

**THE INTERNATIONAL CODE COMPLIANT  
CALCULATOR (IC3) v4.4**

**VALIDATION  
of  
THE RESNET VERIFICATION  
PROCEDURES (NO. 002-2017)**

**May 2019**



**ENERGY SYSTEMS LABORATORY**  
TEXAS A&M ENGINEERING EXPERIMENT STATION

# 1 Results of ARSHRAE STANDARD 140 Tests

ASHRAE Std. 140 results for: **Software Name:** IC3 V 4.4

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

### Annual Heating Loads: Colorado Springs, CO

Heating	range max	range min	Result	pass/fail
L100AC	79.48	48.75	58.04	pass
L110AC	103.99	71.88	81.45	pass
L120AC	64.30	37.82	44.86	pass
L130AC	53.98	41.82	45.10	pass
L140AC	56.48	43.24	49.74	pass
L150AC	71.33	40.95	51.24	pass
L155AC	74.18	43.53	54.20	pass
L160AC	81.00	48.78	58.49	pass
L170AC	92.40	61.03	70.70	pass
L200AC	185.87	106.41	135.76	pass
L202AC	190.05	111.32	141.34	pass
L302XC	90.52	52.66	59.24	pass
L304XC	75.32	43.91	49.87	pass
L322XC	118.20	68.35	92.13	pass
L324XC	80.04	44.01	57.40	pass

### Annual Heating Load deltas: Colorado Springs, CO

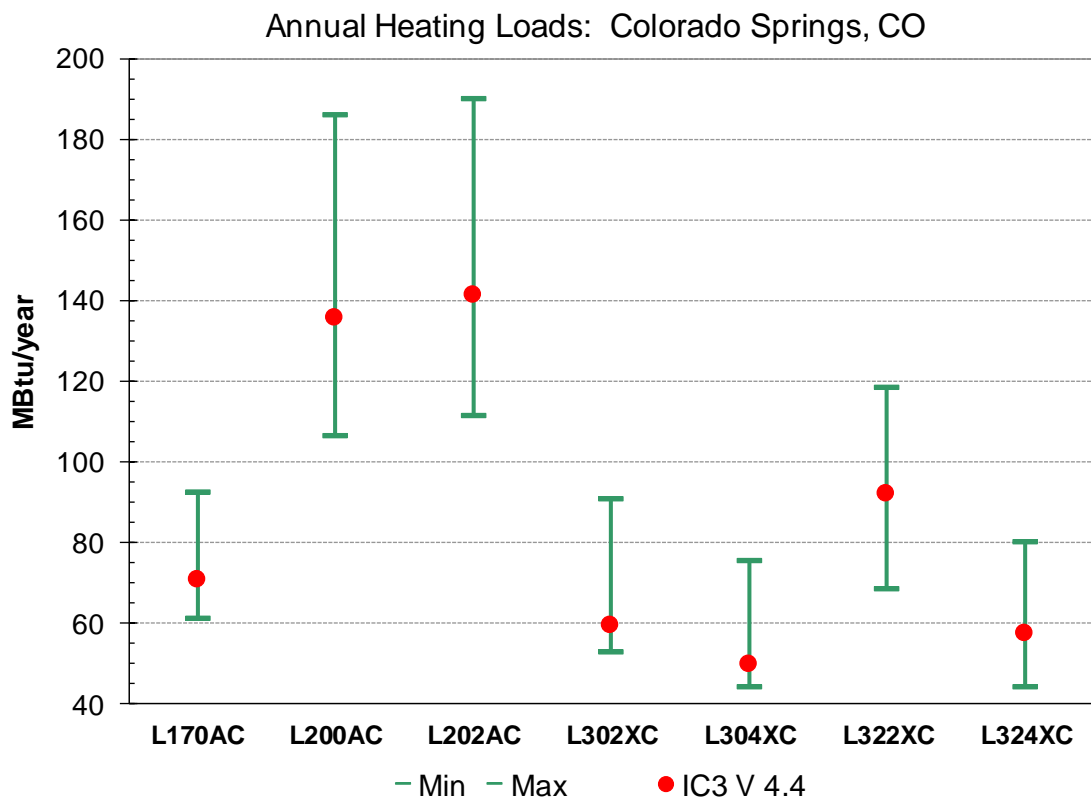
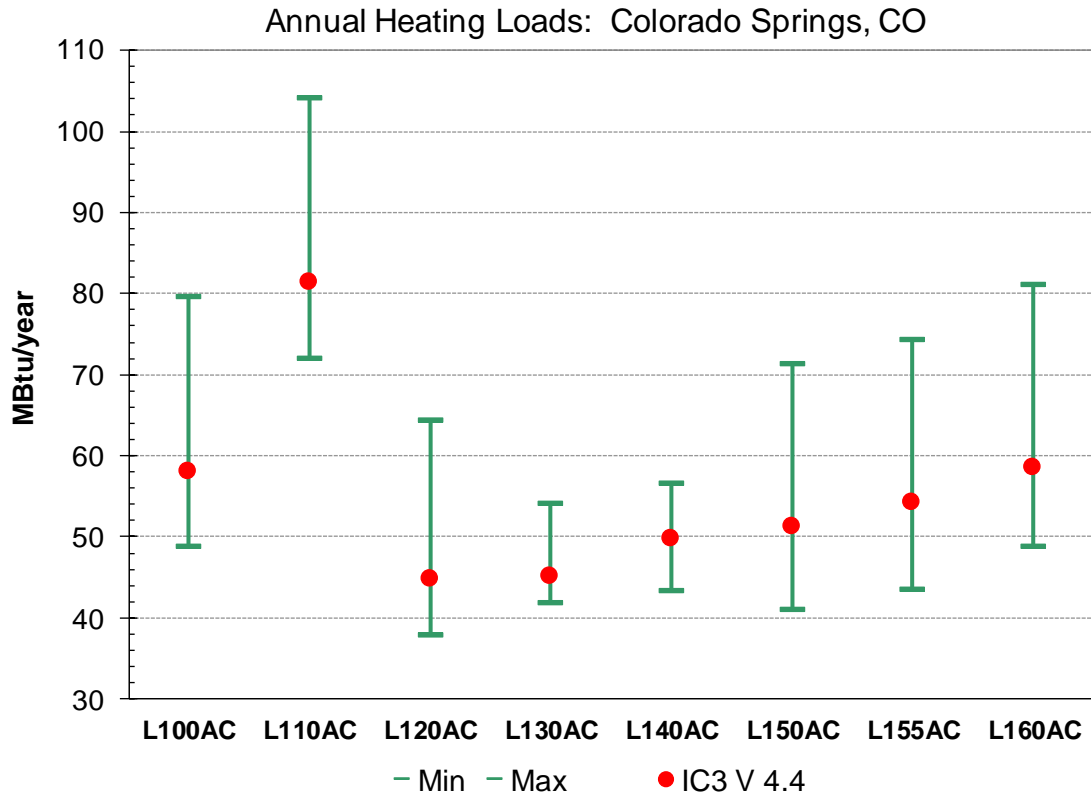
Heating	range max	range min	Result	pass/fail
L110AC-L100AC	28.12	19.37	23.41	pass
L120AC-L100AC	-7.67	-18.57	-13.18	pass
L130AC-L100AC	-5.97	-27.50	-12.94	pass
L140AC-L100AC	-4.56	-24.42	-8.30	pass
L150AC-L100AC	-3.02	-12.53	-6.81	pass
L155AC-L150AC	6.88	-1.54	2.96	pass
L160AC-L100AC	5.10	-3.72	0.45	pass
L170AC-L100AC	17.64	7.12	12.66	pass
L200AC-L100AC	107.66	56.39	77.72	pass
L202AC-L200AC	9.94	-0.51	5.58	pass
L302XC-L100AC	14.50	-3.30	1.20	pass
L302XC-L304XC	17.75	5.66	9.37	pass
L322XC-L100AC	39.29	15.71	34.08	pass
L322XC-L324XC	38.27	20.21	34.72	pass

