FLORIDA SOLAR ENERGY CENTER

Creating Energy Independence Since 1975

Approval for EnergyGauge Summit 5.10

Florida Energy Code for Commercial Buildings 5th ed. 2014. Effective June 30, 2015

Florida Solar Energy Center
Presenters
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A Research Institute of the University of Central Florida

PURPOSE

- To present the findings of the software approval process for EnergyGauge Summit v5.10
- Seek approval for use for Florida Energy Code Compliance for Commercial Buildings 5th Ed 2014

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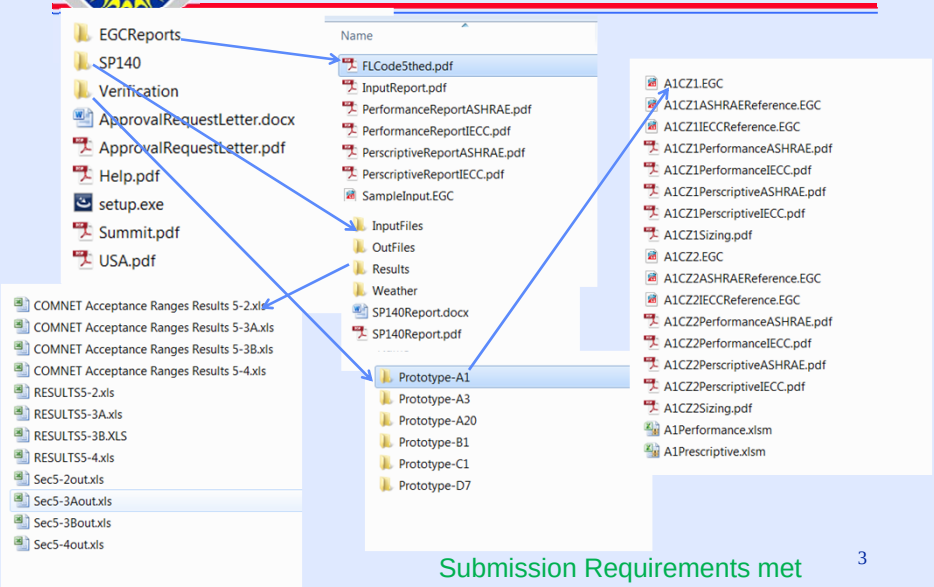
What was Submitted



Submission Requirements met

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Background

Approval application follows:

COMPLIANCE SOFTWARE TOOL ASSISTANCE MANUAL (TAM) FOR THE 2014 FLORIDA BUILDING ENERGY CODE, FSEC-CR-1978-14. June 15, 2014 revised June 30, 2014

TAM Provides test procedures for five compliance Options

1 FEC Prescriptive Method: Six test cases.
2. FEC Total Building Performance Method: Several test cases.
3. ASHRAE Prescriptive Method: Six test cases.
4. ASHRAE Envelope Trade-off Method: Two test cases.
5. ASHRAE Energy Cost Budget Method: Several test cases.

In addition TAM requires vendors supporting the FEC Total Building Performance Method and/or the ASHRAE Energy Cost Budget Method must run their software against ASHRAE Standard 140-2007 suite of tests

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Commercial Evaluation Approach

Test Cases: Prototype Building Summary

Test Suite Buildings	Application	Number of Floors	Total Floor Size, ft^2
A1	Office	1	22,500
A3	Office	3	67,500
A20	Office	20	450,000
B1	Retail, Supermarket	1	40,000
C1	Manufacturing, Warehouse	1	160,000
D7	Mixed use: Retail, Office, and Multifamily	7	179,400
E1	Mixed use: Retail, and Warehouse	1	90,000

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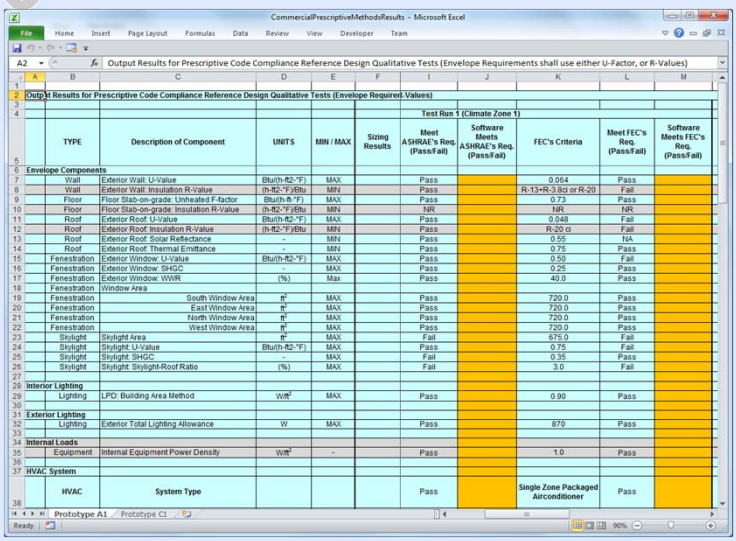
Commercial: Prescriptive Options



