
3.1 Ruleset Implementation Tests

3.1.1 Introduction

The Building Energy Sensitivity Tests in the Reference Method suite of tests verifies that the simulation engine produces results that are within an acceptable range. The tests in this section are intended to verify that the software correctly constructs the Standard Design model and applies rules of the 2013 Nonresidential ACM appropriately to the proposed and Standard Design models. The rule set implementation tests cover representative portions of the rules for building envelope, lighting, daylighting, space use data and HVAC. For each test there is a set of three models defined:

- User Model – the user model contains the user inputs for the as-designed building. In most cases, the values for the Proposed Design will be taken from user inputs with no modification. However, there are some cases where the building input is prescribed for the Proposed Design, or constrained by mandatory minimums or other rules.
- Proposed Design Model – the proposed model is defined by the rules in the ACM Reference Manual and created by the vendor software and is the building modeled for compliance. This model takes user inputs for building geometry, building envelope, lighting and HVAC and is used in the compliance simulation.
- Standard Design Model – this is the baseline model defined by the ACM Reference Manual modeling rules, and is the basis for comparison that determines whether a building passes compliance using the performance method.

These tests do not require that simulation outputs be verified, but they do require that simulation input files for the Proposed Design and Standard Design are properly constructed according to the rules in the ACM Reference Manual. Some tests require that sizing runs be performed, for HVAC inputs whose values are dependent on autosized Standard Design systems.

3.1.2 Overview

The test runs described in this section represent the Title-24 2013 Non-Residential ACM code compliance calculation and use the following Prototype Models- Small Office Building, Medium Office Building, Large Office Building, Warehouse Building and Small Hotel. For further details on the Prototype Models, refer to Section III of the Software Compliance Specification document. Each of the Standard Design test cases shall be created by modifying the Prototype Model as described in Section IV of this document. The modified Prototype Model shall form the proposed case for each test run. The Standard Design model shall be generated by compliance software as per the rules in the 2013 Nonresidential ACM. The Standard Design and proposed model files for each of test cases shall then be evaluated to verify that:

- The Standard Design building envelope constructions are correctly substituted for exterior opaque surfaces and fenestrations.
- Fenestration area in the Standard Design building is reduced in accordance with the 2013 Nonresidential ACM Manual, when the Proposed Design fenestration area is greater than 40% of the exterior wall.
- Skylight area in the Standard Design building is adjusted in accordance with the 2013 Nonresidential ACM Manual, when applicable.

- Default schedules of operation are applied for both the Standard Design building and the Proposed Design.
- The proposed and Standard Design cases use the same defaults or tailored inputs for internal loads as required by the 2013 Nonresidential ACM Manual.
- The Standard Design building lighting system is correctly specified and that exterior lighting is modeled.
- Receptacle loads, process loads is modeled according to the rules in the 2013 Nonresidential ACM Manual.
- The Standard Design building use the correct system types as prescribed in Table 5 of the 2013 Nonresidential ACM Manual.
- An economizer (of the right type) is included in the Standard Design building if required.
- The primary and secondary Standard Design building systems are properly specified and sized.
- Fan brake horsepower is correctly specified for the Standard Design building.
- Prescribed modeling assumptions are applied for both the Standard Design building and the Proposed Design.
- Overhangs are modeled in the Proposed Design for Test Case 7 but not the Standard Design building.
- Unconditioned spaces are modeled.
- Other Standard Design building specifications and/or modeling assumptions are correctly applied. As the software developer verifies the various test conditions, the input and output files should be annotated with comments or other methods to demonstrate that the modeling rules specified in the 2013 Nonresidential ACM Manual are correctly applied. Software developers should use the output format spreadsheets, included in Appendix B, to report the results of these tests. These annotated files shall then be submitted to the Commission for further evaluation. Any errors discovered shall be corrected by making modifications to the software; the runs shall be repeated; and the new results shall be annotated for submittal to the Commission.

The Standard Design Tests are labeled using the format:

Standard Design Fenestration Test/Medium Office -CZ-15, Exterior Envelope Run 01

Run name number

Climate Zone

Prototype Model Type

Test Type

3.1.3 Ruleset Implementation Tests

The following tests shall be performed to verify that the compliance software correctly creates the Standard Design model and applies modeling rules as per the requirements of the Nonresidential ACM 2013. The proposed model shall be created by modifying the appropriate Prototype Model type. The Standard Design Model for each test case shall be generated automatically by the compliance software.