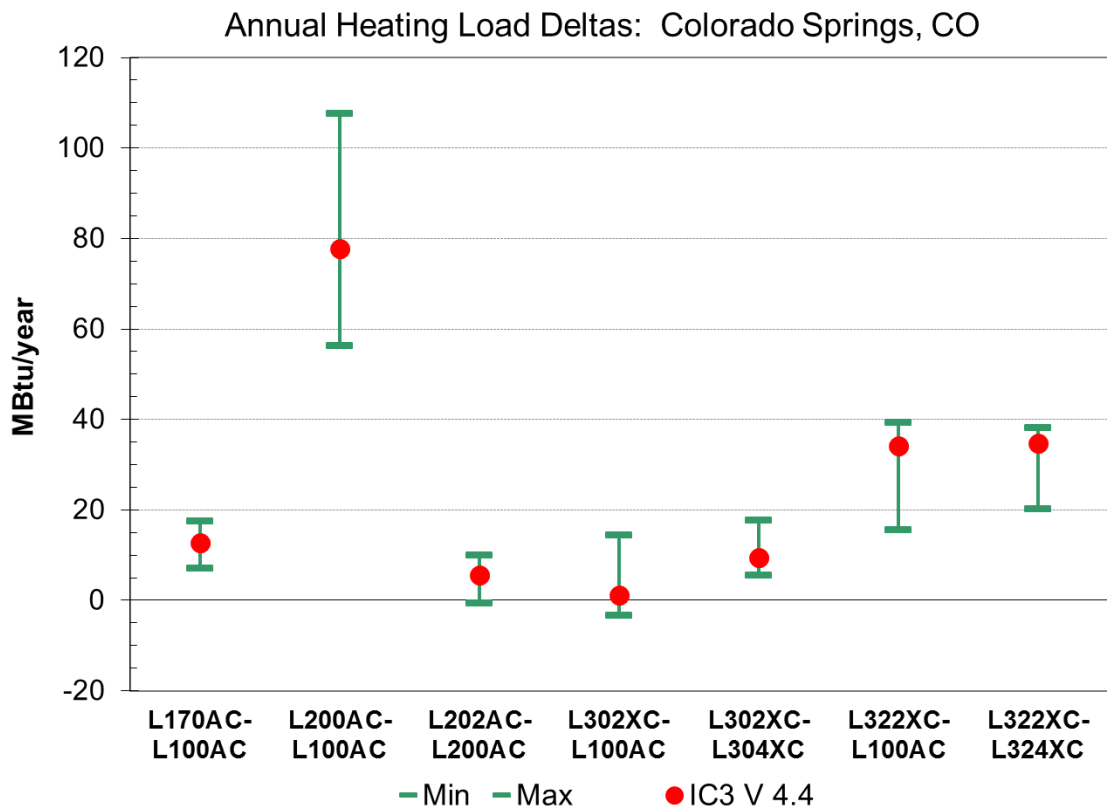
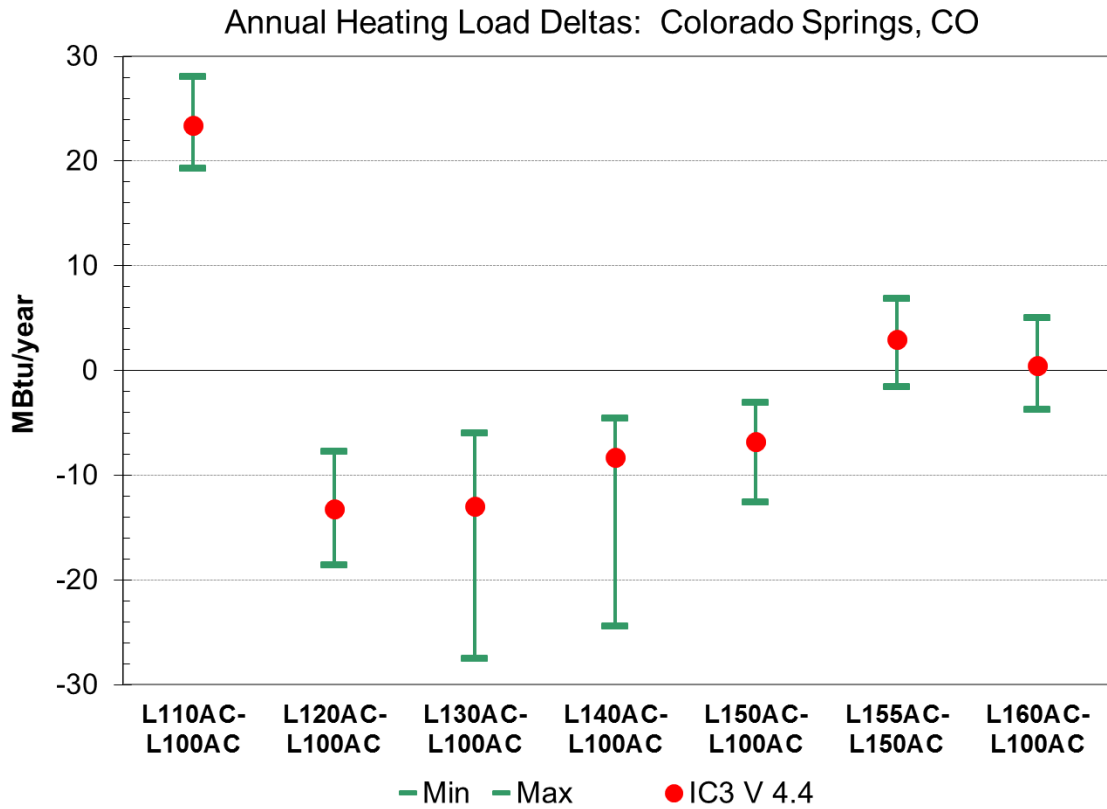
### Annual Cooling Loads: Las Vegas, NV

