NONRESIDENTIAL ~~ACM MANUAL~~ APPENDIX ~~NJ~~NA7-2008

Appendix ~~NJ~~NA7-2008 - Acceptance Requirements for Nonresidential Buildings

~~NJ~~NA7.1 Purpose and Scope

~~ACM NJ~~NA7 defines acceptance procedures that must be completed on certain controls and equipment before the installation is deemed to be in compliance with the Standards. These requirements apply to all newly installed equipment for which there are acceptance requirements in new and existing buildings~~before credit can be claimed for certain compliance measures~~. The procedures apply to nonresidential, high-rise residential and hotel/motel buildings as defined by the California Energy Commission's Energy Efficiency Standards for Nonresidential Buildings.

The purpose of the acceptance tests is to assure:

1. The presence of equipment or building components according to the specifications in the compliance documents.
2. Installation quality and proper functioning of the controls and equipment to meet the intent of the design and the Standards.

~~NJ~~NA7.2 Introduction

Acceptance Requirements are defined as ~~the application~~implementation of targeted inspection checks and functional and performance testing ~~conducted~~ to determine whether specific building components, equipment, systems, and interfaces between systems conform to the criteria set forth in the Standards and to related construction documents (plans or specifications). Acceptance Requirements improve code compliance ~~can effective~~effectiveness~~ly improve code compliance~~ and help ~~determine whether equipment~~ meet~~s~~ the expected level of performance. ~~operational goals and whether it should be adjusted to increase efficiency and effectiveness.~~

~~This section describes the process for completing the Acceptance Requirements. The steps include the following:~~

- ~~Document plans showing sensor locations, devices, control sequences and notes,~~
- ~~Review the installation, perform acceptance tests and document results, and~~
- ~~Document the operating and maintenance information, complete installation certificate and indicate test results on the Certificate of Acceptance, and submit the Certificate to the building department prior to receive a final occupancy permit.~~

~~Acceptance testing is not intended to take the place of commissioning or test and balance procedures that a building owner might incorporate into a building project. It is an adjunct process focusing only on demonstrating compliance with the Standards.~~

~~The installing contractor, engineer of record or owners agent shall be responsible for reviewing the plans and specifications to assure they conform to the Acceptance Requirements. This is typically done prior to signing a Certificate of Compliance.~~

Prior to signing a Certificate of Acceptance the installing contractor, engineer of record or owners agent shall be responsible for reviewing the plans and specifications to assure they conform to the Acceptance Requirements. Persons eligible to sign the Certificate of Acceptance are those responsible for its preparation; and licensed in the State of California as a civil engineer, mechanical engineer, licensed architect~~.~~ or a licensed

contractor performing the applicable work or a person managing work on a structure or type of work described pursuant to Business and Professions Code sections 5537, 5538, and 6737.1.

~~The installing contractor, engineer of record or owners agent shall be responsible for providing all necessary instrumentation, measurement and monitoring, and undertaking all required acceptance requirement procedures. They shall be responsible for correcting all performance deficiencies and again implementing the acceptance requirement procedures until all specified systems and equipment are performing in accordance with the Standards.~~

NA7.3 Responsible Party

The installing contractor, engineer of record or owner's agent shall be responsible for documenting and certifying the results of the acceptance requirements. ~~procedures including paper and electronic copies of all measurement and monitoring results.~~ They shall be responsible for performing data analysis, calculation of performance indices and crosschecking results with the requirements of the Standard. They shall be responsible for issuing a Certificate of Acceptance, as well as copies of all measurement and monitoring results for individual test procedures to the Building Department. Building departments shall not release a final Certificate of Occupancy until a Certificate of Acceptance, and all applicable Acceptance Requirements For Code Compliance forms are ~~-~~approved and submitted by the eligible person ~~is submitted that demonstrates that the specified systems and equipment have been shown to be performing in accordance with the Standards.~~ The installing contractor, engineer of record or owners agent upon completion of undertaking all required acceptance requirement procedures shall record their State of California Contractor's License number or their State of California Professional Registration License Number on each Certificate of Acceptance that they issue.

~~NJ.3~~ NA7.4 Building Envelope Acceptance Tests

Reserved For Future Use

NA7.5 Mechanical Systems Acceptance Tests

NA7.5.1 Outdoor Air

~~NJ.3~~NA7.5.1.1 Variable Air Volume Systems Outdoor Air Acceptance

~~NJ.3~~NA7.5.1.1.1 Construction Inspection

Prior to ~~Acceptance~~ Functional Testing, verify and document the following:

- ~~Outside air flow station is calibrated *OR* a calibration curve of outside air vs. outside air damper position, inlet vane signal, or VFD signal was completed during system TAB procedures.~~System controlling outside airflow was calibrated either in the field or factory.

~~NJ.3~~NA7.5.1.1.2 ~~Equipment Testing~~Functional Testing

Step 1: If the system has an outdoor air economizer, force the economizer high limit to disable economizer control (e.g. for a fixed drybulb high limit, lower the setpoint below the current outdoor air temperature)

Step 2: ~~Drive all VAV boxes~~ Adjust supply airflow to ~~the greater of~~ either the sum of the minimum zone airflows or 30% of the total design airflow. Verify and document the following:

- Measured outside airflow reading ~~corresponds to no less than 9~~is within 10% of the total value found on the Standards Mechanical Plan Check document ~~MECH-3~~MECH-3-C, ~~Column H or~~ Column I ~~(which ever is greater)~~.

- ~~System operation stabilizes within 15 minutes after test procedures are initiated (no hunting).~~

- OSA controls stabilize within 5 minutes

Step 3: Adjust supply air flow ~~Drive all VAV boxes~~ to achieve design airflow. Verify and document the following:

- Measured outside airflow ~~CFM corresponds to no less than 9~~reading is within 10% of the total value found on Standards Mechanical Plan Check document ~~MECH-3~~MECH-3-C, ~~Column H or~~ Column I ~~(which ever is greater)~~.
- OSA controls stabilize within 5 minutes

Step 4: Restore system to "as-found" operating conditions

- ~~System operation stabilizes within 15 minutes after test procedures are initiated (no hunting).~~

~~NJ.3~~NA7.5.1.2 Constant Volume System Outdoor Air Acceptance

~~NJ.3~~NA7.5.1.2.1 Construction Inspection

Prior to ~~Acceptance~~ Functional Testing, verify and document the following:

- Minimum position is marked on the outside air damper
- The system has ~~a fixed or motorized minimum outdoor air damper, or an economizer capable of~~ means of ~~-~~maintaining the~~a~~ minimum outdoor air damper position.

~~NJ.3~~NA7.5.1.2.2 ~~Equipment Testing~~Functional Testing

Step 1: If the system has an outdoor air economizer, force the economizer to the minimum position and stop outside air damper modulation~~high limit to disable economizer control~~ (e.g. for a fixed drybulb high limit, lower the setpoint below the current outdoor air temperature)

- Measured outside airflow ~~CFM with damper at minimum position corresponds to no less than 9~~reading is within 10% of the total value found on the Standards Mechanical Plan Check document ~~MECH-3~~MECH-3-C, ~~Column H or~~ Column I ~~(which ever is greater)~~.

