEC weather data, wherein the hourly time convention is solar time. For the tests of Section 5.4, solar gains are excluded. Therefore, solar time, longitude, latitude, time zone, and ground reflectivity will not impact the simulation results.

235 - 240 **B16.6 Tables and Graphs of Results for Space-Heating Equipment Cases HE100-HE170 and HE210-HE230.** Revise the DOE-2.1E simulation results in the following tables in Section B16.6 (see shaded) and replace the graphs:
Note: Additions are shown in underline and deletions are shown in ~~strikethrough~~.

B16.6 Tables and Graphs of Results for Space-Heating Equipment Cases HE100-HE170 and HE210-HE230. The following tables provide a comparison of the results calculated from the methods outlined in section B17.2 with the results obtained from the test cases using three different software simulation tools: ESP-r/HOT3000[16], EnergyPlus[39], and DOE2.1E. [14]

Comparison of Energy Delivered by Fuel-Fired Furnace (Load) and Rate of Fuel Consumption.

Total Furnace Load (GJ)

Cases	ESP-r /HOT3000	EnergyPlus	DOE 2.1E	Analytical/Quasi-Analytical	
				Heat Transfer Surf Method	Infiltration Method
HE100	77.94	77.75	76.0377.73	77.74	77.77
HE110	77.94	77.75	76.0377.73	77.74	77.77
HE120	31.25	31.1	30.2931.12	31.1	31.11
HE130	0	0	0.160.15804	0	0
HE140	31.26	31.1	30.5031.07	31.1	31.11
HE150	29.88	29.59	28.9929.55	29.65	29.66
HE160	31.26	30.46	29.9330.48	31.1	31.11
HE170	29.88	29.59	28.9929.55	29.65	29.66
HE210	41.36	42.04	41.1742.08	N/A	N/A
HE220	39.41	39.87	38.9239.87	N/A	N/A
HE230	34.32	34.59	34.0234.49	N/A	N/A

Total Furnace Input (GJ)

Cases	ESP-r /HOT3000	EnergyPlus	DOE 2.1E	Analytical/Quasi-Analytical	
				Heat Transfer Surf Method	Infiltration Method
HE100	77.74	77.71	76.6278.30	77.71	77.71
HE110	96.92	97.22	95.7897.81	97.22	97.22
HE120	38.41	38.27	37.5038.41	38.27	38.30
HE130	0.00	0.00	0.14	0.00	0.00
HE140	39.00	39.00	37.9738.71	39.00	39.00
HE150	37.23	36.94	36.1036.64	37.02	37.02
HE160	38.12	38.12	37.2537.82	38.09	38.12
HE170	37.23	36.94	36.1036.64	37.02	37.02
HE210	50.53	52.01	51.2552.30	N/A	N/A
HE220	47.87	49.35	48.4149.35	N/A	N/A
HE230	41.37	42.55	42.7643.14	N/A	N/A

Total Furnace Input (m^3/s)

Cases	ESP-r /HOT3000	EnergyPlus	DOE-2.1E	Analytical/Quasi-Analytical	
				Heat Transfer Surf Method	Infiltration Method
HE100	0.000263	0.000263	0.0002596565	0.000263	0.000263
HE110	0.000328	0.000329	0.0003243131	0.000329	0.000329
HE120	0.00013	0.0001295	0.000127373	0.0001295	0.0001296
HE130	0	0	0.000000	0	0
HE140	0.000132	0.000132	0.0001293131	0.000132	0.000132
HE150	0.000126	0.000125	0.000122124124	0.0001253	0.0001253
HE160	0.000129	0.000129	0.0001268	0.0001289	0.000129
HE170	0.000126	0.000125	0.000122124124	0.0001253	0.0001253
HE210	0.000171	0.000176	0.0001737	N/A	N/A
HE220	0.000162	0.000167	0.0001647	N/A	N/A
HE230	0.00014	0.000144	0.0001456	N/A	N/A

The results of the comparison of the circulating and draft fan energy consumption (kWh) are shown in the following Table. Again, the results for fan energy are in slight disagreement for the comparative cases.

