IC3 RESNET ACCREDITATION USER'S GUIDE

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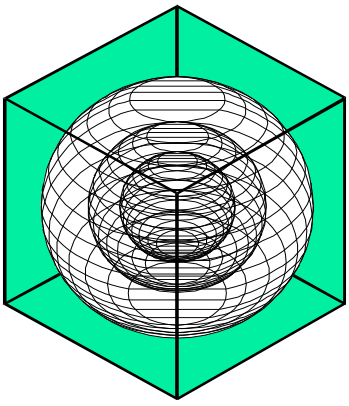

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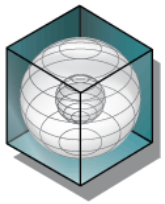

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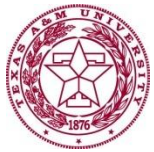

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Executive Summary

This document is intended to provide the users from the Residential Energy Services Network (RESNET) with information on the supporting materials for the RESNET Accreditation of International Code Compliance Calculator (IC3) v3.3 software as an IECC Performance Path Calculation Tool. The CD that accompanies this document contains five files/folders including the electronic copy of the application and the supporting materials for the RESNET accreditation of IC3.

The IC3 software is a web-based tool which was developed by the Energy Systems Laboratory (ESL) to demonstrate compliance of single-family residences with the Texas Building Energy Performance Standards (TBEPS). The Desktop DOE-2 Processor (DDP) spreadsheet is the ESL's internal desktop version that utilizes the same DOE-2 simulation as the web-based IC3. It also provides the batch entry for IC3, which allows the creating and modifying of the proposed design and standard reference design to be done manually or automatically. The simulation inputs are passed to the DOE-2 input file for the energy simulation of the proposed and standard reference designs. Finally, the DDP reports the simulation results back to the DDP spreadsheet.

The user-interface of IC3 was designed to ensure simple and quick input through reduced user input fields, and simple output by reporting the code-compliance as percent above or below code only for the locations in Texas. The DDP spreadsheet has the flexibility to calculate compliance with other codes by auto-generating the corresponding standard reference designs, incorporate additional weather locations, report the simulation results in a desired manner, as well as modify several simulation inputs, which are not available in the user interface of IC3. Since the test runs for RESNET accreditation cannot be performed using the user interface of web-based IC3, a special version of DDP spreadsheet (i.e., RESNET_DDP_IC3.xls) was developed for RESNET accreditation. This spreadsheet can be uploaded to the ESL's web server for processing, and downloaded after the processing is complete, to view the simulation results.

In this manual, Section 1 presents a brief overview of the IC3. Section 2 includes the details of the specially created DDP spreadsheet (RESNET_DDP_IC3.xls) for RESNET accreditation, and Section 3 includes the instructions for replicating the test runs using this spreadsheet. Section 4 presents other helpful information, including contact information and account sign up. At last, Appendix A and B present the results of five tests required for the RESNET accreditation and the contents of the accompanying CD, respectively.

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1 - Introduction of IC3

The International Code Compliance Calculator (IC3) software is a web-based, code compliant, software tool that builders, inspectors, architects, engineers, and others use to demonstrate the performance of proposed single family residences according to the Texas Building Energy Performance Standards (TBEPS). The software is intended to cover the majority of site built houses being produced in Texas. IC3 targets homes using wood framing, conventional systems, one or two stories, and under 10,000 square feet of conditioned space per floor. Other types of residential construction may not be candidates for this software and the user should contact their local Building Official for other Energy Code compliance options. Repairs and remodels of existing construction are not addressed with this software.

IC3 does more than calculate the above code performance of a new home. It also calculates how much pollution has been reduced (emissions reductions) through the home's energy efficiency. The Energy Systems Laboratory (ESL) is working with the different Councils of Government in Texas to develop a verification mechanism in order to report the emissions reductions claimed by County. Instructions for emissions aggregation reporting will be provided by ESL.

1.1 IC3 Background

The United States Environmental Protection Agency (EPA) has designated four areas in Texas as having unacceptable ozone levels in excess of the National Ambient Air Quality Standard (NAAQS) limits, leading to a designation as non-attainment areas. In response, the 77th Texas Legislature's Senate Bill 5 (2001) established the Texas Emissions Reduction Plan (TERP). This legislation directs the ESL at Texas A&M University to develop a series of programs to assist the State in reducing air pollution through Building Energy Efficiency.