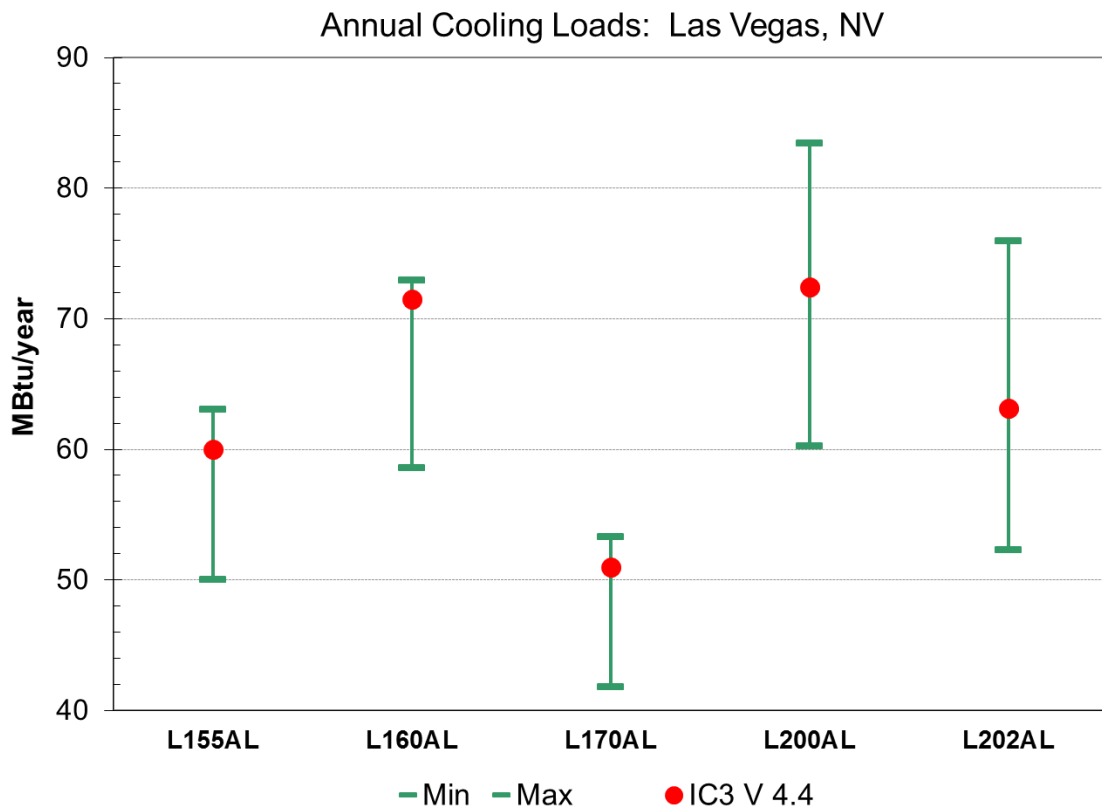
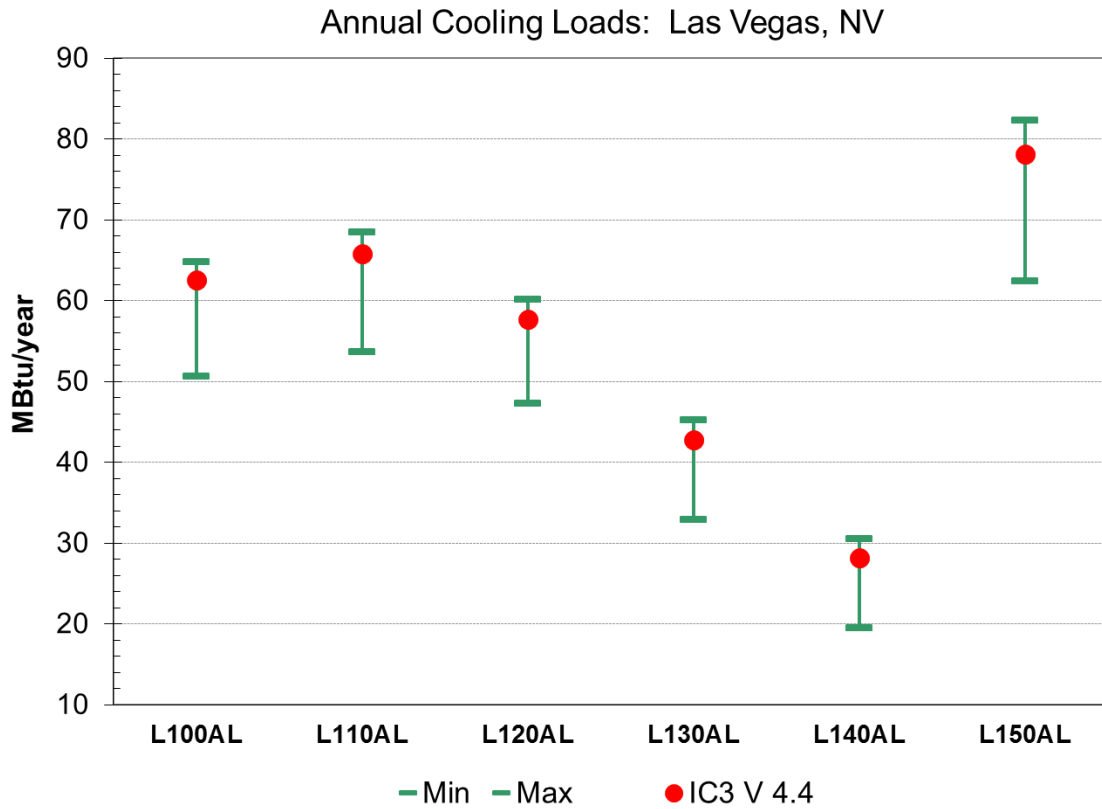
Cooling	range max	range min	Result	pass/fail
L100AL	64.88	50.66	62.58	pass
L110AL	68.50	53.70	65.80	pass
L120AL	60.14	47.34	57.73	pass
L130AL	45.26	32.95	42.74	pass
L140AL	30.54	19.52	28.14	pass
L150AL	82.33	62.41	78.16	pass
L155AL	63.06	50.08	60.02	pass
L160AL	72.99	58.61	71.50	pass
L170AL	53.31	41.83	51.01	pass
L200AL	83.43	60.25	72.43	pass
L202AL	75.96	52.32	63.17	pass