Comparison of Fan Energy Consumption (kWh)

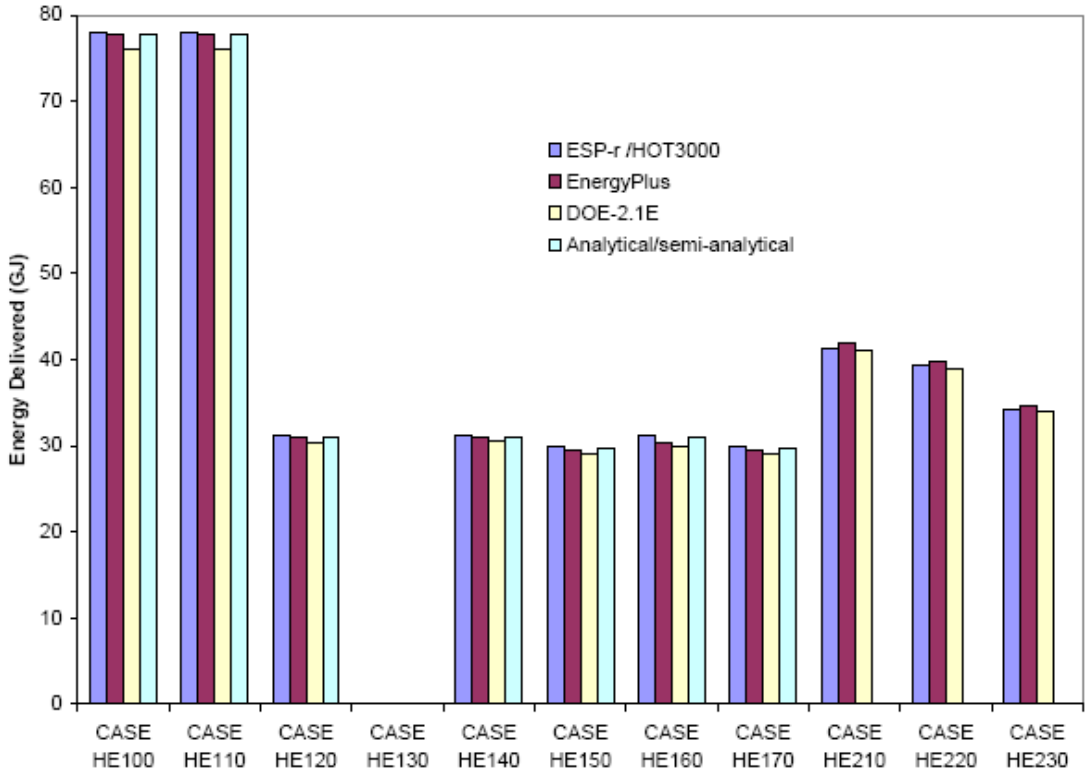
Case	Analytical/ Semi-Analytical	ESP-r/HOT3000	EnergyPlus	DOE-2.1E
HE150	432	432	433.3	432.0~~432.1~~
HE160	172.76	170.2	172.2	169.2~~172.3~~
HE170	473.18	473.4	473.1	472.2~~473.3~~
HE210	N/A	281.6	291.4	292.7~~299.2~~
HE220	N/A	268.3	276.1	275.2~~282.2~~
HE230	N/A	458.3	431.4	473.3~~480~~

In addition, the mean, maximum, and minimum zone temperatures were of interest for the comparative test cases, especially Case HE230 where the furnace is undersized. This table shows a comparison of these values for the three test simulation tools.