The ESL has developed several web-based energy efficiency and emissions reduction calculators. IC3 is used to benchmark the estimated energy performance of new construction single family homes in Texas, and is freely available to all through the internet.

1.2 IC3 Requirements

1. Browser: Internet Explorer v7/8 or Firefox v3+
2. Flash 10.x (to see some of the help animations)
3. Adobe Acrobat Reader 6.x or greater (to view/print/save the certificates)

   We have not tested, nor do we support, Google Chrome or Apple Safari or Opera. You may use these at your own risk.

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2 - The DDP Spreadsheet

2.1 Introduction

The IC3 software is a web-based tool to demonstrate compliance of single-family residences with the TBEPS. IC3 has an internal desktop version called Desktop DOE-2 Processor (DDP) to allow batch entry and additional functions. For each project manually entered in the DDP, it can auto-generate simulation inputs for a corresponding standard reference design. It then passes these two sets of simulation inputs on to the DOE-2.1e Version 119 simulation input files, which is the same as the web-based IC3, and finally, reports the DOE-2.1e simulation results to the DDP spreadsheet and IC3 in certain formats.

IC3 was developed to calculate compliance with the TBEPS (i.e., the 2000 IECC with the 2001 Supplement and 2006 NAECA revisions) only for the locations in Texas. The user-interface of IC3 was designed to ensure simple and quick input through reduced user input fields, and simple output by reporting the code-compliance as percent above or below code. On the other hand, the DDP spreadsheet has the flexibility to calculate compliance with other codes by auto-generating the corresponding standard reference designs, incorporate additional weather locations, report the simulation results in a desired manner, as well as modify several simulation inputs, which are not available in the user interface of IC3. In addition, for the Laboratory's internal applications requiring batch simulation, the DDP spreadsheet allows the user to create and modify simulation inputs for multiple runs.

Since the test runs for RESNET accreditation cannot be performed using the user interface of web-based IC3, a special version of DDP spreadsheet (i.e., RESNET_DDP_IC3.xls) was developed for RESNET accreditation of IC3, which allows replicating the test runs. Table 1 summarizes the capabilities of the specially created DDP spreadsheet of IC3, as compared with the scope of the user interface of IC3. The DDP spreadsheet of IC3 can be uploaded to the ESL's web server for processing, and downloaded after the processing is complete, to view the simulation results. The instructions for replicating the test runs are included in Section 3 as well as the "Readme" worksheet of this spreadsheet.

Table 1: Capabilities of the User Interface of IC3 versus the DDP spreadsheet of IC3

User Interface of IC3	DDP Spreadsheet of IC3
Code-compliance with the TBEPS (i.e., the 2000 IECC with the 2001 Supplement and 2006 NAECA revisions).	Auto-generation of the 2004 IECC and the 2006 IECC standard reference designs.
Energy simulation in locations in Texas, only.	Energy simulation in locations required for the test runs for RESNET accreditation.
Reduced user input fields to ensure simple and quick input, yet accurate simulation.	Modification of simulation inputs required for the test runs for RESNET accreditation.
Reporting of results as percent above or below code.	Reporting of results as heating/cooling loads and end-use energy use.

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2.2 Contents of RESNET_DDP_IC3.xls

This spreadsheet consists of five worksheets for creating/modifying inputs for the proposed designs, auto-generating the corresponding 2004 IECC and 2006 IECC standard reference designs, and reporting the simulation results. A description of these worksheets is included in Table 2.