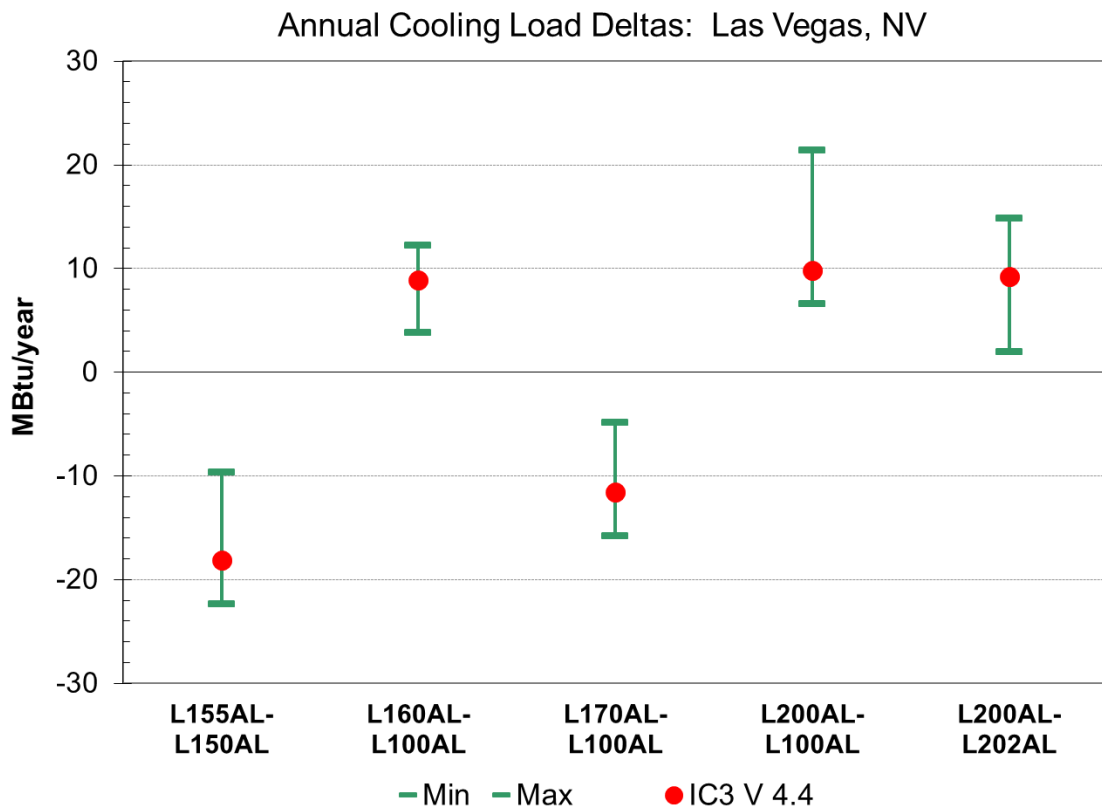
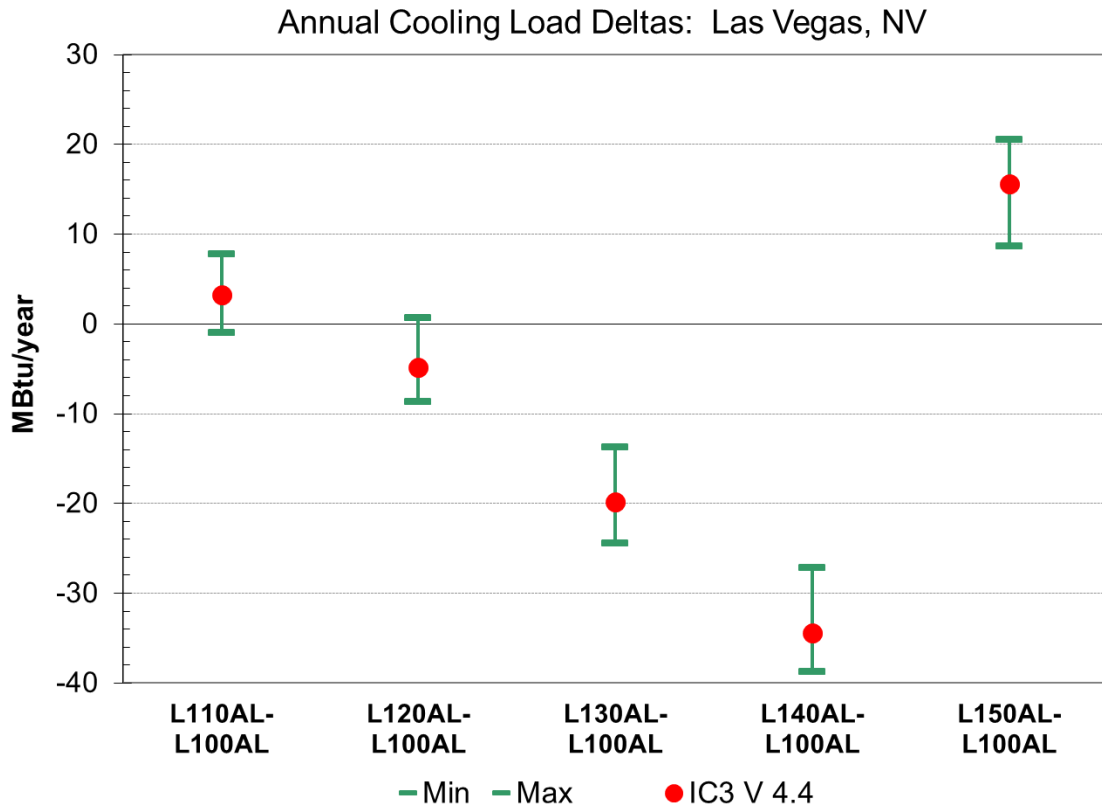
### Annual Cooling Load deltas: Las Vegas, NV