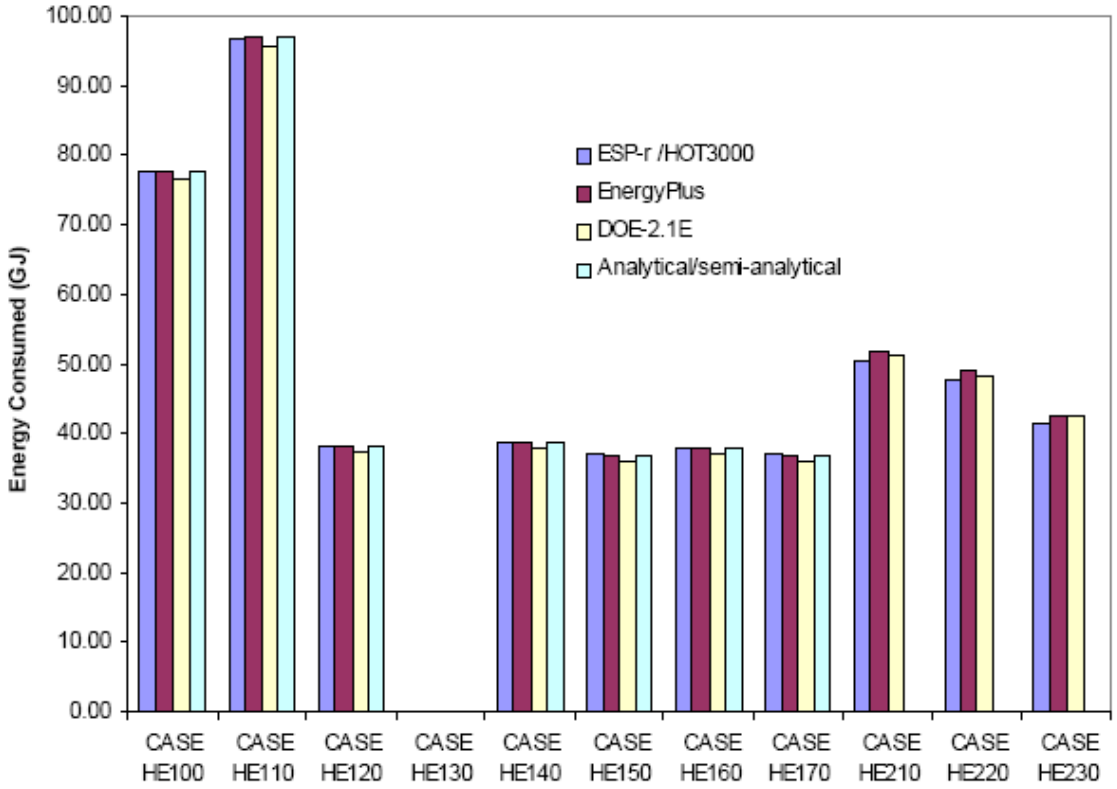
Comparison of the Mean, Maximum, and Minimum temperatures for the Comparative Test Cases

Case	Mean Temperature (°C)			Maximum Temperature (°C)			Minimum Temperature (°C)		
	ESP-r/ HOT3000	Energy Plus	DOE-2.1E	ESP-r/ HOT3000	Energy Plus	DOE- 2.1E	ESP-r/ HOT3000	Energy Plus	DOE- 2.1E
HE210	20.01	20	19.996	21.45	20	20.065	20	20	19.893
HE220	18.75	18.53	18.54	22.7	20	20.1105	15	15	14.9488
HE230	15.48	15.17	15.8846	20.14	20	20.065	1.45	4.48	3.725.33

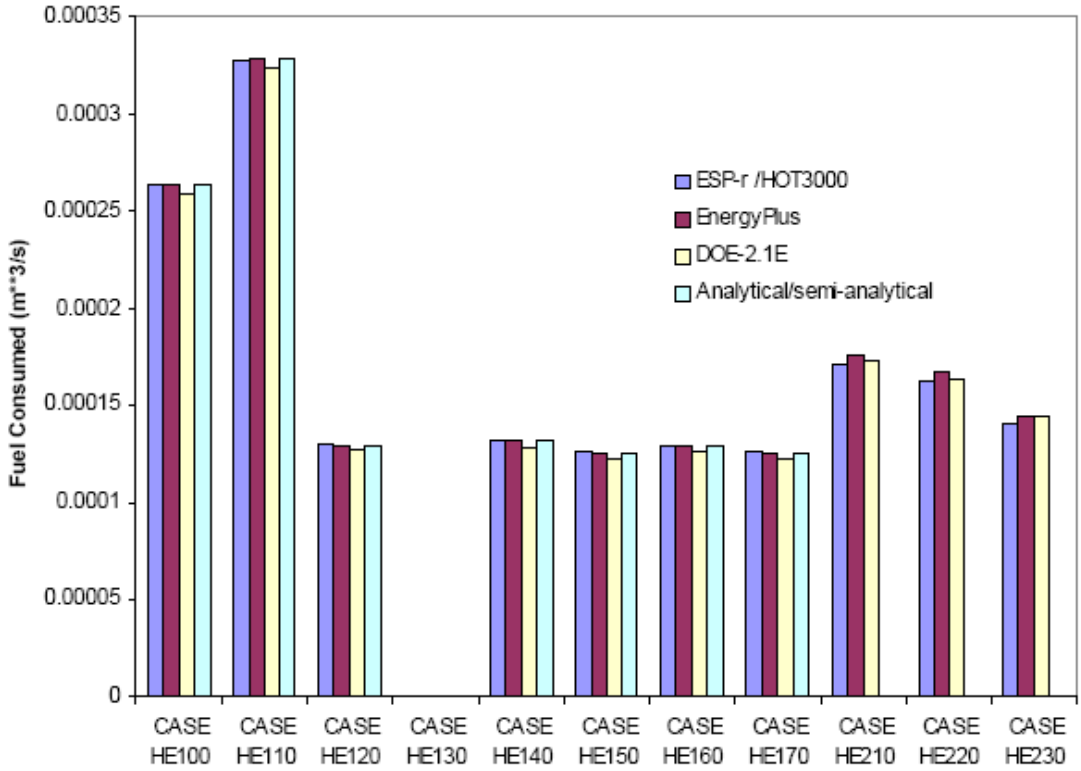
Note: Replace the graphs in Section B 16.6 with the following:



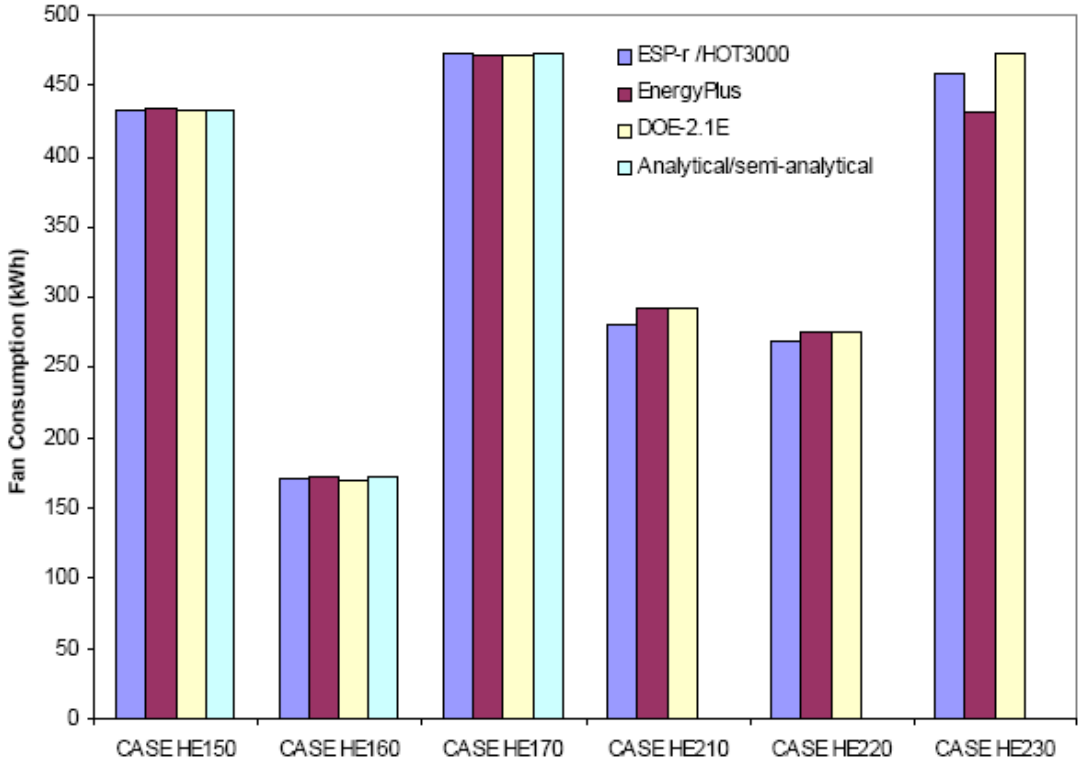
Comparison of the energy delivered for fuel-fired furnace test cases (in GJ).