CommercialPrescriptiveMethodsResults - Microsoft Excel

A2: Output Results for Prescriptive Code Compliance Reference Design Qualitative Tests (Envelope Requirements shall use either U-Factor, or R-Values)

Output Results for Prescriptive Code Compliance Reference Design Qualitative Tests (Envelope Required-Values)

	TYPE	Description of Component	UNITS	MIN / MAX	Sizing Results	Test Run 1 (Climate Zone 1): Meet ASHRAE's Req. (Pass/Fail)	Software Meets ASHRAE's Req. (Pass/Fail)	FEC's Criteria	Meet FEC's Req. (Pass/Fail)	Software Meets FEC's Req. (Pass/Fail)
Envelope Components										
	Wall	Exterior Wall: U-Value	Btu/(h-ft2-°F)	MAX		Pass		0.064	Pass	
	Wall	Exterior Wall: Insulation R-Value	(h-ft2-°F)/Btu	MIN		Pass		R-13+R-3.8ci or R-20	Fail	
	Floor	Floor Slab-on-grade: Unheated F-factor	Btu/(h-ft-°F)	MAX		Pass		0.73	Pass	
	Floor	Floor Slab-on-grade: Insulation R-Value	(h-ft2-°F)/Btu	MIN		NR		NR	NR	
	Roof	Exterior Roof: U-Value	Btu/(h-ft2-°F)	MAX		Pass		0.048	Fail	
	Roof	Exterior Roof: Insulation R-Value	(h-ft2-°F)/Btu	MIN		Pass		R-20 ci	Fail	
	Roof	Exterior Roof: Solar Reflectance	-	MIN		Pass		0.55	NA	
	Roof	Exterior Roof: Thermal Emittance	-	MIN		Pass		0.75	Pass	
	Fenestration	Exterior Window: U-Value	Btu/(h-ft2-°F)	MAX		Pass		0.50	Fail	
	Fenestration	Exterior Window: SHGC	-	MAX		Pass		0.25	Pass	
	Fenestration	Exterior Window: WWR	(%)	Max		Pass		40.0	Pass	
	Fenestration	Window Area								
	Fenestration	South Window Area	ft^2	MAX		Pass		720.0	Pass	
	Fenestration	East Window Area	ft^2	MAX		Pass		720.0	Pass	
	Fenestration	North Window Area	ft^2	MAX		Pass		720.0	Pass	
	Fenestration	West Window Area	ft^2	MAX		Pass		720.0	Pass	
	Skylight	Skylight Area	ft^2	MAX		Fail		675.0	Fail	
	Skylight	Skylight: U-Value	Btu/(h-ft2-°F)	MAX		Pass		0.75	Fail	
	Skylight	Skylight: SHGC	-	MAX		Fail		0.35	Pass	
	Skylight	Skylight: Skylight-Roof Ratio	(%)	MAX		Fail		3.0	Fail	
Interior Lighting										
	Lighting	LPD: Building Area Method	W/ft^2	MAX		Pass		0.90	Pass	
Exterior Lighting										
	Lighting	Exterior Total Lighting Allowance	W	MAX		Pass		870	Pass	
Internal Loads										
	Equipment	Internal Equipment Power Density	W/ft^2	-		Pass		1.0	Pass	
HVAC System										
	HVAC	System Type				Pass		Single Zone Packaged Airconditioner	Pass	

Prototype A1 / Prototype C1

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Commercial: Performance Options

CommercialPerformanceMethodsResults - Microsoft Excel

A2: Output Results for Performance Based Code Compliance Reference Design Tests (Envelope Requirements shall use U-Factor for walls and Roofs, and F-Factor

Output Results for Performance Based Code Compliance Reference Design Tests (Envelope Requirements shall use U-Factor for walls and Roofs, and F-Factor for slab-on-grade floors)