Table 2: Description of the Worksheets of RESNET_DDP_IC3.xls

Worksheet	Description
Readme	Provides instructions for replicating the RESNET test runs. These instructions are also included in Section 3 of this manual.
Test Runs	Allows the user: (i) To “edit” the inputs for a Proposed design, (ii) To specify, which test cases to be simulated, and (iii) To specify for each test case, if a Proposed, a 2004 Standard Reference or a 2006 Standard Reference design is to be simulated. (See Table 3 for a description of this worksheet)
2004Ref	Allows the user to “view” the inputs for the 2004 IECC Standard Reference design corresponding to a Proposed design specified in “Test Runs” worksheet. (See Table 3 for a description of this worksheet)
2006Ref	Allows the user to “view” the inputs for a 2006 IECC Standard Reference design corresponding to a Proposed design specified in “Test Runs” worksheet. (See Table 3 for a description of this worksheet)
IC3 Results	Allows the user to “view” the energy end-use results from IC3 software for the Proposed or Standard Reference designs specified in “Test Runs” worksheet. (See Table 4 for a description of this worksheet)

In this spreadsheet, only the inputs in the white cells of the "Test Runs" worksheet can be modified. All other cells/worksheets are locked for editing.

Worksheets “Test Runs,” “2004Ref” and “2006 Ref” have similar structure, in which the rows correspond to the test cases and the columns correspond to the input for these test cases. Table 3 explains the content of the “Test Runs” worksheet.

In the worksheet “IC3 Results”, the rows correspond to test cases simulated and the columns correspond to the simulation results for these test cases. Table 4 explains the content of this worksheet.

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Table 3: Description of the “Test Runs” Worksheet

Rows	**Description**
1-4	Simulation Control Inputs and Legend
5-9	Description of Input
10-35	HERS BESTEST, Tier 1 Test Cases (Project No. 1-26)
36-51	Auto-Generation Test Cases (Project No. 27-42)
52-58	HVAC Test Cases (Project No. 43-49)
59-66	Duct Distribution Efficiency (DSE) Test Cases (Project No. 50-57)
67-72	Hot Water System Performance Test Cases (Project No. 58-63)
Column	**Description**
A	Project Number
B	Project Name
C	Simulate Proposed or Reference
D	Location/County
E-V	Building Configuration and Dimensions
W-Z	Exterior Surfaces
AA-AR	Windows and Doors
AS-BA	Window Shading
BB-BF	Wall Construction
BG-BI	Roof/Ceiling Construction
BJ-BP	Floor/Foundation Input
BQ-BR	Internal Gains
BS-BW	Infiltration Input
BX-CD	HVAC System Input
CE-CK	Air Distribution System Input
CL-CO	DHW System Input
CP-DS	Input Verification
DT-EA	Window-to-Wall Area Percent

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Table 4: Description of the “IC3 Results” Worksheet

Rows	**Description**
7-9	Description of Simulation Results
10-35	Results of the HERS BESTEST, Tier 1 Test Cases (Project No. 1-26)
36-51	Results of the Auto-Generation Test Cases (Project No. 27-42)
52-58	Results of the HVAC Test Cases (Project No. 43-49)
59-66	Results of the Duct Distribution Efficiency (DSE) Test Cases (Project No. 50-57)
67-72	Results of the Hot Water System Performance Test Cases (Project No. 58-63)
Column	**Description**
A	Project Number
B	Project Name
C	Simulate Proposed or Reference
D	Space Cooling Loads (MBtu)
E	Space Heating Loads (MBtu)
F	Space Cooling Electricity Use (kWh)
G	Space Cooling Fan Electricity Use (kWh)
H	Space Heating Natural Gas Use (Therms)
I	Space Heating Electricity Use (kWh)
J	Space Heating Fan Electricity Use (kWh)
K	Domestic Water Heating Natural Gas Use (Therms)
L	Domestic Water Heating Electricity Use (kWh)
M	Lighting Electricity Use (kWh)
N	Equipment Electricity Use (kWh)
O	Miscellaneous Electricity Use (kWh)
P	Total Natural Gas Use (Therms)
Q	Total Electricity Use (kWh)

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3 - Instructions for Replicating the Test Runs

1. Obtain the DDP spreadsheet (i.e., RESNET_DDP_IC3.xls) from either the accreditation CD or the ESL's web server at http://esl-resnet.tamu.edu/ResnetWeb/login.jsp, and save it on your computer.

2. Open RESNET_DDP_IC3.xls and select the worksheet "Test Runs." In this worksheet, rows 10 through 72 correspond to the RESNET test cases and columns correspond to the input for these test cases. These inputs can be modified and the test cases can be reordered, as desired.