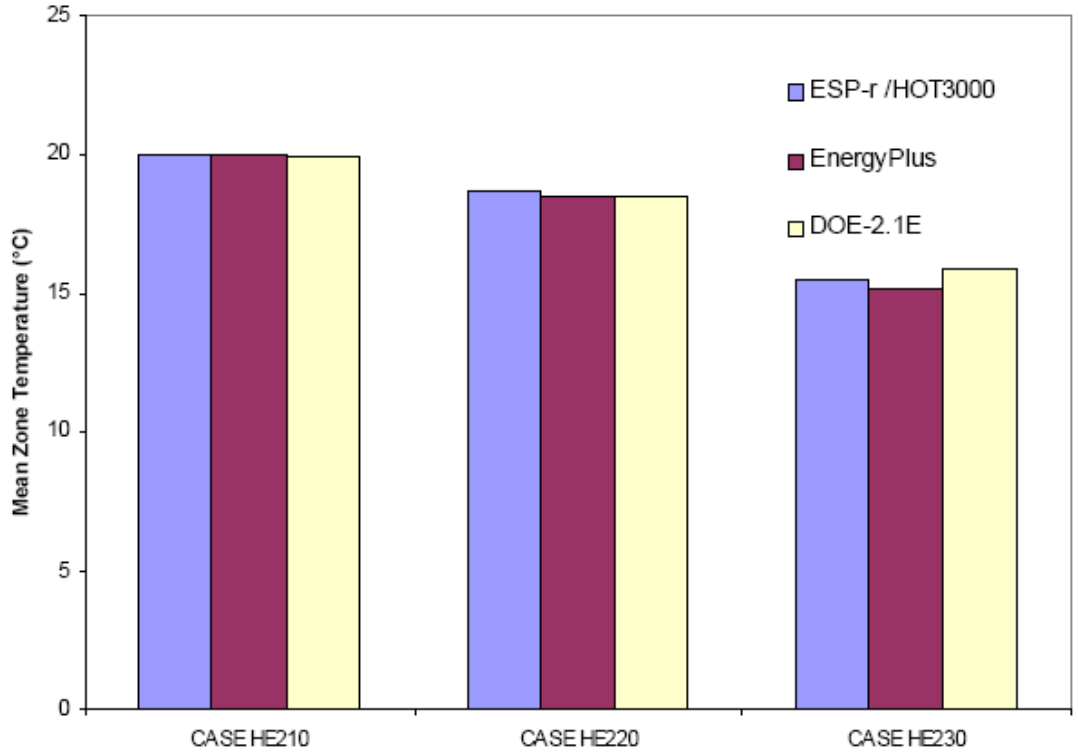
Comparison of the energy consumed for fuel-fired furnace test cases (in GJ).



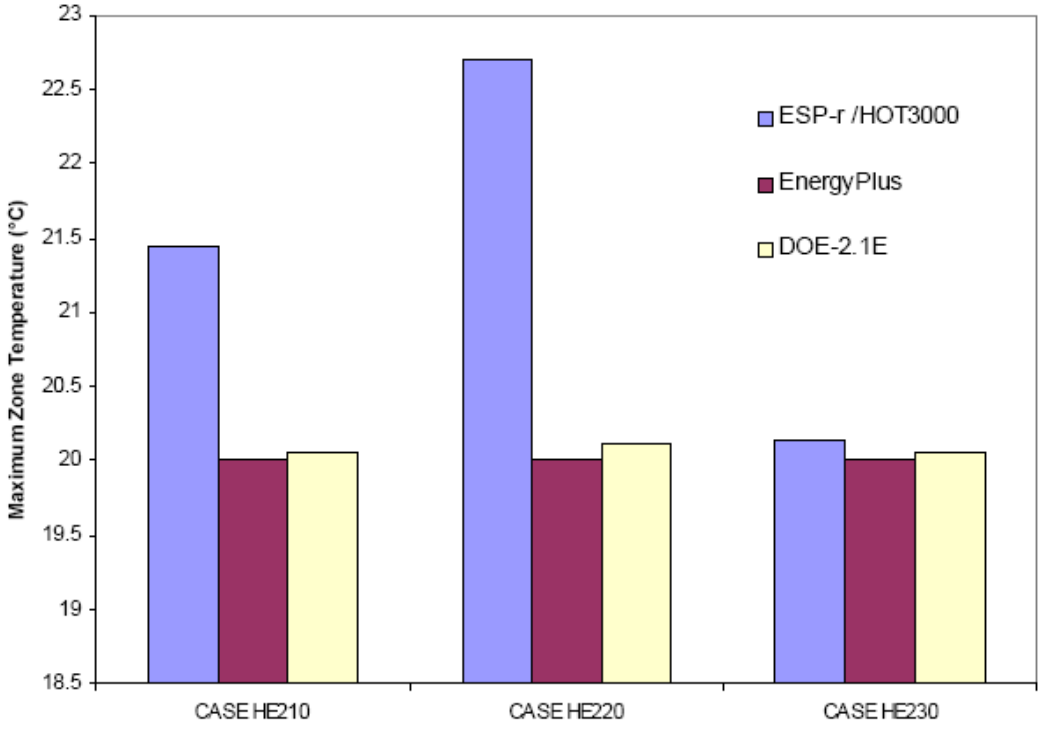
Comparison of the fuel consumed for fuel-fired furnace test cases (in m^3/s).