~~NJ.4~~NA7.5.2 ~~Packaged~~Constant-Volume, Single-Zone, Unitary ~~HVAC Systems~~Air Conditioners and Heat Pumps

~~Acceptance requirements apply only to constant volume, direct expansion (DX) packaged systems with gas furnaces or heat pumps.~~

~~NJ.4.1 Constant Volume Packaged HVAC Systems Acceptance~~

~~NJ.4~~NA7.5.2.~~1~~.1 Construction Inspection

Prior to ~~Performance~~ Functional Testing, verify and document the following:

- Thermostat is located within ~~the~~ the space-conditioning zone ~~zone~~that is ~~that the HVAC system serves~~served by the HVAC system.
- ~~Space temperature thermostat is factory-calibrated (proof required) or field-calibrated.~~
- ~~Appropriate temperature deadband has been programmed~~Thermostat meets the temperature adjustment and dead band requirements of 122(b).
- ~~Appropriate o~~Occupied, unoccupied, and holiday schedules have been programmed per the facility's schedule.
- ~~Appropriate p~~Pre-occupancy purge has been programmed ~~per~~ to meet the requirements of Standards Section 121(c)2.
- ~~Economizer lockout control sensor, if applicable, is factory-calibrated (proof required) or field-calibrated and setpoint properly set (refer to the ECONOMIZERS acceptance requirements section for detail).~~

- ~~Demand control ventilation controller, if applicable, is factory-calibrated (proof required) or field-calibrated and setpoint properly set (refer to the DEMAND CONTROL VENTILATION acceptance requirements section for detail).~~

~~NJ.4~~NA7.5.2.~~1~~.2 ~~Equipment Testing~~Functional Testing

Step 1: Disable economizer and demand control ventilation systems (if applicable).

Step ~~1~~2: Simulate a heating ~~load~~ demand during the occupied condition ~~(e.g. by setting time schedule to include actual time and placing thermostat heating setpoint above actual temperature)~~. Verify and document the following:

- Supply fan operates continually ~~during occupied condition~~.
- ~~Gas-fired furnace, heat pump or electric heater, if applicable, stages on~~The unit provides heating.
- No cooling is provided by the unit.
- Outside air damper is ~~open to~~ at ~~the~~ minimum position.

Step ~~2~~3: Simulate ~~"no-load"~~operation in the dead band during occupied condition ~~(e.g. by setting time schedule to include actual time and placing thermostat heating setpoints below actual temperature and cooling setpoint below actual temperature)~~. Verify and document the following:

- Supply fan operates continually ~~during occupied condition~~.
- Neither heating nor cooling is provided by the unit.
- Outside air damper is ~~open to~~ at ~~the~~ minimum position.

~~Step 3: If there is an economizer, simulate cooling load and economizer operation, if applicable, during occupied condition (e.g. by setting time schedule to include actual time and placing thermostat cooling setpoint below actual temperature). Verify and document the following:~~

- ~~Supply fan operates continually during occupied condition.~~
- ~~Refer to the *ECONOMIZERS* acceptance requirements section for testing protocols.~~
- ~~No heating is provided by the unit.~~

Step ~~4~~4: ~~If there is no economizer, s~~Simulate cooling ~~load~~ demand during occupied condition ~~(e.g. by setting time schedule to include actual time and placing thermostat cooling setpoint below actual temperature)~~. Lock out economizer (if applicable). Verify and document the following:

- Supply fan operates continually ~~during occupied condition~~.
- ~~Compressor(s) stage on~~The unit provides cooling.
- No heating is provided by the unit.
- Outside air damper is ~~open to~~ at ~~the~~ minimum position.

Step ~~5~~5: ~~Change the time schedule~~ Simulate operation in the dead band ~~force the unit into~~ during unoccupied mode. Verify and document the following:

- Supply fan ~~turns~~ is off.
- Outside air damper ~~closes completely~~is fully closed.
- Neither heating nor cooling is provided by the unit.

Step ~~6~~6: Simulate heating ~~load~~ demand during ~~setback~~ unoccupied conditions ~~(e.g. by setting time schedule to exclude actual time and placing thermostat setback heating setpoint above actual temperature)~~. Verify and document the following:

- Supply fan ~~cycles~~ is on (either continuously or cycling).

- Heating is provided by the unit~~Gas-fired furnace, heat pump or electric heater, if applicable, stages on~~T.
- No cooling is provided by the unit.

~~•Supply fan cycles off when heating equipment is disabled.~~

- Outside air damper is either closed or at minimum position.

~~Step 7: If there is an economizer, simulate cooling load and economizer operation, if applicable, during unoccupied condition (e.g. by setting time schedule to exclude actual time and placing thermostat setup cooling setpoint below actual temperature). Verify and document the following:~~

~~•Supply fan cycles on.~~

~~•Refer to the *ECONOMIZERS* acceptance requirements section for testing protocols.~~

~~•Supply fan cycles off when call for cooling is satisfied (simulated by lowering the thermostat setpoint to below actual temperature).~~

~~•Outside air damper closes when unit cycles off.~~

Step ~~8~~7: ~~If there is no economizer, s~~Simulate cooling ~~load~~ demand during ~~setup~~ unoccupied condition ~~(e.g. by setting time schedule to exclude actual time and placing thermostat setup cooling setpoint above actual temperature)~~. Lock out economizer (if applicable). Verify and document the following:

- Supply fan is on (either continuously or cycling).~~Supply fan cycles on.~~
- ~~No c~~Cooling is provided by the unit. ~~Compressor(s) stage on to satisfy cooling space temperature setpoint.~~
- No heating is provided by the unit.

~~•Supply fan cycles off when cooling equipment is disabled.~~

- Outside air damper is either closed or at minimum position.

Step ~~9~~8: Simulate manual override during unoccupied condition ~~(e.g. by setting time schedule to exclude actual time or by pressing override button)~~. Verify and document the following:

- System ~~reverts~~ operates in ~~to~~ "occupied" mode ~~and operates as described above to satisfy a heating, cooling, or no load condition~~.
- System reverts to "unoccupied" mode ~~turns off~~ when manual override time period expires.

Step 9: Restore economizer and demand control ventilation systems (if applicable), and remove all system overrides initiated during the test.

~~NJ.5~~NA7.5.3. Air Distribution Systems

~~Acceptance requirements apply only to systems covered by Section 144(k).~~

~~NJ.5.1 Air Distribution Acceptance~~

~~NJ.5~~NA7.5.3.~~1~~.1 Construction Inspection

Prior to ~~Performance~~ Functional Testing, verify and document the following:

- ~~Drawbands are either stainless steel worm-drive hose clamps or UV-resistant nylon duct ties~~Duct connections meet the requirements of Standards Section124~~(b)~~.
- Flexible ducts are not compressed~~constricted in any way (for example pressing against immovable objects or squeezed through openings)~~.
- Duct~~ leakage tests shall be performed before access to ductwork and associated connections are blocked by permanently installed construction material.~~s are fully accessible for testing.

- Joints and seams are properly sealed according to the requirements of Standards Section 124.~~not sealed with a cloth back rubber adhesive tape unless used in combination with mastic and drawbands~~.
- ~~Duct R-values are verified.~~Insulation R-Values meet the minimum requirements of Standards Section 124(a).
- Insulation is protected from damage and suitable for outdoor service if applicable per Standards Section 124(f).

~~NJ.5~~NA7.5.3.~~1~~.2 ~~Equipment Testing~~Functional Testing

Step 1: Perform duct leakage test per ~~2003 Nonresidential ACM Approved Manual, Appendix NG, Section 4.3.8.2~~Reference Nonresidential Appendix NA5. Certify the following:

- Duct leakage conforms to the requirements of Section 144(k) and 149(b)1D.~~.~~

Step 2: Obtain HERS Rater field verification as required by ~~Chapter 7 and Appendix NG~~Appendix NA5.