3. In column B under column header "Project Name," modify the name of the projects, as desired.

4. For each test case to be simulated, enter the building information of the Proposed home in the corresponding cells of columns D through CO. The Test-Runs_IC3.xls (available in the accreditation CD) can be used to replicate inputs for the test cases (i.e., the Proposed design). The corresponding standard reference design can be viewed in the worksheets "2004Ref" and "2006Ref."

5. In order to simulate a Proposed design (i.e., using the input entered in the "Test Runs" worksheet, select "Proposed" in the dropdown menu of the cells in column C (Simulate Proposed or Reference). Similarly, in order to simulate a standard reference design, select "2004 Ref" or "2006 Ref" in the dropdown menu.

6. In order to enter the Reference designs as Proposed designs (as required by the Auto-Generation Tests), copy cell values E to CO of the " 2004Ref" or " 2006Ref" worksheet, paste them in "Test Runs" worksheet, and select the option "Proposed" in column C under the column header "Simulate Proposed or Reference."

7. In cells B2 and B3, enter the start and end of the project numbers (shown in column A) to simulate the desired test cases.

8. Save the DDP spreadsheet and access it through the "Browse" button of the IC3 RESNET web page. Click "Upload and Simulate" button, and wait until the "Download Results" button becomes active.

9. Click "Download Results" to download the result spreadsheet, open the file and select "IC3 Results" worksheet to view the simulation results.

(Note: These instructions are also included in the worksheet "Readme" of RESNET_DDP_IC3.xls)

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4 - Other Information

4.1 Getting Help

1. Please contact us and in it please put:
   - SUBJECT: RESNET IC3 HELP
   - The question
   - The type of browser you are using (i.e. Firefox, Internet Explorer 7 or 8, Chrome)
   - A screen shot if you are asking about something specific on the screen.

2. Leave a voice mail at the number on the website: http://esl.eslwin.tamu.edu/contact-us/view-14.html
   - Leave your name and phone number and email address
   - Briefly describe the issue you are having and the browser (i.e. Firefox, Internet Explorer 7 or 8, Chrome)
   - We will call you back as soon as we can.

   Please be aware voice mail is the least effective and slowest way to get help.

4.2 General Process

1. Account Sign Up
   - The RESNET Accreditation for IC3 is meant for authorized users from the Residential Energy Services Network (RESNET).
   - If you need access to the RESNET Accreditation for IC3, please contact us using "RESNET Access" as the subject in your email and we will get back to you with a username and password.

2. IC3 RESNET Validation
   - The authorized users can access IC3 RESNET Validation screen using a username and password provided by the Laboratory.

   1) To begin the process, click the "Download Spreadsheet" link to download the spreadsheet.
   2) Modify the spreadsheet if needed. The instructions for replicating the test runs are included in Section 3 as well as the “Readme” worksheet of the downloaded DDP spreadsheet.
   3) Next, click the "Browse" button to navigate your file system to locate and select the spreadsheet on your computer that you want to submit.
   4) After the spreadsheet file has been selected, click the "Upload and Simulate" button.
   5) Wait for the text "Percent Complete 100%" and the "Download Results" link to appear.
   6) Click on the results to download the processed spreadsheet containing the simulation results.

   - For more detail, please refer to the “IC3 RESNET Report” found at: http://esl-resnet.tamu.edu/ResnetWeb/login.jsp

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APPENDIX A: Contents of the Accreditation CD

The CD that accompanies this manual contains five files/folders including the electronic copy of the application and the supporting materials for the RESNET accreditation of IC3. A brief description of these items is provided in Table 5.