	TYPE	Description of Components	UNITS	MIN / MAX	Sizing Results	Test Run 1 (Climate Zone 1): Reference Results for Baseline model (ASHRAE)	Compliance Software Baseline Model Results (ASHRAE)	Reference Results for Baseline model (FEC)	Compliance Software Baseline Model Results (FEC)
Envelope Components									
	Wall	Exterior Wall: U-Value	Btu/(h-ft2-°F)	MAX		0.089		0.064	
	Wall	Exterior Wall: Thermal Capacity	(Btu/ft2-°F)			3.94		NA	
	Wall	Exterior Wall: Solar Reflectance	-	MIN		NA		NR	
	Wall	Exterior Wall: Solar Absorptance	-	MAX		NA		0.75	
	Wall	Exterior Wall: Thermal Emittance	-	MIN		NA		0.90	
	Floor	Floor Slab-on-grade: Unheated F-factor	Btu/(h-ft-°F)	MAX		0.73		0.73	
	Floor	Floor Slab-on-grade: Thermal Capacity	(Btu/ft2-°F)			9.33		NA	
	Roof	Exterior Roof: U-Value	Btu/(h-ft2-°F)	MAX		0.063		0.048	
	Roof	Exterior Roof: Thermal Capacity	(Btu/ft2-°F)			2.79		NA	
	Roof	Exterior Roof: Solar Reflectance	-	MIN		0.60		NA	
	Roof	Exterior Roof: Solar Absorptance	-	MAX		NR		0.75	
	Roof	Exterior Roof: Thermal Emittance	-	MIN		0.90		0.90	
	Fenestration	Exterior Window: U-Value	Btu/(h-ft2-°F)	MAX		1.20		0.50	
	Fenestration	Exterior Window: SHGC	-	MAX		0.25		0.250	
	Fenestration	Exterior Window: WWR	(%)	Max		40.0		40.0	
	Fenestration	Window Area							
	Fenestration	South Window Area	ft^2	MAX		550.0		550.0	
	Fenestration	East Window Area	ft^2	MAX		550.0		550.0	
	Fenestration	North Window Area	ft^2	MAX		550.0		550.0	
	Fenestration	West Window Area	ft^2	MAX		550.0		550.0	
	Skylight	Skylight Area	ft^2	MAX		1125.0		675.0	
	Skylight	Skylight: U-Value	Btu/(h-ft2-°F)	MAX		1.98		0.75	
	Skylight	Skylight: SHGC	-	MAX		0.19		0.35	
	Skylight	Skylight: Skylight-Roof Ratio	(%)	MAX		5.0		3.0	
Interior Lighting									
	Lighting	LPD: Building Area Method	W/ft^2	MAX		0.90		0.90	
Exterior Lighting									
	Lighting	Total Lighting Allowance	W	MAX		870		870	
Internal Loads									
	Equipment	Internal Electric Power Density	W/ft^2	-		1.0		1.0	
HVAC System									
		HVAC System Type				Packaged Roof Top Heat Pump		Packaged Roof Top Heat Pump	

Prototype A1 / Prototype A3 / Prototype A20 / Prototype B1 / Prototype C1 / Prototype D7

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Commercial: Envelope Trade-Off

CommercialEnvelopeTradeOffMethodResults - Microsoft Excel

A2: Building Envelope Trade-Off Option Method Compliance Calculation Results for Miami, Florida

Building Envelope Trade-Off Option Method Compliance Calculation Results for Miami, Florida (Climate Zone 1)

Compliance Summary - FAILS

Compliance Summary: Enevlope Performnace Factor (EPF)			UNITS	Reference Results (EPF)			Vendor's Software Results (EPF)		
	TYPE	Envelope Components		Proposed	Reference	Margin	Proposed	Reference	Margin
	Floor	Roof	-	1931	2009	78			
	Skylight	Skylight	-	113	60	-53			
	Window	Exterior Walls & Windows	-	3885	2923	-962			
	Wall	Below Grade Walls	-	0	0	0			
	Floor	Floors	-	0	0	0			
	Floor	Slabs	-	10	11	1			
	Daylighting	Daylighting Potential	-	11193	11919	726			
	Project	Total	-	17132	16922	-210			

The Following Tabular Ouput Summary are for Inputs Verificatioin Purpose Only

Output Results for Envelope Tade-Off Option Method

	TYPE	Envelope Components	UNITS	Reference Inputs	Vendor's Software Results	Note
Envelope Geometry Summary						
	Floor	Floor Area	ft^2	90000		
	Wall	Gross Wall Area:	ft^2	36750		
	Window	Window Area:	ft^2	2000		
	Window	Window Wall Ratio:	%	5.4		
	Roof	Gross Roof Area:	ft^2	90000		
	Skylight	Skylight Area:	ft^2	20		
	Skylight	Skylight Roof Ratio:	%	0.0		
	Door	Door Area	ft^2	1000		

Opaque Construction Summary

Miami_ClimateZone1A / Orlando_ClimateZone2A

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Requirements - Major

Requirement	Complied
FEC Prescriptive Method: Six test cases.	Yes
FEC Total Building Performance Method Test cases.	Yes
ASHRAE Prescriptive Method: Six test cases.	Yes
ASHRAE Envelope Trade-off Method: Two test cases	Not Supported
ASHRAE Energy Cost Budget Method: Several test cases	Yes
ASHRAE Standard 140-2007	Yes

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Requirements – Supporting cont..