~~NJ.6. Lighting Control Systems~~

~~Lighting control testing is performed on:~~

- ~~Manual Daylighting Controls.~~
- ~~Automatic Daylighting Controls.~~
- ~~Occupancy Sensors.~~
- ~~Automatic Time-switch Control.~~

~~NJ.6.1 Automatic Daylighting Controls Acceptance~~

~~NJ.6.1.1 Construction Inspection~~

~~Prior to Performance Testing, verify and document the following:~~

- ~~All control devices (photocells) have been properly located, factory-calibrated (proof required) or field-calibrated and set for appropriate set points and threshold light levels.~~
- ~~Installer has provided documentation of setpoints, setting and programming for each device.~~
- ~~Luminaires located in either a horizontal daylit area(s) or a vertical daylit area(s) are powered by a separate lighting circuit from non-daylit areas.~~

~~NJ.6.1.2 Equipment Testing~~

~~Continuous Dimming Control Systems~~

~~Step 1: Simulate bright conditions for a continuous dimming control system. Verify and document the following:~~

- ~~Lighting power reduction is at least 65% under fully dimmed conditions.~~
- ~~At least one control step reduces the lighting power by at least 30%.~~
- ~~Only luminaires in daylit zone are affected by daylight control.~~
- ~~Automatic daylight control system reduces the amount of light delivered to the space uniformly.~~
- ~~Dimming control system provides reduced flicker operation over the entire operating range per Standards Section 119(e)2.~~
- ~~Lumen measurements in the space, location of measurements and specific device settings, program settings and other measurements are documented.~~

Step 2: Simulate dark conditions for a continuous dimming control system. Verify and document the following:

- Automatic daylight control system increases the amount of light delivered to the space uniformly.
- Dimming control system provides reduced flicker operation over the entire operating range per Standards Section 119(e)2.
- Lumen measurements in the space, location of measurements and specific device settings, program settings and other measurements are documented.

Stepped Dimming Control Systems

Step 1: Simulate bright conditions for a stepped dimming control system. Verify and document the following:

- Lighting power reduction is at least 50% under fully dimmed conditions.
- Only luminaires in daylit zone are affected by daylight control.
- Automatic daylight control system reduces the amount of light delivered to the space relatively uniformly as per Section 131(b).
- Automatic daylight control system reduces the amount of light delivered to the space per manufacturer's specifications for power level verses light level.
- Minimum time delay between step changes is 3 minutes to prevent short cycling.
- Lumen measurements in the space, location of measurements and specific device settings, program settings and other measurements are documented.

Step 2: Simulate dark conditions for a stepped dimming control system. Verify and document the following:

- Automatic daylight control system increases the amount of light delivered to the space per manufacturer's specifications for power level verses light level.
- Stepped dimming control system provides reduced flicker over the entire operating range per Standards Section 119(e)2.
- Minimum time delay between step changes is 3 minutes to prevent short cycling.
- Lumen measurements in the space, location of measurements and specific device settings, program settings and other measurements are documented.

Stepped Switching Control Systems

Step 1: Simulate bright conditions for a stepped switching control system. Verify and document the following:

- Lighting power reduction is at least 50% under fully switched conditions per Standards Section 119(e)1.
- Only luminaires in daylit zone are affected by daylight control.
- Automatic daylight control system reduces the amount of light delivered to the space relatively uniformly as per Section 131(b).
- Automatic daylight control system reduces the amount of light delivered to the space per manufacturer's specifications for power level verses light level.
- Single- or multiple-stepped switching controls provide a dead band of at least three minutes between switching thresholds to prevent short cycling.
- Lumen measurements in the space, location of measurements and specific device settings, program settings and other measurements are documented.

Step 2: Simulate dark conditions for a stepped switching control system. Verify and document the following:

- Automatic daylight control system increases the amount of light delivered to the space per manufacturer's specifications for power level verses light level.
- Single- or multiple-stepped switching controls provide a dead band of at least three minutes between switching thresholds to prevent short cycling.
- Lumen measurements in the space, location of measurements and specific device settings, program settings and other measurements are documented.

NJ.6.2 Occupancy Sensor Acceptance

NJ.6.2.1 Construction Inspection

Prior to Performance Testing, verify and document the following:

- Occupancy sensor has been located to minimize false signals.
- Occupancy sensors do not encounter any obstructions that could adversely affect desired performance.
- Ultrasound occupancy sensors do not emit audible sound.

NJ.6.2.2 Equipment Testing

Step 1: For a representative sample of building spaces, simulate an unoccupied condition. Verify and document the following:

- Lights controlled by occupancy sensors turn off within a maximum of 30 minutes from the start of an unoccupied condition per Standard Section 119(d).
- The occupant sensor does not trigger a false "on" from movement in an area adjacent to the controlled space or from HVAC operation.
- Signal sensitivity is adequate to achieve desired control.

Step 2: For a representative sample of building spaces, simulate an occupied condition. Verify and document the following:

- Status indicator or annunciator operates correctly.
- Lights controlled by occupancy sensors turn on immediately upon an occupied condition, *OR* sensor indicates space is "occupied" and lights are turned on manually (automatic OFF and manual ON control strategy).

NJ.6.3 Manual Daylighting Controls Acceptance

NJ.6.3.1 Construction Inspection

Prior to Performance Testing, verify and document the following:

- If dimming ballasts are specified for light fixtures within the daylit area, make sure they meet all the Standards requirements, including "reduced flicker operation" for manual dimming control systems.

*NJ.6.3.2 Equipment Testing*Functional Testing

Step 1: Perform manual switching control. Verify and document the following:

- Manual switching or dimming achieves a lighting power reduction of at least 50%.
- The amount of light delivered to the space is uniformly reduced.

NJ.6.4 Automatic Time Switch Control Acceptance

NJ.6.4.1 Construction Inspection

~~Prior to Performance Testing, verify and document the following:~~

- ~~Automatic time switch control is programmed with acceptable weekday, weekend, and holiday (if applicable) schedules.~~
- ~~Document for the owner automatic time switch programming including weekday, weekend, holiday schedules as well as all set-up and preference program settings.~~
- ~~Verify the correct time and date is properly set in the time switch.~~
- ~~Verify the battery is installed and energized.~~
- ~~Override time limit is no more than 2 hours.~~

~~*NJ.6.4.2 Equipment Testing*~~

~~Step 1: Simulate occupied condition. Verify and document the following:~~

- ~~All lights can be turned on and off by their respective area control switch.~~
- ~~Verify the switch only operates lighting in the ceiling-height partitioned area in which the switch is located.~~

~~Step 2: Simulate unoccupied condition. Verify and document the following:~~

- ~~All non-exempt lighting turn off per Section 131 (d)1.~~
- ~~Manual override switch allows only the lights in the selected ceiling height partitioned space where the override switch is located, to turn on or remain on until the next scheduled shut off occurs.~~
- ~~All non-exempt lighting turns off.~~

~~NJ.7~~NA7.5.4. Air Economizer Controls

~~Economizer testing is performed on all built-up systems and on packaged systems per Standards Section 144 (e)1. Air economizers installed by the HVAC system manufacturer and certified to the commission as being factory calibrated and tested do not require field testing.~~

~~*NJ.7.1 Economizer Acceptance*~~

~~*NJ.7*~~*NA7.5.4~~*.1*~~*.1 Construction Inspection*

Prior to ~~Performance~~ Functional Testing, verify and document the following:

- Economizer lockout setpoint complies with Table 144-C per Standards Section 144~~-~~(e)~~-~~3.
- ~~System controls are wired correctly to ensure economizer is fully integrated (i.e. economizer will operate when mechanical cooling is enabled).~~
- Economizer lockout control sensor is located to prevent false readings.~~location is adequate (open to air but not exposed to direct sunlight nor in an enclosure; away from sources of building exhaust; at least 25 feet away from cooling towers)~~.
- ~~Relief fan or return fan (if applicable) operates as necessary when the economizer is enabled to control building pressure.~~
- ~~If no relief fan or return fan is installed, barometric relief dampers are installed to relieve building pressure when the economizer is operating.~~System is designed to provide up to 100% outside air without over-pressurizing the building.
- For systems with DDC controls lockout sensor(s) are either factory calibrated or field calibrated.
- For systems with non-DDC controls, manufacturer's startup and testing procedures have been applied

~~NJ.7~~NA7.5.4~~.1~~.2 ~~Equipment Testing~~Functional Testing

Step 1: Disable demand control ventilation systems (if applicable)

Step ~~1~~2: Enable the economizer and ~~Simulate~~ simulate a cooling ~~load~~ demand ~~and enable the~~ large enough to drive the economizer fully open ~~by adjusting the lockout control (fixed or differential dry-bulb or enthalpy sensor depending on system type) setpoint~~. Verify and document the following:

~~•Economizer damper modulates opens per Standards Section 144 (e)1A to maximum position to satisfy cooling space temperature setpoint.~~

~~•Return air damper modulates closed and is completely closed when economizer damper is 100% open.~~

- Economizer damper is 100% open and return air damper is 100% closed~~before mechanical cooling is enabled~~.
- For systems that meet the criteria of 144(e)1, verify that the economizer remains 100% open when the cooling demand can no longer be met by the economizer alone.
- All~~s~~ applicable fans and ~~Relief~~ dampers ~~fan or return fan (if applicable) is operating or barometric relief dampers freely swing open.~~operate as intended to maintain building pressure.

~~•Mechanical cooling is only enabled if cooling space temperature setpoint is not met with economizer at 100% open.~~

~~•Doors are not pushed ajar from over pressurization.~~

- The unit heating is disabled

Step ~~2~~3: ~~Continue from Step 1 and d~~Disable the economizer ~~by adjusting the lockout control (fixed or differential dry-bulb or enthalpy sensor depending on system type) setpoint~~ and simulate a cooling demand. Verify and document the following:

- Economizer damper closes to its minimum position.
- All~~s~~ applicable fans and dampers operate as intended to maintain building pressure.

~~•Return air damper opens to normal operating position.~~

~~•Relief fan (if applicable) shuts off or barometric relief dampers close. Return fan (if applicable) may still operate even when economizer is disabled.~~

~~•Mechanical cooling remains enabled until cooling space temperature setpoint is met.~~

- The unit heating is disabled

Step 4: Simulate a heating demand and set the economizer so that it is capable of operating (i.e. actual outdoor air conditions are below lockout setpoint). Verify the following:

- The economizer is at minimum position

Step 5~~4~~: Restore demand control ventilation systems (if applicable) and remove all system overrides initiated during the test.

~~NJ.8~~NA7.5.5. Demand Control Ventilation (DCV) Systems

~~Demand control ventilation is tested on package systems per Standards Section 121 (c)3.~~

NJ.8.1 Packaged Systems DCV Acceptance

NJ.8NA7.5.5.1.1 Construction Inspection

Prior to Performance Functional Testing, verify and document the following:

- Carbon dioxide control sensor is factory calibrated (proof required) or field-calibrated per Standard Section 121(c)4. with an accuracy of no less than 75 ppm.
- The sensor is located in the room high density space between 1ft and 6 ft above the floor.
- System controls are wired correctly to ensure proper control of outdoor air damper system.

NJ.8NA7.5.5.1.2 Equipment TestingFunctional Testing

Step 1: Disable economizer controls

Step 12: Simulate a high CO_2 signal load and enable the demand control ventilation by adjusting the demand control ventilation controller setpoint below ambient CO2 levels. Verify and document the following:

- For single zone units, Outdoor outdoor air damper modulates opens per Standards to maximum position to satisfy outdoor air requirements specified in the total value found in the Standards Mechanical Plan Check document MECH-3-C, Column I.
- For multiple zone units, either outdoor air damper or zone damper modulate open to satisfy the zone ventilation requirements.
- Section 121(c).

Step 23: Continue from Step 1 and dSimulate a low CO_2 signalisable demand control ventilation by adjusting the demand control ventilation controller setpoint above ambient CO2 levels. Verify and document the following:

- For single zone units, Outdoor outdoor air damper closes modulates to the design minimum valueto minimum position.
- For multiple zone units, either outdoor air damper or zone damper modulate to satisfy the reduced zone ventilation requirements.

Step 4: Enable economizer controls and simulate conditions that will fully open the economizer damper.

Step 5: Simulate a low CO_2 signal. Verify and document the outside air damper stays fully opened.

Step 6: Restore economizer controls and remove all system overrides initiated during the test.

NJ.9NA7.5.6. Supply Fan Variable Frequency Drive SystemsFlow Controls

NJ.9.1 Supply Fan Variable Flow Controls

NJ.9NA7.5.6.1.1 Construction Inspection

Prior to Performance Functional Testing, verify and document the following:

- Discharge static pressure sensors is are either factory calibrated (proof required) or field-calibrated with secondary source.
- The static pressure location, setpoint and reset control meets the requirements of Standard Section 144(c)2C

~~•**Disable discharge static pressure reset sequences to prevent unwanted interaction while performing tests.**~~

~~**NJ.9**~~**NA7.5.6.~~1~~.2 ~~Equipment Testing~~Functional Testing**

Step 1: ~~Drive all VAV boxes to achieve~~ Simulate demand for design airflow. Verify and document the following:

- ~~Witness proper response from supply fan (e.g. VFD ramps up to full speed; inlet vanes open full)~~Supply fan controls modulate to increase capacity.
- Supply fan maintains discharge static pressure within +/-10% of the current operating set point.~~.~~

~~•Measured maximum airflow corresponds to design and/or TAB report within +/-10%.~~

- ~~System operation~~ Supply fan controls stabilize~~s~~ within a ~~reasonable amount of time~~ 5 minute period~~after test procedures are initiated (no hunting)~~.

Step 2: ~~Drive all VAV boxes to~~ Simulate demand for minimum ~~flow or to achieve 30% total design~~ airflow ~~whichever is larger~~. Verify and document the following:

- ~~Witness proper response from supply fan (VFD slows fan speed; inlet vanes close).~~Supply fan controls modulate to decrease capacity.

~~•Supply fan maintains discharge static pressure within +/-10% of setpoint.~~

~~•System operation stabilizes within a reasonable amount of time after test procedures are initiated (no hunting).~~

- Current operating setpoint has decreased (for systems with DDC to the zone level).
- Supply fan maintains discharge static pressure within +/-10% of the current operating setpoint.
- Supply fan controls stabilize within a 5 minute period.