Cooling	range max	range min	Result	pass/fail
L110AL-L100AL	7.84	-0.98	3.23	pass
L120AL-L100AL	0.68	-8.67	-4.84	pass
L130AL-L100AL	-13.71	-24.40	-19.84	pass
L140AL-L100AL	-27.14	-38.68	-34.44	pass
L150AL-L100AL	20.55	8.72	15.58	pass
L155AL-L150AL	-9.64	-22.29	-18.14	pass
L160AL-L100AL	12.28	3.88	8.92	pass
L170AL-L100AL	-4.83	-15.74	-11.57	pass
L200AL-L100AL	21.39	6.63	9.86	pass
L200AL-L202AL	14.86	2.03	9.26	pass









## 2 Results of HERS Reference Home Auto-Generation Tests

HERS 2017 Auto Generation Test Results: Software Name: IC3 V 4.4

User input data fields indicated by pale yellow

Component	CZ4		CZ3		CZ1		CZ5	
	Test 1	Results	Test 2	Results	Test 3	Results	Test 4	Results
Above-grade walls (U <sub>o</sub> )	0.082	0.082	0.082	0.082	0.082	0.082	0.06	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)	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Basement walls (U <sub>o</sub> )	n/a	N/A	n/a	N/A	n/a	N/A	0.059	0.059
Above-grade floors (U <sub>o</sub> )	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 <sub>o</sub> )	0.03	0.03	0.035	0.035	0.035	0.035	0.03	0.03
Roof solar absorptance (α)	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
Roof infrared emittance (ε)	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Attic vent area* (ft <sup>2</sup> )	5.13	5.13	5.13	5.13	5.13	5.13	5.13	5.13
Crawlspace vent area* (ft <sup>2</sup> )	n/a	N/A	10.26	10.26	n/a	N/A	n/a	N/A
Exposed masonry floor area* (ft <sup>2</sup> )	n/a	N/A	n/a	N/A	307.8	307.8	307.8	307.8
Carpet & pad R-Value	n/a	N/A	n/a	N/A	2	2	2	2
Door Area (ft <sup>2</sup> )	40	40	40	40	40	40	40	40
Door U-Factor	0.4	0.4	0.65	0.65	1.2	1.2	0.35	0.35
North window area* (ft <sup>2</sup> )	69.26	69.26	69.26	69.26	69.26	69.26	102.63	102.63
South window area* (ft <sup>2</sup> )	69.26	69.26	69.26	69.26	69.26	69.26	102.63	102.63
East window area* (ft <sup>2</sup> )	69.26	69.26	69.26	69.26	69.26	69.26	102.63	102.63
West window area* (ft <sup>2</sup> )	69.26	69.26	69.26	69.26	69.26	69.26	102.63	102.63
Window U-Factor	0.4	0.4	0.65	0.65	1.2	1.2	0.35	0.35
Window SHGC <sub>o</sub> (heating)	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34
Window SHGC <sub>o</sub> (cooling)	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28
SLA <sub>o</sub> * (ft <sup>2</sup> /ft <sup>2</sup> )	0.00036	0.00036	0.00036	0.00036	0.00036	0.00036	0.00036	0.00036
Sensible Internal gains* (Btu/day)	55,470	55,470	52,794	52,794	48,111	48,111	83,103	83,100
Latent Internal gains* (Btu/day)	13,807	13,805	12,698	12,698	9,259	9,259	17,934	17,929
Labeled heating system rating and efficiency	AFUE = 78%	78%	HSPF = 7.7	7.7	HSPF = 7.7	7.7	AFUE = 78%	78%
Labeled cooling system rating and efficiency	SEER = 13	13	SEER = 13	13	SEER = 13	13	SEER = 13	13
Air Distribution System Efficiency	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Thermostat Type	Manual	Manual	Manual	Manual	Manual	Manual	Manual	Manual
Heating thermostat settings	68 F (all hours)	68 F	68 F (all hours)	68 F	68 F (all hours)	68	68 F (all hours)	68 F
Cooling thermostat settings	78 F (all hours)	78 F	78 F (all hours)	78 F	78 F (all hours)	78	78 F (all hours)	78 F
Mechanical ventilation (kWh/y) (±0.1%)	0	0	77.9	77.8	140.4	140.4	379.1	379.1
DHW pipe length refPipeL (±0.1 ft)	88.5	88.5	88.5	88.5	88.5	88.5	98.5	98.5
DHW loop length refLoopL (±0.1 ft)	156.9	156.9	156.9	156.9	156.9	156.9	176.9	176.9
e-Ratio		0.998		0.999		1.000		1.000