Requirement	Complied
Forms General Requirements (per section 7.4 of TAM) Minimum Required Content and Format shall be per Appendix C Name of the individual completing the compliance report Name and version of the compliance software tool	Yes
Performance Based Methods Report : The compliance software shall generate a report that documents and compares the annual energy costs of proposed design building and the standard reference design building. (per section 7.4 of TAM)	Yes
Document Minimum and mandatory requirements of Chapter 4 of the Florida Energy Code or ASHRAE 90.1 option. Prescriptive method test is a “Pass” or a “Fail”. And other req per (per section 7.4 of TAM)	Yes

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Requirements – Supporting cont…

Requirement	Complied
User's Manual or help system: The vendor shall develop a user's manual and/or help system that meets the specifications in Section 4 of this Manual.	Yes
Submit at least one fully working program version of the compliance software to the Commission's staff and also to provide the Commission's Energy Technical Advisory Committee and interest groups access to the software for review during the approval process.	Yes
Provide technical support on how to use their program for energy code compliance calculations.	Yes
Submit Commercial Application Checklist 1 thru 8 (per section 3.2 TAM)	Yes Except 7
Where to Send Application , Florida Building Commission, 1940 North Monroe Street, Tallahassee, Florida 32399	Yes

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Requirements – Supporting cont…

Requirement	Complied
User's Manual and Help System Requirements of Chapter 4	Yes
Commercial Building Inputs Restrictions per Section 5.1.	Yes
User Interface Requirements per section 5.2, such as Compulsory Input Checks, Handling Missing Inputs, Handling Invalid Input, Handling Inconsistent Inputs, Validity Checks, Consistency Checks	Yes

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SUPPORTING SLIDES

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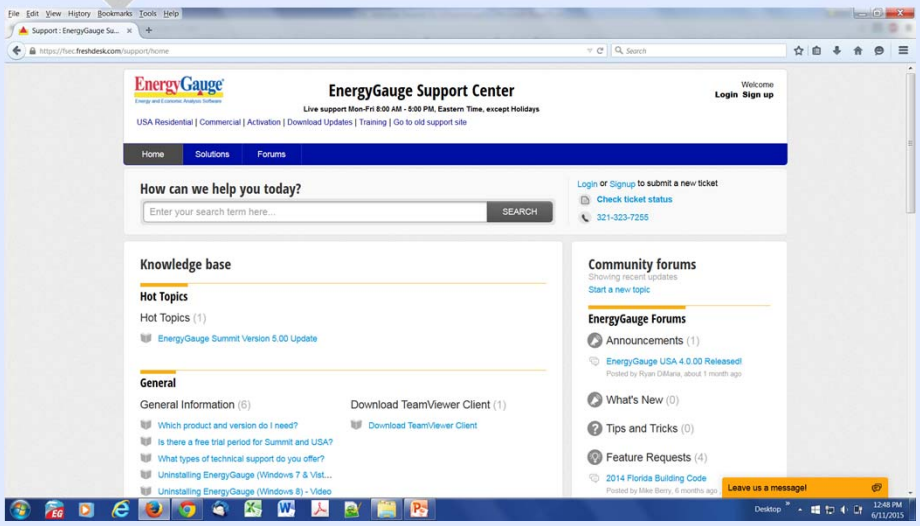
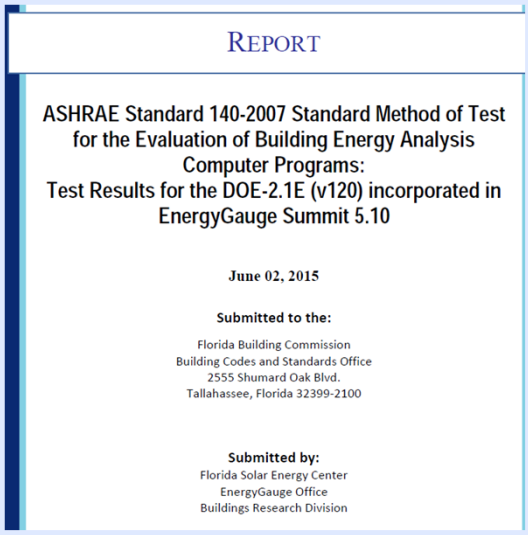
TECHNICAL SUPPORT SYSTEM