Comparison of the fan energy for fuel-fired furnace test cases (in kWh).

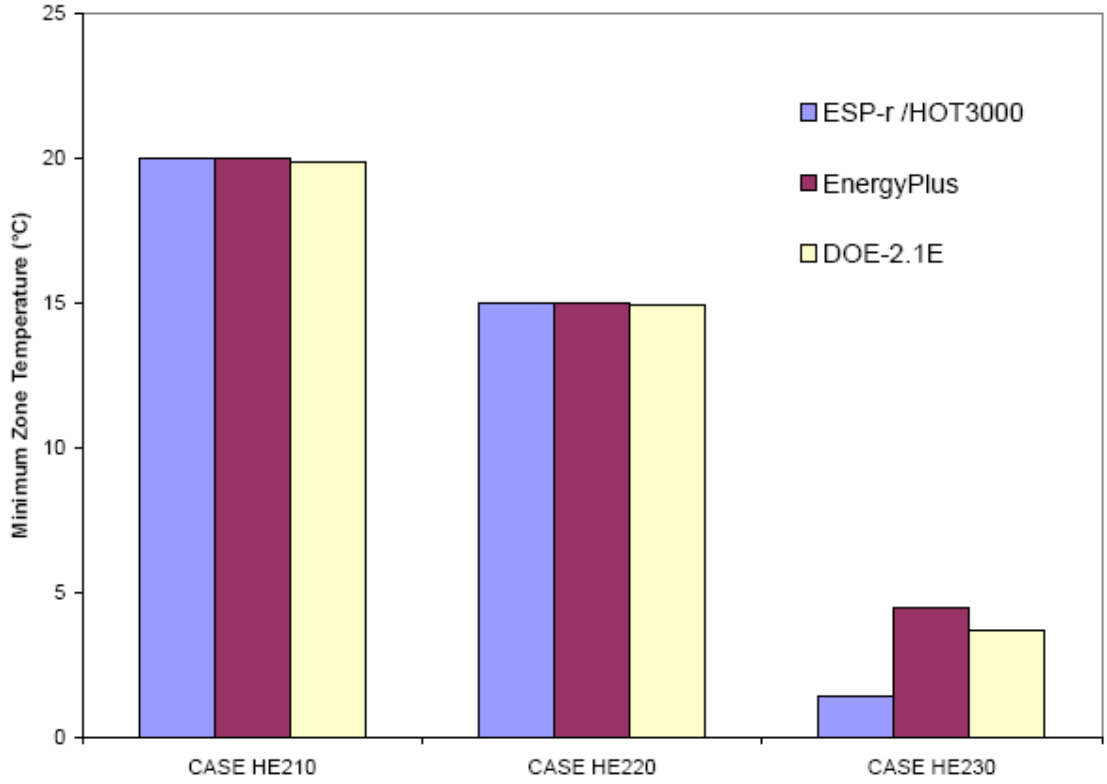


Comparison of the mean zone temperature for fuel-fired furnace test cases (in ˚C).