### 3 Results of HERS Method Tests

HERS 2014 Method Tests Software Name: **IC3 V 4.4**

User input data fields indicated by pale yellow													Test result fields indicated by pale green					
Test Case	HERS Index	Reference Home End Use Loads (REUL)			Reference Home End Use Energy Consumption (EC_r)			Rated Home End Use Energy Consumption (EC_x)				HERS Index Tests	Manufacturer's Equipment Performance Rating (MEPR)					
		Winter (MBtu)	Summer (MBtu)	Hot Water (MBtu)	Heating (MBtu)	Cooling (MBtu)	Hot Water (MBtu)	Heating (MBtu)	Cooling (MBtu)	Hot Water (MBtu)	L&A (MBtu)		Heating		Cooling		Hot Water	
													Fuel	MEPR	Fuel	MEPR	Fuel	MEPR
L100A-01	129.21	23.55	10.56	10.75	16.35	2.25	11.85	27.43	3.44	12.40	18.52	PASS	elec	6.80	elec	10.00	elec	0.88
L100A-02	121.22	23.13	10.85	10.75	16.14	2.26	18.60	27.21	3.55	14.31	20.59	PASS	elec	6.80	elec	10.00	gas	0.82
L100A-03	127.36	23.95	10.30	8.59	40.74	2.25	9.71	65.35	3.43	10.28	19.36	PASS	gas	78%	elec	10.00	elec	0.88
L100A-04	117.45	22.71	11.15	12.85	15.94	2.37	13.93	21.73	3.66	14.48	19.54	PASS	elec	9.85	elec	10.00	elec	0.88
L100A-05	117.20	23.13	10.85	10.75	39.39	2.26	11.85	55.30	3.85	12.40	20.59	PASS	gas	96%	elec	10.00	elec	0.88

### 4 Results of HVAC Tests

RESNET HVAC Test Suite Results: Software Name: **IC3 V 4.4**

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	max	
HVAC-1a	7507	1663.476	9170.476	---			
HVAC-1b	5562	1663.476	7225.476	-21.21%	-21.24%	-17.38%	pass

Heating tests:

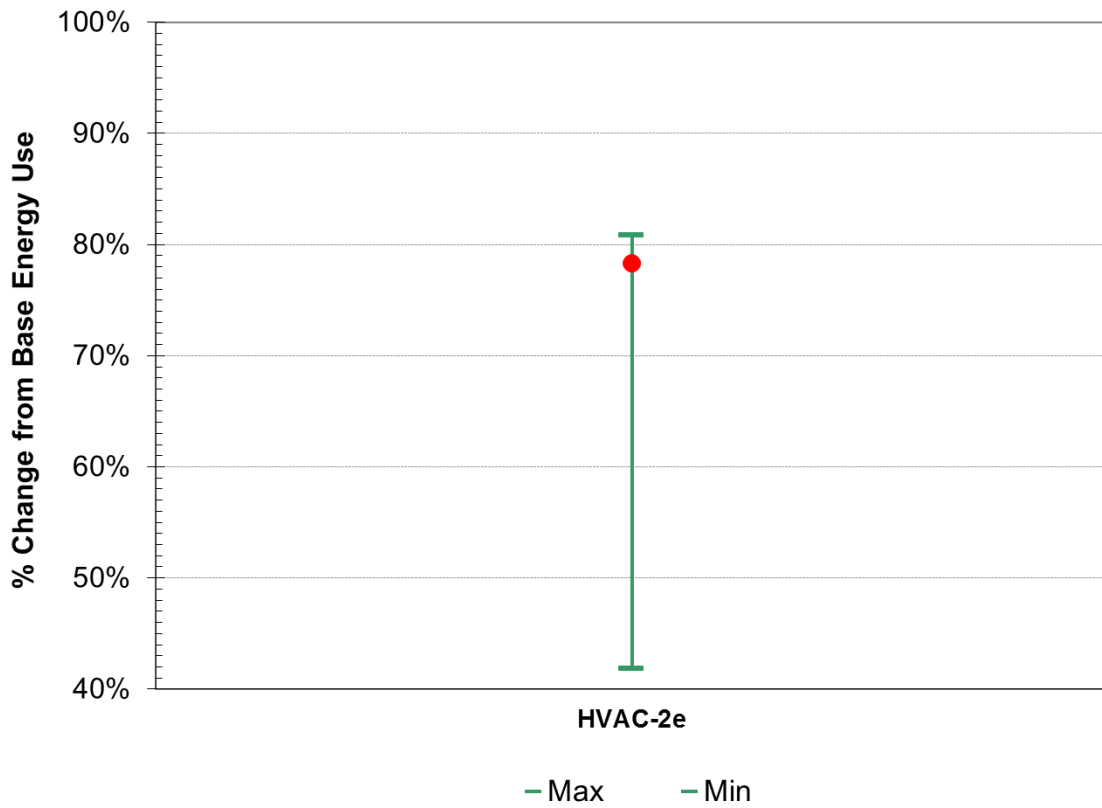
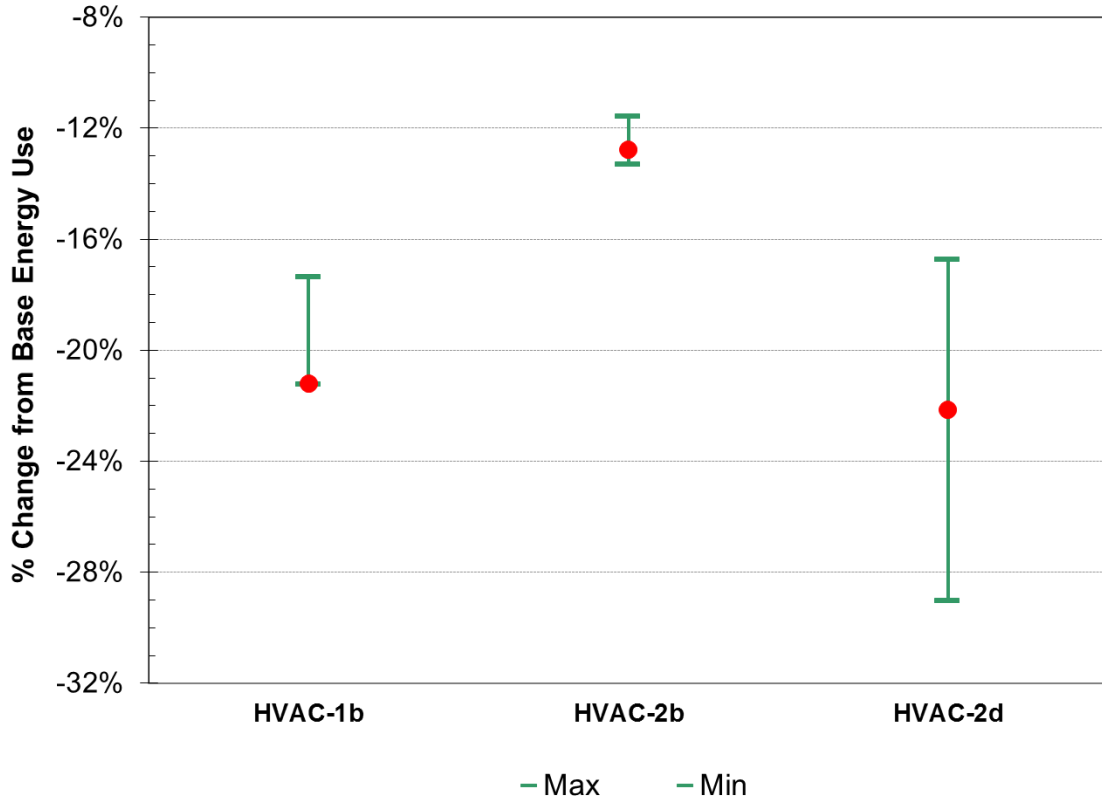
Case	Heat	Heat Fan	Heat Tot	% change	Criteria		
					min	max	
HVAC-2a	894	1082.624	93.09	---			
HVAC-2b	775	1082.624	81.19	-12.78%	-13.30%	-11.57%	pass
HVAC-2c	10943	1285.369	12228.37	---			
HVAC-2d	8538	982	9520	-22.15%	-29.03%	-16.73%	pass
HVAC-2e	20720	1082.643	21802.64	78.30%	41.81%	80.81%	pass