REPORT

ASHRAE Standard 140-2007 Standard Method of Test for the Evaluation of Building Energy Analysis Computer Programs:
Test Results for the DOE-2.1E (v120) incorporated in EnergyGauge Summit 5.10

June 02, 2015

Submitted to the:

Florida Building Commission
Building Codes and Standards Office
2555 Shumard Oak Blvd.
Tallahassee, Florida 32399-2100

Submitted by:
Florida Solar Energy Center
EnergyGauge Office
Buildings Research Division

SP140/COMNET Acceptance Tests

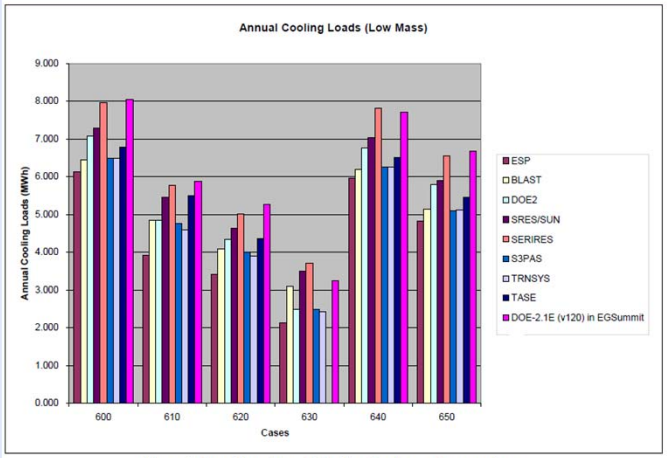


Figure 4: Low Mass Annual Cooling Loads result comparison

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SP140/COMNET Acceptance Tests

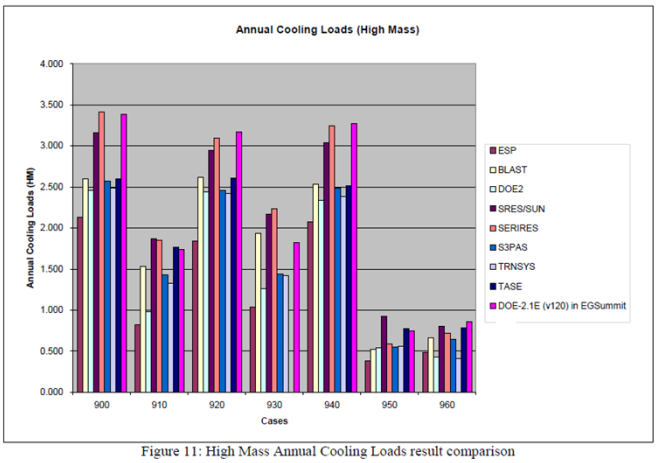

Figure 11: High Mass Annual Cooling Loads result comparison

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SP140/COMNET Acceptance Tests

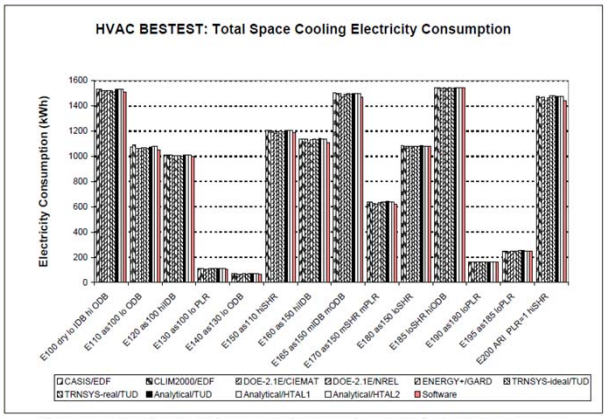

Figure 7: Total Cooling Electricity Consumption comparison results for the HVAC component performance tests

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Mandatory Checklist FEC

Project: TAM A1
Title: TAM Prototype Building A1
Type: Office
(WEA File: FL_MIAMI_INTL_AP.tm3)

Mandatory Requirements (as applicable)