Step 3: Restore system to correct operating conditions

~~NJ.10. Hydronic System Controls Acceptance~~

~~Hydronic controls Acceptance Testing will be performed on:~~

~~•Variable Flow Controls~~

~~•Automatic Isolation Controls~~

~~•Supply Water Temperature Reset Controls~~

~~•Water-loop Heat Pump Controls~~

~~•Variable Frequency Drive Control~~

~~***NJ.10.1 Variable Flow Controls***~~

~~*NJ.10.1.1 Construction Inspection*~~

~~Prior to Acceptance Testing, verify and document the following:~~

~~•Valve and piping arrangements were installed per the design drawings to achieve flow reduction requirements.~~

~~•Installed valve and hydronic connection pressure ratings meet specifications.~~

~~•Installed valve actuator torque characteristics meet specifications.~~

~~*NJ.10.1.2 Equipment Testing~~*Functional Testing*

~~RStep 1: Open all control valves. Verify and document the following:~~

- ~~System operation achieves design conditions.~~

~~Step 2: Initiate closure of icontrol valves. Verify and document the following:~~

- ~~The design pump flow control strategy achieves flow reduction requirements.~~
- ~~Ensure all valves operate correctly against the minimum flow system pressure condition.~~

~~NJ.10~~NA7.5.7~~.2 Automatic Isolation Controls~~Valve Leakage Test

~~NJ.10~~NA7.5.7~~.2~~1~~.1~~ Construction Inspection

Prior to ~~Acceptance~~ Functional Testing, verify and document the following:

- Valve and piping arrangements were installed per the design drawings ~~to achieve equipment isolation requirements~~.
- ~~Installed valve and hydronic connection pressure ratings meet specifications.~~
- ~~Installed valve actuator torque characteristics meet specifications.~~

~~NJ.10~~NA7.5.7~~.2.2 Equipment Testing~~Functional Testing

Step 1: Dead head the pumps using the discharge isolation valves at the pumps. Document the following:

- Record the differential pressure across the pumps

Step 2: Reopen the pump discharge isolation valves. Automatically close all valves on ~~these~~the systems being tested. If 3-way valves are present, close off the bypass line. Verify and document the following:

- The valves automatically close.
- Record the pressure differential across the pump
- Verify that the pressure differential is within 5% of the reading from Step 1.

Step 3: Restore system to correct operating conditions

~~Step 1: Open all control valves. Verify and document the following:~~

- ~~System operation achieves design conditions.~~

~~Step 2: Initiate shut-down sequence on individual pieces of equipment. Verify and document the following:~~

- ~~The design control strategy meets isolation requirements automatically upon equipment shut-down.~~
- ~~Ensure all valves operate correctly at shut-off system pressure conditions.~~

~~NJ.10~~NA7.5.8~~.3~~ Supply Water Temperature Reset Controls

~~*NJ.10*~~*NA7.5.8~~.3~~.1 Construction Inspection*

Prior to ~~Acceptance~~ Functional Testing, verify and document the following:

- ~~All sensors have been calibrated.~~Supply water temperature sensors have been either factory or field calibrated.
- ~~Sensor locations are adequate to achieve accurate measurements.~~
- ~~Installed sensors comply with specifications.~~

~~*NJ.10*~~*NA7.5.8~~.3~~.2 ~~Equipment Testing~~Functional Testing*

Step 1: Manually change design control variable to maximum setpoint. Verify and document the following:

- Chilled or hot water temperature setpoint is reset to appropriate value.
- Actual supply temperature changes to meet setpoint.

Step 2: Manually change design control variable to minimum setpoint. Verify and document the following:

- Chilled or hot water temperature setpoint is reset to appropriate value.
- Actual supply temperature changes to meet setpoint.

Step 3: Manually change design control variable back to correct condition. Verify and document the following:

- Chilled or hot water temperature set-point is reset to appropriate value.
- Actual supply temperature changes to meet setpoint.

~~NJ.10.4 Water-loop Heat Pump Controls~~

~~*NJ.10.4.1 Construction Inspection*~~

~~Prior to Acceptance Testing, verify and document the following:~~

- ~~Valves were installed per the design drawings to achieve equipment isolation requirements.~~
- ~~Installed valve and hydronic connection pressure ratings meet specifications.~~
- ~~Installed valve actuator torque characteristics meet specifications.~~
- ~~All sensor locations comply with design drawings.~~
- ~~All sensors are calibrated.~~
- ~~VFD minimum speed setpoint exceeds motor manufacturer's requirements.~~
- ~~VFD minimum speed setpoint should not be set below the pumping energy curve inflection point (i.e. combination of pump-motor-VFD efficiency at reduced load may cause power requirements to increase upon further reduction in load).~~

~~*NJ.10.4.2 Equipment Testing*~~

~~Step 1: Open all control valves. Verify and document the following:~~

- ~~System operation achieves design conditions +/- 5%.~~

- ~~VFD operates at 100% speed at full flow conditions.~~

~~Step 2: Initiate shut-down sequence on each individual heat pumps. Verify and document the following:~~

- ~~Isolation valves close automatically upon unit shut-down.~~
- ~~Ensure all valves operate correctly at shut-off system pressure conditions.~~
- ~~Witness proper response from VFD (speed decreases as valves close).~~
- ~~System operation stabilizes within 5 minutes after test procedures are initiated (no hunting).~~

~~Step 3: Adjust system operation to achieve 50% flow. Verify and document the following:~~

- ~~VFD input power less than 30% of design.~~

~~Step 4: Adjust system operation to achieve a flow rate that would result in the VFD operating below minimum speed setpoint. Verify and document the following:~~

- ~~Ensure VFD maintains minimum speed setpoint regardless of system flow operating point.~~

~~NJ.10~~NA7.5.9~~.5~~ Hydronic System Variable ~~Frequency Drive~~ Flow Controls

~~NJ.10~~NA7.5.9~~.5~~.1 Construction Inspection

Prior to ~~Acceptance~~ Functional Testing, verify and document the following:

- ~~All valves, sensors, and equipment were installed per the design drawings.~~
- ~~All installed valves, sensors, and equipment meet specifications.~~
- ~~All~~ Pressure sensors are either factory or field calibrated.
- ~~VFD minimum speed setpoint exceeds motor manufacturer's requirements.~~
- ~~VFD minimum speed setpoint should not be set below the pumping energy curve inflection point (i.e. combination of pump-motor-VFD efficiency characteristics at reduced load may cause input power to increase upon further reduction in load).~~

~~NJ.10~~NA7.5.9~~.5~~.2 ~~Equipment Testing~~Functional Testing

Step 1: Open ~~all~~ control valves to increase water flow ~~(~~to a minimum of 90% design flow~~)~~. Verify and document the following:

- ~~System operation achieves design conditions +/- 5%.~~
- ~~VFD operates at 100% speed at full flow conditions.~~Pump speed increases
- System pressure is either within ±5% of current operating setpoint or the pressure is below the setpoint and the pumps are operating at 100% speed.
- System operation stabilizes within 5 minutes after test procedures are initiated.

Step 2: Modulate control valves ~~closed~~to reduce water flow to 50% of the design flow or less, but not lower than the pump minimum flow. Verify and document the following:

- ~~Ensure all valves operate correctly at system operating pressure conditions.~~

- ~~Witness proper response from VFD (~~Pump speed decreases~~ as valves close)~~.

~~•System operation stabilizes within 5 minutes after test procedures are initiated (no hunting).~~

~~System pressure is within 5% of setpoint~~

- Current operating setpoint has decreased (for systems with DDC to the zone level).
- Current operating setpoint has not increased (for all other systems).
- System pressure is within 5% of current operating setpoint
- System operation stabilizes within 5 minutes after test procedures are initiated.

NA7.5.10 Fault Detection and Diagnostics (FDD) for Packaged Direct-Expansion Units

NA7.5.10.1 Construction Inspection

Verify FDD hardware is installed on equipment by the manufacturer and that equipment make and model include factory-installed FDD hardware that match the information indicated on copies of the manufacturer's cut sheets and on the plans and specifications.