The intent of each test run, characteristics of the proposed model and inputs to be verified in the Standard Design model are described below.

1. Standard Design Exterior Envelope Test/Small Office-CZ-6, Run01– This test will verify that the applicant software models the wall, floor and roof construction correctly in the Standard Design model and that the envelope and fenestration performance requirements for the Standard Design are modelled as per the requirements of 2013 Nonresidential ACM.

The user model is a small office building in climate zone 6 with the following envelope characteristics:

- Low sloped concrete roof with assembly U-value of [0.065044](#), Aged Solar Reflectance of 0.75 and Thermal emittance of 0.78
- Wood-framed wall with assembly U-value of [0.095091](#)
- Mass floor with assembly U-value of [0.052039](#)
- Fixed window with U-factor of 0.25, SHGC of 0.20 and VT of 0.45

The following inputs in the Proposed Design and Standard Design model file shall be verified and reported in the output form provided in Appendix 3C:

- Standard Design roof, wall and floor construction assembly type
- Standard Design roof, wall and floor overall U-value
- Standard Design roof, wall and floor construction assembly layer inputs
- Standard Design roof aged solar reflectance and thermal emittance
- Window U-factor, SHGC and VT

2. Standard Design Exterior Envelope Test/Small Office-CZ-15, Run02 – This test will verify that the applicant software models the wall, floor, roof construction and fenestrations correctly and that the envelope performance requirements for the Standard Design are modelled as per the 2013 Nonresidential ACM.

The user model is a small office building in climate zone 15 with the following envelope characteristics:

- Steep sloped metal building roof with assembly U-factor of [0.055053](#), Aged Solar Reflectance of 0.60 and Thermal emittance of 0.70
- Metal-framed wall with assembly U-factor of 0.056
- Slab on grade floor with floor F-factor of 0.70
- Horizontal overhang of 2 feet on south facing windows and vertical fins of 2 feet on right and left of west facing windows

The following inputs in the Proposed Design and Standard Design model file shall be verified and reported in the output form:

- Standard Design roof, wall and floor construction assembly type
- Standard Design roof, wall and floor construction assembly layer inputs
- Standard Design roof, wall overall U-value
- Standard Design floor slab F-factor
- Standard Design roof aged solar reflectance and thermal emittance.
- Window overhangs for south and west windows

3. Standard Design Exterior Envelope Test/Small Hotel-CZ-15, Run03 – This test will verify that the applicant software models the wall, floor and roof construction correctly in the Standard Design model and that the envelope and fenestration performance requirements for the Standard Design are modelled as per the requirements of 2013 Nonresidential ACM.

The proposed model is a small hotel building in climate zone 15 with the following characteristics:

- Low sloped Metal building Roof with assembly U-value of 0.055, Aged Solar Reflectance of 0.60 and Thermal emittance of 0.70
- Metal-framed wall with assembly U-value of 0.82
- Mass Floor with assembly U-value of 0.952058
- Fixed windows in the first floor with U-factor of 0.25, RSHGC of 0.20 and V.T of 0.47
- Operable windows in guest room windows with U-factor of 0.42, SHGC of 0.18 and V.T of 0.35

The following inputs in the Standard Design model file shall be verified and reported in the output form:

- Standard Design roof, wall and floor construction assembly type
 - Standard Design roof, wall and floor construction assembly layer inputs
 - Standard Design roof, wall and floor U-value
 - Standard Design roof aged solar reflectance and thermal emittance.
 - Window U-value, SHGC and VT
4. Standard Design Exterior Envelope Test/Medium Office-CZ6, Run04 – This test will verify that mandatory minimum opaque envelope insulation requirements are applied. The user model is a small office building in climate zone 6, with a metal-framed wall containing R-5.21 continuous insulation on the exterior and a U-factor of 0.438136.
 - a. For this test, the proposed model should be **undefined**, and the compliance simulation should not run.
 5. Standard Design Fenestration Test/Large Office-CZ-6, WWR Run05 - Run 05 tests whether the applicant software determines the window area of the Standard Design model as per the rules in 2013 Nonresidential ACM.