Topic	Section	Component	Description	Yes	N/A	Ex
Air Leakage	C402.4.1,C402.4.2	Envelope	The building envelope contains a continuous air barrier that is sealed in an approved manner and	☐	☐	☐
Air Leakage	C402.4.3,C402.4.4	Envelope	either constructed or tested in an approved manner. Air barrier penetrations are sealed in an approved manner. Factory-built fenestration and doors are labeled as meeting air leakage requirements.	☐	☐	☐
Air Leakage	C402.4.7	Envelope	Vestibules are installed on all building entrances. Doors have self-closing devices.	☐	☐	☐
Air Leakage	C402.4.1.1	Envelope	All sources of air leakage in the building thermal envelope are sealed, caulked, gasketed, weather	☐	☐	☐
Air Leakage	C402.4.6	Envelope	stripped or wrapped with moisture vapor-permeable wrapping material to minimize air leakage. Weatherseals installed on all loading dock cargo doors.	☐	☐	☐
Air Leakage	C402.4.8	Envelope	Recessed luminaires in thermal envelope to limit infiltration and be IC rated and labeled. Seal	☐	☐	☐
Fenestration	C303.1.3	Envelope	between interior finish and luminaire housing. Fenestration products rated in accordance with NFRC.	☐	☐	☐
Fenestration	C303.1.3	Envelope	Fenestration products are certified as to performance labels or certificates provided.	☐	☐	☐
Fenestration	C402.2.7	Envelope	U-factor of opaque doors associated with the building thermal envelope meets requirements.	☐	☐	☐
Insulation	C303.2	Envelope	Below-grade wall insulation installed per manufacturer's instructions.	☐	☐	☐
Insulation	C303.2	Envelope	Slab edge insulation installed per manufacturer's instructions.	☐	☐	☐
Insulation	C402.2.6	Envelope	Slab edge insulation depth/length. Slab insulation extending away from building is covered by	☐	☐	☐

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Mandatory Checklist ASHRAE

Project: TAM A1
Title: TAM Prototype Building A1
Type: Office
(WEA File: FL_MIAMI_INTL_AP.tm3)

Mandatory Requirements (as applicable)

Topic	Section	Component	Description	Yes	N/A	Ex
Air Leakage	5.4.3.1	Envelope	Continuous air barrier is wrapped, sealed, caulked, gasketed, and/or taped in an approved	☐	☐	☐
Air Leakage	5.4.3.2	Envelope	manner, except in semiheated spaces and in climate zones 1-6. Factory-built fenestration and doors are labeled as meeting air leakage requirements.	☐	☐	☐
Air Leakage	5.4.3.4	Envelope	Vestibules are installed where building entrances separate conditioned space from the exterior, and	☐	☐	☐
Air Leakage	5.4.3.1	Envelope	meet exterior envelope requirements. Doors have self-closing devices, and are >=7 ft apart. All sources of air leakage in the building thermal envelope are sealed, caulked, gasketed, weather	☐	☐	☐
Fenestration	5.8.2.1	Envelope	stripped or wrapped with moisture vapor-permeable wrapping material to minimize air leakage. Fenestration products rated in accordance with NFRC.	☐	☐	☐
Fenestration	5.8.2.2	Envelope	Fenestration products are certified as to performance labels or certificates provided.	☐	☐	☐
Fenestration	5.8.2.3,5.5.3.6	Envelope	U-factor of opaque doors associated with the building thermal envelope meets requirements.	☐	☐	☐
Insulation	5.8.1.2	Envelope	Below-grade wall insulation installed per manufacturer's instructions.	☐	☐	☐
Insulation	5.8.1.2	Envelope	Slab edge insulation installed per manufacturer's instructions.	☐	☐	☐
Insulation	5.8.1.7.3	Envelope	Insulation in contact with the ground has <=0.3% water absorption rate per ASTM C272.	☐	☐	☐
Insulation	6.4.4.1.5	Envelope	Bottom surface of floor structures incorporating radiant heating insulated to >=R-3.5.	☐	☐	☐

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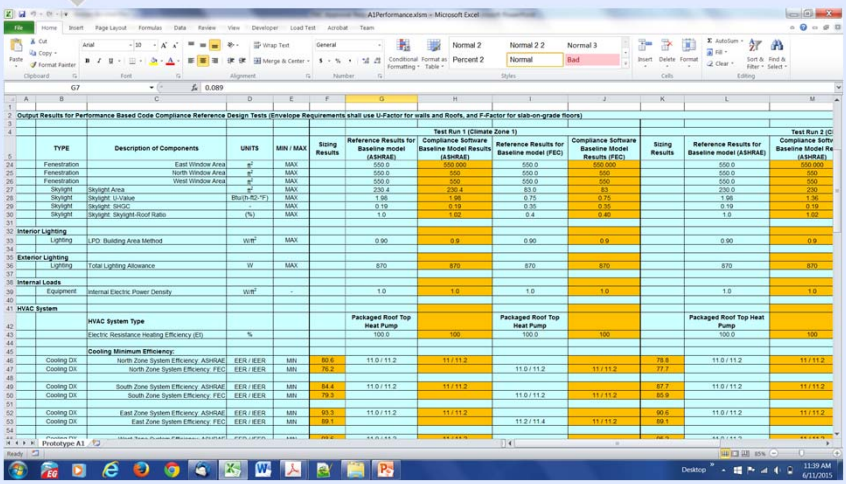
Software Performance Verification Results Prototype A1