Comparison of the maximum zone temperature for fuel-fired furnace test cases (in ˚C).*

* ESP-r's finite-difference discretization scheme with respect to time can be fully explicit, fully implicit, or any weighting in between. The program's default 50/50 weighting was employed for the simulations reported here and was found to produce some temperature solution oscillations for particular cases. However, subsequent analysis revealed that these oscillations had no effect upon the predicted fuel and electricity consumptions, the metrics of primary interest in these test cases.



Comparison of the minimum zone temperature for fuel-fired furnace test cases (in ˚C).

242 **B17.2 For Space-Heating Equipment Cases (HE100-HE170).** Add the following text to Section B17.2 and add a new Table B17-3:
Note: Additions are shown in underline and deletions are shown in ~~strikethrough~~.

B17.2 For Space-Heating Equipment Cases (HE100-HE170).
The analytical and quasi-analytical solutions and programs used to generate the example simulation results are described in Table B17-3. Table B17-3 is organized similarly to Table B17-1; see section B17.1.1.1.2 for description of information included in the table. Input files used to generate the simulation results are provided on the accompanying CD; see the README*.DOC file.

Table B17-3 Participating Organizations and Computer Programs, Analytical Verification and Comparative Test Cases HE100–HE230

Model	Authoring Organization	Implemented By	Abbreviation
Analytic and quasi-analytical solutions	Natural Resources Canada (NRCan), Canada	NRCan[a], Canada	Analytical/semi-analytical
DOE-2.1E-c133	LANL/LBNL/JJH,[b,c,d] USA	NRCan[a], Canada	DOE-2.1E
EnergyPlus 1.0.2.008	LBNL/UIUC/CERL/OSU/GARD Analytics/ FSEC/DOE-OBT[b,c,e,f,g,h,i]	GARD Analytics, USA	EnergyPlus
ESP-r/HOT3000	University of Strathclyde, UK; NRCan[a], Canada	NRCan[a], Canada	ESP-r/HOT3000

[a] NRCan: Natural Resources Canada
[b] LANL: Los Alamos National Laboratory

[c] LBNL: Lawrence Berkeley National Laboratory
[d] JJH: James J. Hirsch & Associates
[e] UIUC: University of Illinois Urbana/Champaign
[f] CERL: U.S. Army Corps of Engineers, Construction Engineering Research Laboratories
[g] OSU: Oklahoma State University
[h] FSEC: University of Central Florida, Florida Solar Energy Center
[i] DOE-OBT: Office of Building Technologies, Energy Efficiency and Renewable Energy, U.S. Department of Energy

244 **B17.2.2.1 Case HE140.** In the first paragraph of Section B17.2.2.1 change "Table B17-3" to "Table B17-4".

244 **B17.2.2.2 Case HE 150.** In the second paragraph of Section B17.2.2.2 change "Table B17-4" to "Table B17-5".

244 **B17.2.2.3 Case HE160.** In the fourth paragraph of Section B17.2.2.3 change "Table B17-5" to "Table B17-6".

245 **B17.2.2.4 Case HE170.** In the third paragraph of Section B17.2.2.4 change "Table B17-6" to "Table B17-7".

245 **Table B17-3 Heat Load, Efficiency, and Fuel Consumption for the Complex Part-Load Test.** Renumber the existing Table B17-3 as Table B17-4.

246 **B17.2.3 Analytical Solution for Alternate Cases.** In the fifth paragraph of Section B17.2.3 change "Table B17-7" to "Table B17-8".

246 **Table B17-4 Heat Load, Efficiency, Fuel and Electricity Consumption for the Circulating Fan Test.** Renumber the existing Table B17-4 as Table B17-5.

247 **Table B17-5 Heat Load, Efficiency, Fan Power, Fuel and Electricity Consumption for Cycling Fan Case.** Renumber the existing Table B17-5 as Table B17-6.

248 **Table B17-6 Heat Load, Efficiency, Fan Power, Fuel and Electricity Consumption for draft Fan Case.** Renumber the existing Table B17-6 as Table B17-7.

248 **Table B17-7 Energy Delivered and Consumed by Fuel-Fired Furnace for Alternate Tests, in GJ.** Renumber the existing Table B17-7 as Table B17-8.