The user model is the Large office building in climate zone 6 with an overall window-to-wall ratio (WWR) of 52% made of a continuous band of glass distributed evenly across all facades. For this run, the building is rotated 15 degrees to the east in azimuth.

The following inputs in the Proposed Design and Standard Design model file shall be verified and reported in the output form:

- WWR
6. Standard Design Fenestration Test/Large Office-CZ-6, WWR Run06 - Run 06 tests whether the applicant software determines the window area of the Standard Design model as per the rules in 2013 Nonresidential ACM.

The user model is the Large office building in climate zone 6 with overall building WWR-46% and 50% WWR in the west, 40% in South, 45% in East and 50% in the North façade.

The following inputs in the Proposed Design and Standard Design model file shall be verified and reported in the output form:

- Window Area (and WWR) for each orientation
- Window Area (and Overall WWR) for the building

7. Standard Design Skylight Test/Warehouse-CZ-6, Run07 – This test verifies whether the applicant software models the Standard Design skylight as per the performance requirements for skylights in 2013 Nonresidential ACM. This test checks whether the applicant software determines the skylight area of the Standard Design model correctly.

The user model is a Warehouse building in climate zone 6 with an overall skylight-to-roof ratio (SRR) of 7%. Curb mounted glass Skylight with U-value 0.55, SHGC 0.20 and VT 0.40. The building has ceiling heights of 10 feet and a LPD of 0.8 W/ft².

The following inputs in the Standard Design model file shall be verified and reported in the output form:

- Skylight U-factor, SHGC and VT, and SRR

8. Standard Design Skylight Test/Warehouse-CZ-6, SRR Run08 – This test checks whether the applicant software determines the skylight area of the Standard Design model correctly.

The proposed model is a Warehouse building in climate zone 6 with ceiling heights of 20 feet and a lighting power density of 0.8 W/ft². The SRR of the proposed building is 15% and 80% of the building area gets daylighting from skylights or sidelights.

The following Standard Design inputs shall be verified:

- Standard Design SRR, Standard Design total daylit area as a fraction of gross building area

9. Standard Design Skylight Test/Warehouse-CZ-6, SRR Run09 – This test checks whether the applicant software determines the skylight area of the Standard Design model correctly.

The proposed model is a Warehouse building in climate zone 6 with ceiling heights of 20 feet and a lighting power density of 0.8 W/ft². The SRR of the proposed building is 5% and 55% of the building area gets daylighting from skylights or sidelights.

The following Standard Design inputs shall be verified:

- Standard Design SRR, Standard Design total daylit area as a fraction of gross building area

10. Standard Design Occupancy Test/Medium Office-CZ-6, Whole Building Method Run10 – This test verifies whether the applicant software inserts the correct Standard Design inputs for schedules, occupant density, equipment power density, lighting power density, hot water load and ventilation rates using the Complete Building lighting method and in accordance with 2013 Nonresidential ACM. The user model is an office occupancy with:

- Occupant Density- 50 ft²/person

- Equipment Power Density- 3 W/ft²
- Lighting Power Density- 1.2 W/ft²
- Hot Water Load- 106 Btu/person
- Ventilation Rate- 0.15 cfm/ft²

The Proposed Design and Standard Design Standard Design model inputs shall be verified for:

- Schedules (verified shall include occupancy schedule, lighting schedule, receptacle schedule, hot water schedule, infiltration schedule and elevator schedule)
- Occupant Density
- Equipment Power Density
- Lighting Power Density
- Hot Water Load
- Ventilation Rate

11. Standard Design Occupancy Test/Large Office- CZ-6, Area Category Run11 – This test verifies whether the applicant software inserts the correct Proposed Design and Standard Design inputs for schedules, occupant density, equipment power density, lighting power density, hot water load and ventilation rates in accordance with 2013 Nonresidential ACM. This run tests the capability of the applicant software to model Standard Design inputs for multiple space types using the Area Category lighting method.