TYPE	Description of Components	UNITS	MIN / MAX	Sizing Results	Reference Results for Baseline model (ASHRAE)	Compliance Software Baseline Model Results (ASHRAE)	Reference Results for Baseline model (FEC)	Compliance Software Baseline Model Results (FEC)	Sizing Results	Reference Results for Baseline model (ASHRAE)	Compliance Software Baseline Model Re (ASHRAE)
					Test Run 1 (Climate Zone 1)						Test Run 2 (Cl
Fenestration	East Window Area	m^2	MAX		550.0	550.000	550.0	550.000		550.0	550.000
Fenestration	North Window Area	m^2	MAX		550.0	550	550.0	550		550.0	550
Fenestration	West Window Area	m^2	MAX		550.0	550	550.0	550		550.0	550
Skylight	Skylight Area	m^2	MAX		230.4	230.4	83.0	83		230.0	230
Skylight	Skylight U-Value	Btu/(h-ft2-°F)	MAX		1.98	1.98	0.75	0.75		1.98	1.98
Skylight	Skylight SHGC	-	MAX		0.19	0.19	0.35	0.35		0.19	0.19
Skylight	Skylight Skylight-Roof Ratio	(%)	MAX		1.0	1.02	0.4	0.40		1.0	1.02
Interior Lighting											
Lighting	LPD: Building Area Method	W/m^2	MAX		0.90	0.9	0.90	0.9		0.90	0.9
Exterior Lighting											
Lighting	Total Lighting Allowance	W	MAX		870	870	870	870		870	870
Internal Loads											
Equipment	Internal Electric Power Density	W/m^2	-		1.0	1.0	1.0	1.0		1.0	1.0
HVAC System											
	HVAC System Type				Packaged Roof Top Heat Pump		Packaged Roof Top Heat Pump			Packaged Roof Top Heat Pump	
	Electric Resistance Heating Efficiency (Et)	%			100.0	100	100.0	100		100.0	100
	Cooling Minimum Efficiency:										
Cooling DX	North Zone System Efficiency: ASHRAE	EER / IEER	MIN	80.6	11.0 / 11.2	11 / 11.2			78.8	11.0 / 11.2	11 / 11.2
Cooling DX	North Zone System Efficiency: FEC	EER / IEER	MIN	76.2			11.0 / 11.2	11 / 11.2	77.7		
Cooling DX	South Zone System Efficiency: ASHRAE	EER / IEER	MIN	84.4	11.0 / 11.2	11 / 11.2			87.7	11.0 / 11.2	11 / 11.2
Cooling DX	South Zone System Efficiency: FEC	EER / IEER	MIN	79.3			11.0 / 11.2	11 / 11.2	85.9		
Cooling DX	East Zone System Efficiency: ASHRAE	EER / IEER	MIN	93.3	11.0 / 11.2	11 / 11.2			90.6	11.0 / 11.2	11 / 11.2
Cooling DX	East Zone System Efficiency: FEC	EER / IEER	MIN	89.1			11.2 / 11.4	11 / 11.2	89.1		

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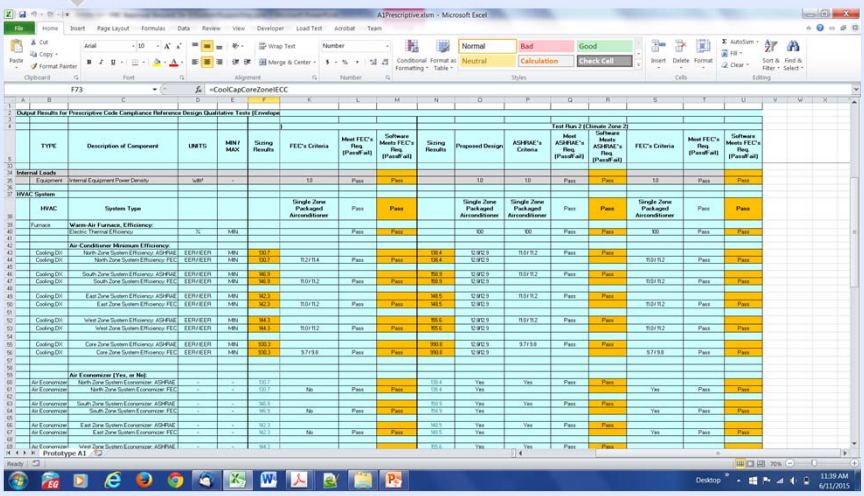
Software Prescriptive Verification Results Prototype A1