NA7.5.10.2 Functional Testing

1. Test low airflow condition by replacing the existing filter with a dirty filter or appropriate obstruction.
2. Verify that the fault detection and diagnostics system reports the fault.
3. Verify that the system is able to verify the correct refrigerant charge.
4. Calibrate outside air, return air, and supply air temperature sensors.

NA7.5.11 Automatic fault detection and diagnostics (FDD) for air handling units and zone terminal units.

NA7.5.11.1 Functional Testing for Air Handling Units

Testing of each AHU with FDD controls shall include the following tests.

1. Sensor drift/failure:

Step 1: Disconnect outside air temperature sensor from unit controller.

Step 2: Verify that the FDD system reports a fault (question: what kind of notification is required? Email/page?)

Step 3: Connect OAT sensor to the unit controller.

Step 4: Verify that FDD indicates normal system operation.

2. Damper/actuator fault:

Step 1: From the control system workstation, command the mixing box dampers to full open (100% outdoor air).

Step 2: Disconnect power to the actuator and verify that a fault is reported at the control workstation.

Step 3: (Is there an alarm that requires clearing?) Reconnect power to the actuator and command the mixing box dampers to full open.

Step 4: Verify that the control system does not report a fault.

Step 5: From the control system workstation, command the mixing box dampers to a full-closed position (0% outdoor air),

Step 6: Disconnect power to the actuator and verify that a fault is reported at the control workstation.

Step 7: Reconnect power to the actuator and command the dampers closed.

Step 8: Verify that the control system does not report a fault during normal operation.

3. Valve/actuator fault:

From the control system workstation, command the heating and cooling coil valves valve to full open or closed, then disconnect power to the actuator and verify that a fault is reported at the control workstation.

4. Inappropriate simultaneous heating, mechanical cooling, and/or economizing:

Step 1: From the control system workstation, override the heating coil valve and verify that a fault is reported at the control workstation.

Step 2: From the control system workstation, override the cooling coil valve and verify that a fault is reported at the control workstation.

Step 3: From the control system workstation, override the mixing box dampers and verify that a fault is reported at the control workstation.

NA7.5.11.2 Functional Testing for Zone Terminal Units

Testing shall be performed on one of each type of terminal unit (VAV box) in the project. A minimum of 5% of the terminal boxes shall be tested.

1. Sensor drift/failure:

Step 1: Disconnect the tubing to the differential pressure sensor of the VAV box.

Step 2: Verify that control system detects and reports the fault.

Step 3: Reconnect the sensor and verify proper sensor operation.

Step 4: Verify that the control system does not report a fault.

2. Damper/actuator fault:

(a) Damper stuck open.

Step 1: Command the damper to be fully open (room temperature above setpoint).

Step 2: Disconnect the actuator to the damper.

Step 3: Adjust the cooling setpoint so that the room temperature is below the cooling setpoint to command the damper to the minimum position. Verify that the control system reports a fault.

Step 4: Reconnect the actuator and restore to normal operation.

(b) Damper stuck closed.

Step 1: Set the damper to the minimum position.

Step 2: Disconnect the actuator to the damper.

Step 3: Set the cooling setpoint below the room temperature to simulate a call for cooling. Verify that the control system reports a fault.

Step 4: Reconnect the actuator and restore to normal operation.

3. Valve/actuator fault (For systems with hydronic reheat):

Step 1: Command the reheat coil valve to (full) open.

Step 2: Disconnect power to the actuator. Set the heating setpoint temperature to be lower than the current space temperature, to command the valve closed. Verify that the fault is reported at the control workstation.

Step 3: Reconnect the actuator and restore normal operation.

4. Feedback loop tuning fault (unstable airflow):

Step 1: Set the integral coefficient of the box controller to a value 50 times the current value.

Step 2: The damper cycles continuously and airflow is unstable. Verify that the control system detects and reports the fault.

Step 3: Reset the integral coefficient of the controller to the original value to restore normal operation.

5. Disconnected inlet duct:

From the control system workstation, command the damper to full closed, then disconnect power to the actuator and verify that a fault is reported at the control workstation.

~~Step 3: Adjust system operation to achieve 50% flow. Verify and document the following:~~

- ~~VFD input power less than 30% of design.~~

~~Step 4: Adjust system operation to achieve a flow rate that would result in the VFD operating below minimum speed setpoint. Verify and document the following:~~

- ~~Ensure VFD maintains minimum speed setpoint regardless of system flow operating point.~~

NA7.5.12 Thermal Energy Storage DX AC Systems Acceptance Tests

These acceptance requirements apply only to constant or variable volume, direct expansion (DX) systems with distributed energy storage (DES/DXAC). These acceptance requirements are in addition to those for other systems or equipment such as economizers, packaged equipment, etc.

NA7.11.1 Construction Inspection

Prior to Performance Testing, verify and document the following:

- The water tank is filled to the proper level.
- The water tank is sitting on a foundation with adequate structural strength.
- The water tank is insulated and the top cover is in place.
- The DES/DXAC is installed correctly (refrigerant piping, etc.).
- Verify that the correct model number is installed and configured.

NA7.11.2 Equipment Testing

Step 1: Simulate cooling load during Daytime period (e.g. by setting time schedule to include actual time and placing thermostat cooling set-point below actual temperature). Verify and document the following:

- Supply fan operates continually.
- If the DES/DXAC has cooling capacity, DES/DXAC runs to meet the cooling demand (in Ice Melt mode).
- If the DES/DXAC has no ice and there is a call for cooling, the DES/DXAC runs in direct cooling mode.

Step 2: Simulate no cooling load during daytime condition. Verify and document the following:

- Supply fan operates as per the facility thermostat or control system.
- The DES/DXAC and the condensing unit do not run.

Step 3: Simulate no cooling load during morning shoulder time period. Verify and document the following:

- The DES/DXAC is idle.

Step 4: Simulate a cooling load during morning shoulder time period. Verify and document the following:

- The DES/DXAC runs in Direct Cooling mode.

NA7.11.3 Calibrating Controls

- Set the proper time and date, as per manufacturer's installation manual for approved installers.

~~NJ~~NA7.6. Indoor Lighting Control Systems

Lighting control testing is performed on:

- Manual Daylighting Controls.
- Automatic Daylighting Controls.
- Occupancy Sensors.
- Automatic Time-switch Control.

~~NJ~~NA7.6.1 Automatic Daylighting Controls Acceptance

~~NJ~~NA7.6.1.1 Construction Inspection

Prior to ~~Performance Testing~~Functional testing, verify and document the following:

- All control devices (~~photocells~~photocontrols) have been properly located, ~~factory-calibrated (proof required) or~~ field-calibrated and set for appropriate set points and threshold light levels.
- Installer has provided documentation of setpoints, setting and programming for each device.
- Luminaires located in ~~either a horizontal daylit area~~primary or secondary sidelit zone(s) or ~~a vertical daylit~~in skylit area(s) are powered by a separate lighting circuit from non-daylit areas. Compare location of daylighting controlled luminaires against description of sidelit and skylit zones on the building plans.
- Luminaires located in primary or secondary sidelit zone(s) are powered by a separate lighting circuit from skylit area(s)
- If the total area of the primary sidelit area or the total area of the toplit area in an enclosed space is greater than 2,500 sf, the location where calibration adjustments are made is remote from photosensor
- In spaces with ceiling heights greater than 11 feet, the location where calibration adjustments are made is readily accessible to authorized personnel.