The user model is the Large office building in climate zone six with the following characteristics:

• First Floor -

Core and North, West Perimeter Zones - Retail space occupancy - Occupant Density 33 #2/pp/1000ft2erson, EPD-2W/ft², LPD-1W/ft², Ventilation rate- 0.75 cfm/ft², Hot Water Load- 120 Btuh/person

East Perimeter Zone - Corridors, Restrooms, Stairs and Support Areas -

Occupant Density 10 ppl/1000ft2, EPD-0.2W/ft², LPD-0.5W/ft², Ventilation rate- 0.15 cfm/ft².

• South Perimeter Zone - Lobby, Main Entry - Occupant Density 10 ppl/1000ft2, EPD-0.5W/ft², LPD-1.5W/ft², Ventilation rate- 0.15 cfm/ft².

• Second to Sixth Floor-

Core and South, West, North Perimeter Zones - Medical occupancy- Occupant Density 100 #2/personpp/1000ft2, EPD-1.5 W/ft², LPD-1W/ft², Ventilation rate- 0.15 cfm/ft², Hot Water Load- 160 Btuh/person

East Perimeter Zone - Corridors, Restrooms, Stairs and Support Areas - Occupant Density 10 ppl/1000ft2, EPD-0.2W/ft², LPD-0.5W/ft², Ventilation rate- 0.15 cfm/ft².

• ThirdSeventh to 12th Eleventh Floor

Core and South, West, North Perimeter Zones - Medical occupancy- Occupant Density 10 ppl/1000ft2, EPD-1.5 W/ft², LPD-0.75W/ft², Ventilation rate- 0.15 cfm/ft², Hot Water Load- 120 Btuh/person

East Perimeter Zone - Corridors, Restrooms, Stairs and Support Areas - Occupant Density 10 ppl/1000ft2, EPD-0.2W/ft², LPD-0.5W/ft², Ventilation rate- 0.15 cfm/ft².

• North, South, West and East zones -Offices occupancy- Occupant Density 150 ft2/person, EPD 1.5 W/ft², LPD 0.75 W/ft², Ventilation rate- 0.15 cfm/ft², Hot Water Load- 120 Btuh/person

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- ~~Third and Fifteenth~~ Floor Core zones
 - Core and South, West, North Perimeter Zones - Medical occupancy- Occupant Density 67 ppl/1000ft², EPD-1W/ft², LPD-1.2W/ft², Ventilation rate- 1 cfm/ft², Hot Water Load- 60 Btuh/person
 - East Perimeter Zone – Corridors, Restrooms, Stairs and Support Areas - Occupant Density 10 ppl/1000ft², EPD-0.2W/ft², LPD-0.5W/ft², Ventilation rate- 0.15 cfm/ft².
 - ~~Lobby occupancy- Occupant Density 100 ft²/person, EPD-0.5 W/ft², LPD-1.5 W/ft², Ventilation rate- 0.15 cfm/ft²~~
 - ~~Fourth, Seventh, 10th and 12th Floor Core Zones- Conference occupancy- Occupant Density 100 ft²/person, EPD-1.0 W/ft², LPD-1.2 W/ft², Ventilation rate- 1 cfm/ft², Hot Water Load- 60 Btuh/person~~
 - ~~Sixth, Eighth Floor Core Zone- Restroom occupancy- Occupant Density 100 ft²/person, EPD-0.2 W/ft², LPD-0.5 W/ft², Ventilation rate- 0.15 cfm/ft²~~
 - ~~Ninth and 11th Floor Core Zones- Corridor occupancy- Occupant Density 100 ft²/person, EPD-0.2 W/ft², LPD-0.5 W/ft², Ventilation rate- 0.15 cfm/ft²~~

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For each space type, the Proposed Design and Standard Design model inputs shall be verified for:

- Schedules (verified shall include occupancy schedule, lighting schedule, receptacle schedule, hot water schedule, infiltration schedule and elevator schedule)
- Occupant Density
- Equipment Power Density
- Lighting Power Density
- ~~Hot Water Load~~
- Ventilation Rate

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12. Standard Design Tailored Lighting Method/Medium Office-CZ-6, Run12 – This test verifies if the applicant software applies the requirements of the Tailored Lighting Method appropriately.