TYPE	Description of Component	UNITS	MIN / MAX	Sizing Results	FEC's Criteria	Meet FEC's Req. (Pass/Fail)	Software Meets FEC's Req. (Pass/Fail)	Sizing Results	Proposed Design	ASHRAE's Criteria	Meet ASHRAE's Req. (Pass/Fail)	Software Meets ASHRAE's Req. (Pass/Fail)	FEC's Criteria	Meet FEC's Req. (Pass/Fail)	Software Meets FEC's Req. (Pass/Fail)
								Test Run 2 (Climate Zone 2)							
Internal Loads															
Equipment	Internal Equipment Power Density	W/m^2	-		10	Pass	Pass		10	10	Pass	Pass	10	Pass	Pass
HVAC System															
HVAC	**System Type**				**Single Zone Packaged Airconditioner**	Pass	**Pass**		**Single Zone Packaged Airconditioner**	**Single Zone Packaged Airconditioner**	Pass	**Pass**	**Single Zone Packaged Airconditioner**	Pass	**Pass**
Furnace	**Warm-Air Furnace, Efficiency:**														
	Electric Thermal Efficiency	%	MIN			Pass	Pass		100	100	Pass	Pass	100	Pass	Pass
	Air-Conditioner Minimum Efficiency:														
Cooling DX	North Zone System Efficiency: ASHRAE	EER/IEER	MIN	10.7				10.4	12.9/12.9	11.0/11.2	Pass	Pass			
Cooling DX	North Zone System Efficiency: FEC	EER/IEER	MIN	10.7	11.2/11.4	Pass	Pass	10.4	12.9/12.9				11.0/11.2	Pass	Pass
Cooling DX	South Zone System Efficiency: ASHRAE	EER/IEER	MIN	10.9				10.5	12.9/12.9	11.0/11.2	Pass	Pass			
Cooling DX	South Zone System Efficiency: FEC	EER/IEER	MIN	10.9	11.0/11.2	Pass	Pass	10.5	12.9/12.9				11.0/11.2	Pass	Pass
Cooling DX	East Zone System Efficiency: ASHRAE	EER/IEER	MIN	10.3				10.5	12.9/12.9	11.0/11.2	Pass	Pass			
Cooling DX	East Zone System Efficiency: FEC	EER/IEER	MIN	10.3	11.0/11.2	Pass	Pass	10.5	12.9/12.9				11.0/11.2	Pass	Pass
Cooling DX	West Zone System Efficiency: ASHRAE	EER/IEER	MIN	10.3				10.6	12.9/12.9	11.0/11.2	Pass	Pass			
Cooling DX	West Zone System Efficiency: FEC	EER/IEER	MIN	10.3	11.0/11.2	Pass	Pass	10.6	12.9/12.9				11.0/11.2	Pass	Pass
Cooling DX	Core Zone System Efficiency: ASHRAE	EER/IEER	MIN	10.0				10.0	12.9/12.9	9.7/9.8	Pass	Pass			
Cooling DX	Core Zone System Efficiency: FEC	EER/IEER	MIN	10.0	9.7/9.8	Pass	Pass	10.0	12.9/12.9				9.7/9.8	Pass	Pass
	Air Economizer (Yes, or No):														
Air Economizer	North Zone System Economizer: ASHRAE	-	-	10.7				10.4	Yes	Yes	Pass	Pass			
Air Economizer	North Zone System Economizer: FEC	-	-	10.7	No	Pass	Pass	10.4	Yes				Yes	Pass	Pass
Air Economizer	South Zone System Economizer: ASHRAE	-	-	10.9				10.5	Yes	Yes	Pass	Pass			
Air Economizer	South Zone System Economizer: FEC	-	-	10.9	No	Pass	Pass	10.5	Yes				Yes	Pass	Pass
Air Economizer	East Zone System Economizer: ASHRAE	-	-	10.3				10.5	Yes	Yes	Pass	Pass			
Air Economizer	East Zone System Economizer: FEC	-	-	10.3	No	Pass	Pass	10.5	Yes				Yes	Pass	Pass
Air Economizer	West Zone System Economizer: ASHRAE	-	-	10.3				10.6	Yes	Yes	Pass	Pass			

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CONCLUSION

- EnergyGauge Summit 5.10 meets all essential TAM requirements
- Ready for release for June 30, 2015 Effective date
- Provides state-of the are technical support system that includes, web, chat and phone
- ASHRAE Envelope trade-off option not supported

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