**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	-21.21%	-12.78%	-22.15%

	HVAC-2e
min	41.81%
max	80.81%
avg	61.31%
Result	78.30%





## 5 Results of Duct Distribution System Efficiency Tests

### DSE Test Suite Results

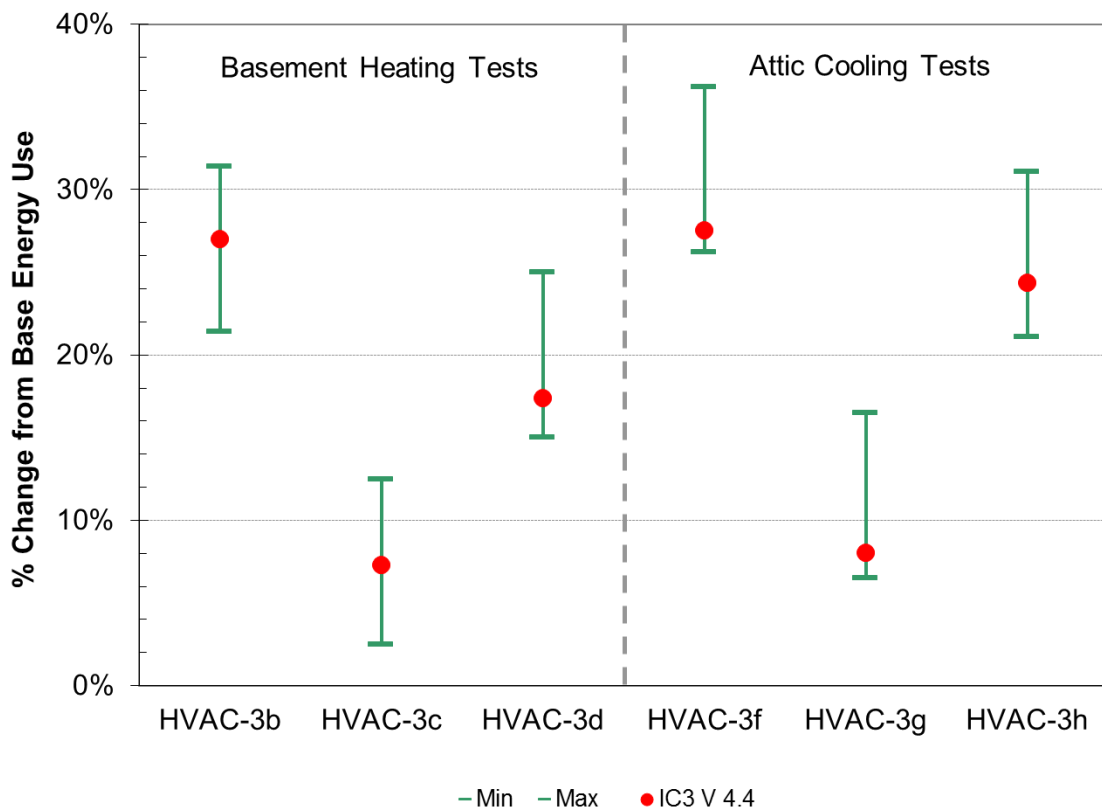
Software Name: **IC3 V 4.4**

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	644	781.736	67.07	--- base for cases 3b - 3d
HVAC-3e	6159	1331.333	7490.333	--- base for cases 3f - 3h