The User Model is a medium office building in climate Zone 6 with the following characteristics:

- Perimeter zones on all floors are modelled as main entry spaces using the Tailored Lighting Method. The space has a general lighting of 0.5 W/ft²
- Core zones on all floors are modelled as waiting spaces using the Tailored Lighting Method. The space has a general lighting of 0.75 W/ft² and ornamental lighting of 0.2 W/ft²

For each space type, the Proposed Design and Standard Design model inputs shall be verified for:

- Lighting Power Density for main entry area
- Lighting Power Density General Lighting Power for waiting area
- Lighting Power Density Custom Lighting Power for waiting area
- Lighting Schedules

13. Standard Design Tailored Lighting Method/Medium Office-CZ-6, Run13 – This test verifies if the applicant software applies the requirements of the Tailored Lighting Method appropriately.

Proposed Model is a medium office building in climate Zone 6 with the following characteristics:

- Perimeter zones on all floors are modelled as main entry spaces using the Tailored Lighting Method. The space has a general lighting of 0.8 W/ft² and task lighting of 0.1 W/ft²
- Core zones on all floors are modelled as waiting spaces using the Tailored Lighting Method. The space has a general lighting of 0.6 W/ft², floor display lighting of 0.1 W/ft², and decorative lighting of 1.2 W/ft²

For each space type, the Proposed Design and Standard Design model inputs shall be verified for:

- Lighting Power Density for main entry area
- Lighting Power Density General Lighting Power for waiting area
- Lighting Power Density Custom Lighting Power for waiting area
- Lighting Schedules

14. Standard Design Lighting Control Test/Small Office-CZ-6, PAF Run14 – This test verifies if the applicant software models lighting power density and schedules for eligible California Power adjustment factors as required by the 2013 Nonresidential ACM.

The proposed model is a small office building (area=5500 sq ft) with demand responsive lighting controls. The model files shall be examined to verify whether adjustment factors are applied as per the requirements in the 2013 Nonresidential ACM.

For this test, the lighting power density of the proposed model and Standard Design are verified.

15. Standard Design Lighting Control Test/Warehouse-CZ-6, Daylightcontrol Run15 – This test verifies the ability of the applicant software to model daylighting controls as per the requirements of the 2013 Nonresidential ACM.

The user model is a warehouse building in CZ-6 with the following characteristics:

- The building has three spaces – Office, Fine Storage and Bulk Storage. The office space gets daylighting from four windows. Fine Storage gets daylighting from skylights and bulk storage gets both sidelighting from windows and skylighting.
- Daylighting controls are installed in primary and skylit daylit areas in all spaces and in the secondary daylit area of the Bulk Storage.
- The installed general lighting power controlled by daylight controls in the office space is 150 Watts. The installed lighting power in the primary daylit zone is 150 Watts and the installed lighting power in the secondary daylit zone is 150 Watts.
- The illuminance setpoint for the office spaces is set at 400 lux and the illuminance setpoint in the fine storage and bulk storage are each set at 250 lux.
- The reference position for the office space is 5 feet from the exterior wall, at the midpoint between the two interior walls, for the primary daylit zone, and 12 feet from the exterior wall, at the midpoint between the two interior walls, for the secondary daylit zone

The Proposed Design and Standard Design model inputs shall be verified for:

For the office space primary daylit zone and secondary daylit zone:

- Lighting Power in Daylit Zone – for this input, the lighting power for general lighting is assumed to be uniform throughout the space for the Standard Design, so the fraction of

lighting power in the space in the primary daylit zone and secondary daylit zone is equal to the fraction of space floor area that is in the primary daylit zone

- Secondary Daylit Zone Adjustment Factor – by space type, from Appendix 5.4A
 - Daylight control type
 - Reference position and illuminance setpoint
- For the bulk storage space:
- Lighting Power in the Daylit Zone
 - Daylight control type
 - Reference position and illuminance setpoint
- For the fine storage space:
- Lighting Power in the Daylit Zone
 - Daylight control type
 - Reference position and illuminance setpoint

16. Standard Design Lighting Control Test/Retail-CZ-6, Daylightcontrol Run16 – This test verifies the ability of the applicant software to model daylighting controls as per the requirements of the 2013 Nonresidential ACM.