~~NJ~~

NA7.6.1.2 ~~Equipment Testing~~Functional testing

All photocontrols serving more than 5,000 square feet of daylit area shall undergo functional testing. Photocontrols that are serving smaller spaces may be sampled as follows:

For buildings with up to five (5) photocontrols, all occupancy sensors shall be tested. For buildings with more than five (5) photocontrols, sampling may be done on spaces with similar sensors and cardinal orientations of glazing. If the first photocontrol in the sample group passes the functional test, the remaining building spaces in the sample group also pass. If any photocontrol in the sample group fails, it shall be repaired or replaced as required until it passes the test. An additional photocontrol in the group shall be selected and tested. This process shall repeat until all photocontrols have passed the test or the photocontrol tested passes on the first testing.

For each photocontrol to be tested do the following:

Continuous Dimming Control Systems

This requirement is for systems that have more than 10 levels of controlled light output in a given zone.

Step 1: Identify the minimum daylighting location in the controlled zone (Reference Location). This can be identified using either the illuminance method or the distance method.

Illuminance Method

- Turn OFF controlled lighting and measure daylight illuminances within zone illuminated by controlled luminaires
- Identify the Reference Location; this is the location with lowest daylight illuminance in the zone illuminated by controlled luminaires. This location will be used for illuminance measurements in subsequent tests.
- Turn controlled lights back ON.

Distance Method

- Identify the location within the zone illuminated by controlled luminaires that is furthest way for daylight sources. This is the Reference Location and will be used for illuminance measurements in subsequent tests.

Step 2 No daylight test. Simulate ~~bright~~or provide conditions ~~for a continuous dimming control system.~~without daylight. Verify and document the following:

- ~~Lighting power reduction is at least 65% under fully dimmed conditions.~~
- ~~At least one control step reduces the lighting power by at least 30%.~~
- ~~Only luminaires in daylit zone are affected by daylight control.~~
- ~~Automatic daylight control system reduces the amount of light delivered to the space uniformly.~~
- Automatic daylight control system provides appropriate control so that electric lighting system is providing full light output unless otherwise specified by design documents.
- Document the Reference Illuminance, which is the electric lighting illuminance level at the Reference Location identified in Step 1.
- Dimming control system provides reduced flicker operation over the entire operating range per Standards Section 119(e)2.
- ~~Lumen measurements in the space, location of measurements and specific device settings, program settings and other measurements are documented.~~

~~Step 2: Simulate dark conditions for a continuous dimming control system.~~

Step 3: Full daylight test. Simulate or provide bright conditions so that the illuminance (fc) from daylight only at the Reference Location identified in Step 1 is greater than the Reference Illuminance (fc) measured at this location during the no daylight test documented in Step 2. Verify and document the following:

- ~~Automatic daylight control system increases the amount of light delivered to the space uniformly.~~Lighting power reduction is at least 65% under fully dimmed conditions and light output is stable with no discernable flicker.
- ~~Dimming control system provides reduced flicker operation over the entire operating range per Standards Section 119(e)2.~~
- ~~Lumen measurements in the space, location of measurements and specific device settings, program settings and other measurements are documented.~~

~~*Stepped Dimming Control Systems*~~

- ~~Step 1: Simulate bright conditions for a stepped dimming control system.~~Only luminaires in daylit zone are affected by daylight control.
- Automatic daylight control system reduces the amount of light delivered to the space uniformly as described in Section 131(b).

Step 4: Partial daylight test. Simulate or provide bright conditions where illuminance (fc) from daylight only at the Reference Location is between 60% and 95% of Reference Illuminance (fc) documented in Step 2. Verify and document the following:

- ~~Lighting power reduction is at least 50% under fully dimmed conditions.~~Measured combined illuminance of daylight and controlled electric lighting (fc) at the Reference Location is no less than the than the electric lighting illuminance (fc) at this location during the no daylight test documented in Step 2,
- Measured combined illuminance of daylight and controlled electric lighting (fc) at the Reference Location is no greater than 150% of the Reference Illuminance (fc) documented in Step 2
- ~~Only luminaires in daylit zone are affected by daylight control.~~
- ~~Automatic daylight control system reduces the amount of light delivered to the space relatively uniformly as per Section 131(b).~~
- ~~Automatic daylight control system reduces the amount of light delivered to the space per manufacturer's specifications for power level verses light level.~~
- ~~Minimum time delay between step changes is 3 minutes to prevent short cycling.~~
- ~~Lumen measurements in the space, location of measurements and specific device settings, program settings and other measurements are documented.~~

~~Step 2: Simulate dark conditions for a stepped dimming control system. Verify and document the following:~~

- ~~Automatic daylight control system increases the amount of light delivered to the space per manufacturer's specifications for power level verses light level.~~
- ~~Stepped dimming control system provides reduced flicker over the entire operating range per Standards Section 119(e)2.~~
- ~~Minimum time delay between step changes is 3 minutes to prevent short cycling.~~
- ~~Lumen measurements in the space, location of measurements and specific device settings, program settings and other measurements are documented.~~

Step 5 Fade rate test. Simulate or provide a dark condition with no daylight at the light sensor and suddenly simulate or provide a bright condition that is greater than the Reference Illuminance (fc) under full daylighting at the light sensor.

- The duration of time required for the control to dim to minimum light output from full light output takes at least 5 seconds (fade time).

Stepped Switching or Stepped Dimming Control Systems

This requirement is for systems that have no more than 10 discrete steps of control of light output.

If the control has three steps of control or less, conduct the following tests for all steps of control. If the control has more than three steps of control, testing three steps of control is sufficient for showing compliance.

Step 1: Identify the minimum daylighting location(s) in the controlled zone

If lighting controls are staged so that one stage is closer to the daylight source, identify a minimum daylighting location for each stage of control. If one stage of control is not closer to the daylight source, select a single minimum daylighting location representing all stages of the control. This minimum daylighting location for each stage of control is designated as the Reference Location for that stage of control and will be used for illuminance measurements in subsequent tests. The Reference Location can be identified using either the illuminance method or the distance method.

Illuminance Method

- Turn OFF controlled lighting and measure daylight illuminances within zone illuminated by controlled luminaires
- Identify the Reference Location; this is the location with lowest daylight illuminance in the zone illuminated by controlled luminaires. This location will be used for illuminance measurements in subsequent tests.
- Turn controlled lights back ON.

Distance Method

- Identify the location within the zone illuminated by controlled luminaires that is furthest way for daylight sources. This is the Reference Location and will be used for illuminance measurements in subsequent tests.

~~Step 1: Simulate bright conditions for a stepped switching control system. Verify and document the following:~~

- ~~Lighting power reduction is at least 50% under fully switched conditions per Standards Section 119(e)1.~~
- ~~Only luminaires in daylit zone are affected by daylight control.~~
- ~~Automatic daylight control system reduces the amount of light delivered to the space relatively uniformly as per Section 131(b).~~
- ~~Automatic daylight control system reduces the amount of light delivered to the space per manufacturer's specifications for power level verses light level.~~
- ~~Single- or multiple-stepped switching controls provide a dead band of at least three minutes between switching thresholds to prevent short cycling.~~
- ~~Lumen measurements in the space, location of measurements and specific device settings, program settings and other measurements are documented.~~

~~Step 2: Simulate dark conditions for a stepped switching control system. Verify and document the following:~~

- ~~Automatic daylight control system increases the amount of light delivered to the space per manufacturer's specifications for power level verses light level.~~
- ~~Single- or multiple-stepped switching controls provide a dead band of at least three minutes between switching thresholds to prevent short cycling.~~
- ~~Lumen measurements in the space, location of measurements and specific device settings, program settings and other measurements are documented.~~

~~NJ~~Step 2: No daylight test. Simulate or provide conditions without daylight for a stepped switching or stepped dimming control system. Verify and document the following:

- If the control is manually adjusted (not self commissioning), make note of the time delay and override time delay or set time delay to minimum setting. This condition shall be in effect through step 4..
- Automatic daylight control system turns ON all stages of controlled lights
- Stepped dimming control system provides reduced flicker over the entire operating range per Standards Section 119(e)2.