Table 5: Description of the Contents of the Accreditation CD

Files/Folders	Description
RESNET Application of IC3.pdf	An electronic copy of the application (6 pages).
RESNET IC3 Manual.pdf	An electronic copy of the manual (i.e., this document; 17 pages), which provides an explanation for the supporting documents of the application and instructions for replicating the test runs.
Test-Results_IC3	A folder containing the following test results spreadsheets: 1. bestest_results_IC3 2. auto-results_IC3 3. HVAC-results_IC3 4. DSE-results_IC3 5. DHW-results_IC3
Test-Runs_IC3.xls	A spreadsheet showing the inputs for the RESNET test runs. This spreadsheet contains only one worksheet – “Test Runs”, which is one of the five worksheets of the DDP spreadsheet (RESNET_DDP_IC3.xls). In this worksheet, the rows correspond to the test cases and the columns show input for these test cases. A description of the rows and columns of this spreadsheet is provided in Table 3.
RESNET_DDP_IC3.xls	A special version of Desktop DOE-2 Processor (DDP) spreadsheet developed for RESNET accreditation of IC3. This spreadsheet consists of several worksheets for creating/ modifying inputs for the proposed designs, auto-generating the corresponding 2004 IECC and 2006 IECC standard reference designs, and reporting the simulation results (see Section 2 for details). The DDP spreadsheet allows replicating the test runs for RESNET accreditation. For replicating the test runs, this spreadsheet should be uploaded to the ESL’s web server for processing, and downloaded after the processing is complete, to view the simulation results (see Section 3 for details).

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APPENDIX B: IC3 Test Results

This Appendix presents the IC3 test results for the following tests:

1. HERS Bestest;
2. IECC Reference Home Software Auto-Generation tests;
3. IECC Performance HVAC tests;
4. IECC Performance Duct Distribution Efficiency tests; and
5. IECC Performance Hot Water Performance tests.

Table 6: HERS Bestest Results

IECC BESTEST results for: **Software Name:** IC3 v3.3

User input data fields indicated by pale yellow
Test result fields indicated by pale green

Annual Loads

Heating	range max	range min	Result	pass/fail
L100AC	79.48	48.75	57.10	pass
L110AC	103.99	71.88	80.08	pass
L120AC	64.30	37.82	43.54	pass
L130AC	53.98	41.82	44.64	pass
L140AC	56.48	42.24	47.43	pass
L150AC	71.33	40.95	49.87	pass
L155AC	74.18	43.53	53.15	pass
L160AC	81.00	48.78	57.46	pass
L170AC	92.40	61.03	70.09	pass
L200AC	185.87	106.41	136.40	pass
L202AC	190.05	111.32	142.60	pass
L302AC	86.90	56.12	57.80	pass
L304AC	73.15	46.11	48.36	pass
L322AC	111.69	73.71	92.36	pass
L324AC	77.47	46.38	55.99	pass

Annual Load deltas

Heating	range max	range min	Result	pass/fail
L110-L100	28.12	19.36	22.98	pass
L120-L100	-7.67	-18.57	-13.56	pass
L130-L100	-5.97	-27.50	-12.46	pass
L140-L100	-4.56	-24.42	-9.68	pass
L150-L100	-3.02	-12.53	-7.23	pass
L155-L150	6.88	-1.54	3.28	pass
L160-L100	5.10	-3.72	0.36	pass
L170-L100	17.64	7.12	12.99	pass
L200-L100	107.66	56.39	79.30	pass
L202-L200	9.94	-0.51	6.20	pass
L302-L100	14.50	-3.29	0.70	pass
L302-L304	17.75	5.66	9.44	pass
L322-L100	39.29	15.71	35.26	pass
L322-L324	38.22	21.25	36.37	pass

Cooling	range max	range min	Result	pass/fail
L100AL	64.88	50.66	62.93	pass
L110AL	68.50	53.70	65.49	pass
L120AL	60.14	47.34	58.26	pass
L130AL	45.26	32.95	43.63	pass
L140AL	30.54	19.52	27.40	pass
L150AL	82.33	62.41	82.29	pass
L155AL	63.06	50.08	60.29	pass
L160AL	72.99	58.61	71.56	pass
L170AL	53.31	41.83	51.02	pass
L200AL	83.43	60.25	76.37	pass
L202AL	75.96	52.32	62.00	pass

Cooling	range max	range min	Result	pass/fail
L110-L100	7.84	-0.98	2.56	pass
L120-L100	0.68	-8.87	-4.67	pass
L130-L100	-13.71	-24.40	-19.29	pass
L140-L100	-27.14	-38.68	-35.53	pass
L150-L100	20.55	8.72	19.36	pass
L155-L150	-9.64	-22.29	-22.00	pass
L160-L100	12.28	3.88	8.64	pass
L170-L100	-4.83	-15.74	-11.91	pass
L200-L100	21.39	6.63	13.44	pass
L200-L202	14.86	2.03	14.37	pass