The user model is a retail building in CZ-6 with the following characteristics:

- The building has five spaces – Front Entry, Point of Sale, Front Retail, Core Retail and Back Space. The front retail space has daylighting from 5 feet high glass on the exterior with a sill height of 3.74 ft. This test only tests the daylighting control in the front retail space.
- Daylighting controls are installed in primary and skylit daylit areas in all spaces and in the secondary daylit area of the Bulk Storage.
- The front retail space has a general lighting power of 1.6 W/ft² and task and floor display accent lighting in the space of 0.75 W/ft² in the front half of the space closest to the exterior window.
- The illuminance setpoint is set at 950 lux in all spaces.
- The reference position for the front retail space is 5 feet from the exterior wall, at the midpoint between the two interior walls, for the primary daylit zone, and 12 feet from the exterior wall, at the midpoint between the two interior walls, for the secondary daylit zone.

The Proposed Design and Standard Design model inputs shall be verified for:

For the front retail space, primary daylit zone and secondary daylit zone:

- Lighting Power Density, General Lighting – this is calculated from the room cavity ratio and illuminance level
- Lighting Power in Daylit Zone – this input defines the lighting power that is controlled by daylight dimming controls
- Secondary Daylit Zone Adjustment Factor – by space type, from Appendix 5.4A
- Daylight control type
- Reference position and illuminance setpoint

17. Standard Design Ext. Light, SHW Test/Large Office-CZ-6, Run17 – This test verifies if the 2013 Nonresidential ACM rules for exterior lighting are applied accurately for exterior lighting power,

exterior lighting control and schedules. This test also verifies if the Service Hot Water systems are modelled correctly.

The user model is a large office building in climate zone 6, with the following characteristics:

- a. Hot water load of 106 Btu/h-person
- b. Thermal efficiency of 0.78
- c. An exterior hardscape comprising of:
 - i. Driveway of dimensions 20x30 feet with lighting load of 1115 Watts
 - ii. Parking lot of dimensions 180x56 feet with lighting load of 6566 Watts
 - iii. 2 sidewalks of dimensions 6x30 feet with total lighting load of 977 Watts
 - iv. A building entrance door light of 90 Watts.
 - v. 50 square feet of hardscape ornamental light of 2 Watts
 - vi. Lighting load of 6566 Watts on the building façade.
 - vii. Signage of 40 square feet with lighting load of 80 Watts

This test verifies that the Proposed Design and standard design are specified correctly for:

- d. Service Water Heating: thermal efficiency, hot water load
- e. Exterior Lighting Power

18. Standard Design HVAC Test/Small Office-CZ-6, System Type Run18 – This test checks if the applicant software models the Standard Design HVAC system in accordance with the requirements of the 2013 Nonresidential ACM.

The proposed model is a small office building in climate zone 6 with the following characteristics:

- DX cooling
- Cooling COP-3.84
- Gas Furnace Heating
- Thermal Efficiency – 80%
- Constant Volume Fan

The following Standard Design model inputs shall be verified:

- HVAC System Type
- Heating and Cooling Type
- Heating and Cooling Efficiency
- System Sizing
- Maximum and minimum supply air temperature
- Fan Control Method
- Cooling and heating efficiency curve
- Cooling, Heating and Fan Schedule

19. Standard Design HVAC Test/Medium Office-CZ-6, System Type Run19 – This test checks if the applicant software models the Standard Design HVAC system in accordance with the requirements of the 2013 Nonresidential ACM.

The proposed model is a medium office building in climate zone 6 with the following characteristics:

- Core, Mid and Top Bottom Zones are computer rooms with a zone Cooling load= 110,000 Btuh-Packaged Single Zone unit and constant volume fan

- All Perimeter zones- DX Cooling and Hot water Boiler with reheat and variable volume fan
- Cooling Efficiency- COP=4 for packaged single zone units; COP=3.8 for VAV units serving perimeter zones
- Heating Efficiency – 82% for VAV unit serving perimeter zones

The following Standard Design model inputs shall be verified:

- HVAC System Type
- Heating and Cooling Type
- Heating and Cooling Efficiency
- System Sizing
- Maximum and minimum supply air temperature
- SAT Reset Control
- Economizer Type and limits
- Fan Power
- Fan Control Method
- Cooling and heating capacity adjustment curve
- Cooling and heating efficiency curve
- Cooling, Heating and Fan Schedule
- Terminal heat type and capacity
- Terminal minimum stop
- Terminal heat control type
- Boiler type and Number of boilers
- Boiler Heat loss, boiler minimum unloading ratio
- Hot water supply and return temperature

20. Standard Design HVAC Test/Large Office-CZ-6, System Type Run20 – This test checks if the applicant software models the Standard Design HVAC system in accordance with the requirements of the 2013 Nonresidential ACM.