Test Cases	Heat/cool	Fan	Total % change	Criteria:			Pass/Fail
				max	avg	min	
HVAC-3b	818	991.925	85.19 27.0%	31.4%	26.4%	21.4%	pass
HVAC-3c	691	838.673	71.96 7.3%	12.5%	7.5%	2.5%	pass
HVAC-3d	756	919.386	78.74 17.4%	25.0%	20.0%	15.0%	pass
HVAC-3f	7849	1705.673	9554.673 27.6%	36.2%	31.2%	26.2%	pass
HVAC-3g	6652	1442.415	8094.415 8.1%	16.5%	11.5%	6.5%	pass
HVAC-3h	7662	1654.249	9316.249 24.4%	31.1%	26.1%	21.1%	pass



## 6 Results of Hot Water System Performance Tests

### RESNET Pub 002-17 DHW Test Results:

Software Name: IC3 V 4.4

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

### Test Case Results:

Minnesota	DHW Energy [therms]	Recirc Pump [kWh]
L100AD-HW-01	194.7	
L100AD-HW-02	258.8	
L100AD-HW-03	173.1	
L100AD-HW-04	250.5	
L100AD-HW-05	546.9	438
L100AD-HW-06	226.9	5
L100AD-HW-07	206.3	

Florida	Energy [therms]	Pump [kWh]
L100AM-HW-01	108.6	
L100AM-HW-02	134.3	
L100AM-HW-03	89.7	
L100AM-HW-04	131.2	
L100AM-HW-05	292.7	438
L100AM-HW-06	121.4	5
L100AM-HW-07	119.4	

### Test Case Pass/Fail Criteria

Duluth MN Cases:	MBtu/y	Range Min	Range Max	Pass/Fail
L100AD-HW-01	19.47	19.11	19.73	pass
L100AD-HW-02	25.88	25.54	26.36	pass
L100AD-HW-03	17.31	17.03	17.50	pass
L100AD-HW-04	25.05	24.75	25.52	pass
L100AD-HW-05	56.18	55.43	57.15	pass
L100AD-HW-06	22.70	22.39	23.09	pass
L100AD-HW-07	20.63	20.29	20.94	pass
Miami FL Cases:	MBtu/y	Range Min	Range Max	Pass/Fail
L100AM-HW-01	10.86	10.59	11.03	pass
L100AM-HW-02	13.43	13.17	13.68	pass
L100AM-HW-03	8.97	8.81	9.13	pass
L100AM-HW-04	13.12	12.87	13.36	pass
L100AM-HW-05	30.77	30.19	31.31	pass
L100AM-HW-06	12.16	11.90	12.38	pass
L100AM-HW-07	11.94	11.68	12.14	pass
MN Delta Cases:	%Change	Range Min	Range Max	Pass/Fail
MN (1-2 delta)	-32.92%	-34.01%	-32.49%	pass
MN (1-3 delta)	11.07%	10.74%	11.57%	pass
MN (2-4 delta)	3.17%	3.06%	3.22%	pass
MN (2-5 delta)	-117.13%	-118.52%	-115.63%	pass
MN (2-6 delta)	12.26%	12.17%	12.51%	pass
MN (2-7 delta)	20.28%	20.15%	20.78%	pass
FL Delta Cases:	%Change	Range Min	Range Max	Pass/Fail
FL (1-2 delta)	-23.65%	-24.54%	-23.47%	pass
FL (1-3 delta)	17.40%	16.65%	18.12%	pass
FL (2-4 delta)	2.34%	2.20%	2.38%	pass
FL (2-5 delta)	-129.05%	-130.88%	-127.52%	pass
FL (2-6 delta)	9.47%	9.38%	9.74%	pass
FL (2-7 delta)	11.14%	11.00%	11.40%	pass
MN-FL Delta Cases	%Change	Range Min	Range Max	Pass/Fail
MN-FL (01)	44.20%	43.35%	45.00%	pass
MN-FL (02)	48.09%	47.26%	48.93%	pass
MN-FL (03)	48.17%	47.38%	48.74%	pass
MN-FL (04)	47.64%	46.81%	48.48%	pass
MN-FL (05)	45.24%	44.41%	45.99%	pass
MN-FL (06)	46.44%	45.60%	47.33%	pass
MN-FL (07)	42.14%	41.32%	42.86%	pass

## 7 Results of HERS Method IAF Test

2018 HERS Method IAF Test Software Name: **IC3 V 4.4**

User input data fields indicated by pale yellow																			
Test result fields indicated by pale green																			
Test Case	HERS Index	Reference Home End Use Loads (REUL)			Reference Home End Use Energy Consumption (EC <sub>r</sub> )			Rated Home End Use Energy Consumption (EC <sub>x</sub> )				IAD <sub>SAVE</sub> (%)	HERS Index Tests	Manufacturer's Equipment Performance Rating (MEPR)					
		Winter (MBtu)	Summer (MBtu)	Hot Water (MBtu)	Heating (MBtu)	Cooling (MBtu)	Hot Water (MBtu)	Heating (MBtu)	Cooling (MBtu)	Hot Water (MBtu)	L&A (MBtu)			Heating		Cooling		Hot Water	
														Fuel	MEPR	Fuel	MEPR	Fuel	MEPR
L100A-01	133.00	23.55	10.56	10.75	16.35	2.25	11.85	27.43	3.44	12.40	18.52	-12.26%	PASS	elec	6.80	elec	10.00	elec	0.88
L100A-02	124.00	23.13	10.85	10.75	16.14	2.26	18.60	27.21	3.55	14.31	20.59	-11.82%	PASS	elec	6.80	elec	10.00	gas	0.82
L100A-03	130.00	23.95	10.30	8.59	40.74	2.25	9.71	65.35	3.43	10.28	19.36	-11.98%	PASS	gas	78%	elec	10.00	elec	0.88
L100A-04	123.00	22.71	11.15	12.85	15.94	2.37	13.93	21.73	3.66	14.48	19.54	-16.28%	PASS	elec	9.85	elec	10.00	elec	0.88
L100A-05	122.00	23.13	10.85	10.75	39.39	2.26	11.85	55.30	3.85	12.40	20.59	-16.73%	PASS	gas	96%	elec	10.00	elec	0.88