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Table 7: IECC Reference Home Software Auto-Generation Tests Results

IECC Auto Generation Test Results: **Software Name:** IC3 v3.3

User input data fields indicated by pale yellow

Reference Home Building Component		Test 1	Results	Test 2	Results	Test 3	Results	Test 4	Results
Above-grade walls (U_o)		0.082	0.082	0.082	0.082	0.082	0.082	0.060	0.06
Above-grade wall solar absorptance (α)		0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
Above-grade wall infrared emittance (ε)		0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Basement walls (U_o)		n/a	n/a	n/a	n/a	n/a	n/a	0.059	0.059
Above-grade floors (U_o)		0.047	0.047	0.047	0.047	n/a	n/a	n/a	n/a
Slab insulation R-Value		n/a	n/a	n/a	n/a	0	0	0	0
Ceilings (U_o)		0.030	0.030	0.035	0.035	0.035	0.035	0.030	0.030
Roof solar absorptance (α)		0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
Roof infrared emittance (ε)		0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Attic vent area* (ft^2)		5.13	5.13	5.13	5.13	5.13	5.13	5.13	5.13
Crawlspace vent area* (ft^2)		n/a	n/a	10.26	10.26	n/a	n/a	n/a	n/a
Exposed masonry floor area * (ft^2)		n/a	n/a	n/a	n/a	307.8	307.8	307.8	307.8
Carpet & pad R-Value		n/a	2.0	n/a	2.0	2.0	2.0	2.0	2.0
Door Area (ft^2)		40	40	40	40	40	40	40	40
Door U-Factor		0.40	0.40	0.65	0.65	1.20	1.20	0.35	0.35
North window area* (ft^2)	IECC 2004	69.26	69.26	69.26	69.26	69.26	69.26	102.63	102.64
	(IECC 2006)	(67.50)	67.50	(67.50)	67.50	(67.50)	67.50	(67.50)	67.50
South window area* (ft^2)	IECC 2004	69.26	69.26	69.26	69.26	69.26	69.26	102.63	102.64
	(IECC 2006)	(67.50)	67.50	(67.50)	67.50	(67.50)	67.50	(67.50)	67.50
East window area* (ft^2)	IECC 2004	69.26	69.26	69.26	69.26	69.26	69.26	102.63	102.64
	(IECC 2006)	(67.50)	67.50	(67.50)	67.50	(67.50)	67.50	(67.50)	67.50
West window area* (ft^2)	IECC 2004	69.26	69.26	69.26	69.26	69.26	69.26	102.63	102.64
	(IECC 2006)	(67.50)	67.50	(67.50)	67.50	(67.50)	67.50	(67.50)	67.50
Window U-Factor		0.4	0.4	0.65	0.65	1.2	1.2	0.35	0.35
Window $SHGC_o$ (heating)		0.340	0.340	0.340	0.340	0.340	0.340	0.340	0.340
Window $SHGC_o$ (cooling)		0.280	0.280	0.280	0.280	0.280	0.280	0.280	0.280
SLA_o* (ft^2/ft^2)	IECC 2004	0.00048	0.00048	0.00048	0.00048	0.00048	0.00048	0.00048	0.00048
	(IECC 2006)	(0.00036)	0.00036	(0.00036)	0.00036	(0.00036)	0.00036	(0.00036)	0.00036
Internal gains * (Btu/day)		66,840	66,840	66,840	66,840	62,736	62,736	107,572	107,572
Labeled heating system rating		AFUE = 78%	0.78 AFUE	HSPF = 7.7	7.7 HSPF	HSPF = 7.7	7.7 HSPF	AFUE = 78%	0.78 AFUE
Labeled cooling system rating		SEER = 13	13 SEER	SEER = 13	13 SEER	SEER = 13	13 SEER	SEER = 13	13 SEER
Air Distribution System Efficiency		0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
Thermostat Type		Manual	Manual	Manual	Manual	Manual	Manual	Manual	Manual
Heating thermostat settings		68 F (all hours)	68F	68 F (all hours)	68F	68 F (all hours)	68F	68 F (all hours)	68F
Cooling thermostat settings		78 F (all hours)	78F	78 F (all hours)	78F	78 F (all hours)	78F	78 F (all hours)	78F
e-Ratio			1.000		1.000		1.000		1.000