The proposed model is a Large office building in climate zone 6 with the following characteristics:

- Basement Zone is a computer room with cooling only dedicated packaged DX system.
- All other zones have a Built-up VAV system.
- Cooling Efficiency- COP 6.2 for chiller; EER 11, SEER 14 for packaged DX system
- Heating Efficiency – 82% for boiler; not applicable for packaged DX system

The following Standard Design model inputs shall be verified:

- HVAC System Type
- Heating and Cooling Type
- Heating and Cooling Efficiency
- System Sizing
- Sizing Factor (zone, system)
- Maximum and minimum supply air temperature
- Sat Reset Control
- Economizer Type and limits
- Fan Power

- Fan Control Method
- Cooling, Heating and Fan Schedule
- Terminal heat type and capacity
- Boiler type and Number of boilers
- Boiler Heat loss, boiler minimum unloading ratio
- Boiler Performance Curve
- Hot water supply and return temperature
- Boiler pump type
- Pump motor power and efficiency
- Pump part load curve.
- Chiller Type and Number of chillers
- Chiller fuel, capacity and efficiency
- Chiller Minimum Unloading ratio
- Chiller cooling capacity and adjustment curves
- Chilled water supply and return air temperature
- Condenser Type
- Cooling Tower Fan control type and horse power
- Cooling Tower Set Point Control
- Pump Control Type, Motor Power, Efficiency and design flow rate

21. Standard Design HVAC Test/Warehouse-CZ-6, System Type Run21 – This test checks if the applicant software models the Standard Design HVAC system in accordance with the requirements of the 2013 Nonresidential ACM.

The proposed model is a Warehouse building in climate zone 6 with the following characteristics:

- Zones are served by a gas furnace heat only system.
- Heating Efficiency – 84%

The following Standard Design model inputs shall be verified-

- HVAC System Type
- Heating and Cooling Type
- Heating and Cooling Efficiency
- System Sizing
- Maximum and minimum supply air temperature
- Sat Reset Control
- Economizer Type and limits
- Fan Power
- Fan Control Method
- Cooling, Heating and Fan Schedule

22. Standard Design HVAC Test/Hotel-CZ-6, System Type Run22 – This test checks if the applicant software models the Standard Design HVAC system in accordance with the requirements of the 2013 Nonresidential ACM.

The proposed model is a ten-story Hotel in climate zone 6 with a full-service restaurant, and an assembly area that uses demand control ventilation.

- Guestrooms are served by a four-pipe fan coil with water-cooled chiller and boiler

- Building has a water-side economizer

The following Standard Design inputs shall be verified:

- System Type is four-pipe fan coil for the hotel, and kitchen is served by a dedicated kitchen system with exhaust meeting ACM requirements
- Assembly area contains demand control ventilation in Standard Design
- Standard Design building does not contain a water-side economizer

23. Standard Design HVAC Test/MediumOffice-CZ-6, System Type Run23 – This test checks the Standard Design building for an existing, altered building that has the roof replaced with a metal building roof, R-15 continuous insulation, and that has the windows replaced on the South façade with low-e, double glazed windows with $U=0.40$, $SHGC=0.33$ and $VT=0.50$. The windows on the North, East and West facades are existing, unchanged single-paned windows with $U=0.55$, $SHGC=0.56$, $VT=0.6$.

3.1.4 Results Comparison

The applicant shall perform all tests specified in Section IV and report the outputs in the forms provided in Appendix 3C. Note that the Standard Design for some inputs, such as cooling efficiency and pump power, are dependent upon the autosizing of the HVAC equipment. The ruleset implementation tests do not check that the autosized capacity matches the Reference Method, but rather, that the Standard Design input is properly defined in relation to the autosized capacity.