Table 8: IECC Performance HVAC Tests Results

IECC HVAC Test Suite Results: **Software Name:** IC3 v3.3

User input data fields indicated by pale yellow
Test result fields indicated by pale green

Results

Cooling tests:

Case	Cool	Cool Fan	Cool Tot	% change	Criteria min	Criteria max	
HVAC-1a	6854	1333.569	8187.569	---			
HVAC-1b	5272	1333.569	6605.569	-19.32%	-21.24%	-17.38%	pass

Heating tests:

Case	Heat	Heat Fan	Heat Tot	% change			
HVAC-2a	823	923.006	85.45	---			
HVAC-2b	714	923.006	74.55	-12.76%	-13.30%	-11.57%	pass

Case	Heat	Heat Fan	Heat Tot	% change			
HVAC-2c	10486	1381.274	11867.27	---			
HVAC-2d	8334	1054	9388	-20.89%	-29.03%	-16.73%	pass
HVAC-2e	17665	923.013	18588.01	56.63%	41.81%	80.81%	pass

Plot Data:	HVAC-1b	HVAC-2b	HVAC-2d
min	-21.24%	-13.30%	-29.03%
max	-17.38%	-11.57%	-16.73%
avg	-19.31%	-12.43%	-22.88%
Result	-19.32%	-12.76%	-20.89%

	HVAC-2e
min	41.81%
max	80.81%
avg	61.31%
Result	56.63%

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Table 9: IECC Performance Duct Distribution Efficiency Tests Results

IECC DSE Test Suite Results **Software Name:** IC3 v3.3

User input data fields indicated by pale yellow
Test result fields indicated by pale green

Results:

Base Cases	Heat/cool	Fan	Total	% change	
HVAC-3a	744	836.994	77.26	---	base for cases 3b - 3d
HVAC-3e	6857	1334.171	8191.171	---	base for cases 3f - 3h

					Criteria:			
Test Cases	Heat/cool	Fan	Total	% change	max	avg	min	Pass/Fail
HVAC-3b	952	1076.421	98.87	28.0%	31.4%	26.4%	21.4%	pass
HVAC-3c	789	887.958	81.93	6.0%	12.5%	7.5%	2.5%	pass
HVAC-3d	873	979.79	90.64	17.3%	25.0%	20.0%	15.0%	pass
HVAC-3f	8738	1709.995	10448	27.6%	36.2%	31.2%	26.2%	pass
HVAC-3g	7313	1425.765	8738.765	6.7%	16.5%	11.5%	6.5%	pass
HVAC-3h	8423	1627.534	10050.53	22.7%	31.1%	26.1%	21.1%	pass

Table 10: IECC Performance Hot Water Performance Tests Results

IECC DHW Test Results:

Software Name: IC3 v3.3

User input data fields indicated by pale yellow
Test result fields indicated by pale green

Raw Results:

Minnesota	Energy Use (therms)	Florida	Energy Use (therms)
DHW-MN-56-2	200	DHW-FL-56-2	127
DHW-MN-56-4	258	DHW-FL-56-4	156
DHW-MN-62-2	182	DHW-FL-62-2	109

Test Cases:	% Change	Average	Range Min	Range Max	Pass/Fail
MN,0.56,4 (delta)	29.0%	29.3%	26.5%	32.2%	pass
MN,0.62,2 (delta)	-9.0%	-9.3%	-11.8%	-6.8%	pass
FL,0.56,4 (delta)	22.8%	24.1%	19.1%	29.1%	pass
FL,0.62,2 (delta)	-14.2%	-13.6%	-19.5%	-7.7%	pass
% [(MN-FL)/(MN)]	36.5%	37.0%	28.9%	45.1%	pass

	MBtu	Average	Range Min	Range Max	Pass/Fail
MN,0.56,2 (MBtu)	20	20.1	18.2	22.0	pass
FL,0.56,2 (MBtu)	12.7	12.7	10.9	14.4	pass
MN-FL (MBtu)	7.3	7.4	5.5	9.4	pass

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