- Document the Reference Illuminance(s) which are the electric lighting illuminance level measured at the Reference Location(s) identified in Step 1.

Step 3: Full daylight test. Simulate or provide bright conditions so that the illuminance (fc) from daylight only at all of the Reference Location(s) identified in Step 1 is greater than the corresponding Reference Illuminance(s) documented in Step 2. Verify and document the following:

- Lighting power reduction of controlled luminaires is at least 65%
- Only luminaires in daylit zone s (toplit zone, primary sidelit zone and secondary sidelit zone) are affected by daylight control.
- Automatic daylight control system reduces the amount of light delivered to the space relatively uniformly as per Section 131(b).

Step 4: Partial daylight test. For each stage of control that is tested in this step, the control stages with lower setpoints than the stage tested are left ON and those stages of control with higher setpoints are dimmed or controlled off. Simulate or provide moderately bright conditions to that each control stage turns on and off or dims. Verify and document the following for each control stage

- The measured illuminance contribution from the control stage tested at its corresponding Reference Location.
- The total daylight and electric lighting illuminance level measured at its Reference Location just after the stage of control dims or shuts off the stage of lighting.
    - The total measured illumination shall be no less than the than the Reference Illuminance measured at this location during the no daylight test documented in Step 2.
    - The total measured illumination shall be no greater than 150% of the Reference Illuminance.
- The total daylight and electric lighting illuminance measured at the Reference Location that results in the control stage increasing the light output from the controlled lighting shall be greater than the total daylight and electric lighting illuminance measured at the Reference Location just after the stage of control dims or shuts off the stage of lighting.
- The control stage shall not cycle on and off or cycle between dim and undimmed while daylight illuminance remains constant.
- Only luminaires in daylit zones (toplit zone, primary sidelit zone and secondary sidelit zone) are affected by daylight control.
- Automatic daylight control system reduces the amount of light delivered to the space relatively uniformly as per Section 131(b).

Step 5: Verify time delay.

- Verify that time delay automatically resets to normal mode within 60 minutes
- Set normal mode time delay to at least three minutes.
- Confirm that there is a time delay of at least 3 minutes between the time when illuminance exceeds the setpoint for a given dimming stage and when the control dims or switches off the controlled lights.

NA7.6.2 Occupancy Sensor Acceptance

~~NJ~~NA7.6.2.1 Construction Inspection

Prior to ~~Performance Testing~~Functional testing, verify and document the following:

- Occupancy sensor has been located to minimize false signals.
    - No closer than four (4) feet from HVAC diffuser

- PIR sensor pattern does not enter into adjacent zones

- Occupancy sensors do not encounter any obstructions that could adversely affect desired performance.
- ~~Ultrasound~~ Ultrasonic occupancy sensors do not emit audible sound.

~~NJ~~NA7.6.2.2 ~~Equipment Testing~~Functional testing

For buildings with up to seven (7) occupancy sensors, all occupancy sensors shall be tested. For buildings with more than seven (7) occupancy sensors, sampling may be done on spaces with similar sensors and space geometries. If the first occupancy sensor in the sample group passes the acceptance test, the remaining building spaces in the sample group also pass. If any occupancy sensor in the sample group fails it shall be repaired or replaced as required until it passes the test. An additional sensor in the group shall be selected and tested. This process shall repeat until all sensors have passed the test or the sensor tested passes on the first testing.

For each sensor to be tested do the following:

Step 1: For a representative sample of building spaces, simulate an unoccupied condition. Verify and document the following:

- Lights controlled by occupancy sensors turn off within a maximum of 30 minutes from the start of an unoccupied condition per Standard Section 119(d).
- The occupant sensor does not trigger a false "on" from movement in an area adjacent to the ~~controlled space~~space containing the controlled luminaires or from HVAC operation.
- Signal sensitivity is adequate to achieve desired control.

Step 2: For a representative sample of building spaces, simulate an occupied condition. Verify and document the following:

- Status indicator or annunciator operates correctly.
- Lights controlled by occupancy sensors turn on immediately upon an occupied condition, *OR* sensor indicates space is "occupied" and lights are turned on manually (automatic OFF and manual ON control strategy).

~~NJ~~NA7.6.3 Manual Daylighting Controls Acceptance

~~NJ~~NA7.6.3.1 Construction Inspection

Prior to ~~Performance Testing~~Functional testing, verify and document the following:

- If dimming ballasts are specified for light fixtures within the ~~daylit area~~primary sidelit zone or skylight zone, make sure they meet all the Standards requirements, including "reduced flicker operation" for manual dimming control systems.

~~NJ~~NA7.6.3.2 ~~Equipment Testing~~Functional testing

Step 1: Perform manual switching control. Verify and document the following:

- Only lights in the primary sidelit zone or the skylit zone as defined in Section 131(c) are controlled. Compare daylighting controlled luminaires against description of the primary sidelit and skylit zones on the building plans.
- Manual switching or dimming achieves a lighting power reduction of at least 50%.
- The amount of light delivered to the space is uniformly reduced.

~~NJ~~NA7.6.4 Automatic Time Switch Control Acceptance

~~NJ~~NA7.6.4.1 Construction Inspection

Prior to ~~Performance Testing~~Functional testing, verify and document the following:

- Automatic time switch control is programmed with acceptable weekday, weekend, and holiday (if applicable) schedules.
- Document for the owner automatic time switch programming including weekday, weekend, holiday schedules as well as all set-up and preference program settings.
- Verify the correct time and date is properly set in the time switch.
- Verify the battery back-up (if applicable) is installed and energized.
- Override time limit is set to no more than 2 hours.
- ~~NJ~~Override switches remote from area with controlled luminaires have annunciator lights

NA7.6.4.2 ~~Equipment Testing~~Functional testing

Step 1: Simulate occupied condition. Verify and document the following:

- All lights can be turned on and off by their respective area control switch.
- Verify the switch only operates lighting in the enclosed space (ceiling-height partitioned area) in which the switch is located.

Step 2: Simulate unoccupied condition. Verify and document the following:

- All non-exempt lighting turn off per Section 131 (d)1.
- Manual override switch allows only the lights in the ~~selected~~ enclosed space (ceiling height partitioned ~~space~~) where the override switch is located, to turn on or remain on until the next scheduled shut off occurs.

NA7.7 Outdoor Lighting Acceptance Tests

NA7.7.1 Outdoor Motion Sensor Acceptance

NA7.7.1.1 Construction Inspection

Prior to Functional testing, verify and document the following:

- Motion sensor has been located to minimize false signals
  - Sensor is not triggered by motion outside of adjacent area
- Desired motion sensor coverage is not blocked by obstructions that could adversely affect performance.

NA7.7.1.2 Functional testing

Step 1: Simulate motion in area under lights controlled by the motion sensor. Verify and document the following:

- Status indicator operates correctly.
- Lights controlled by motion sensors turn on immediately upon entry into the area lit by the controlled lights near the motion sensor.

- Signal sensitivity is adequate to achieve desired control.

Step 2: Simulate no motion in area with lighting controlled by the sensor but with adjacent to this area. Verify and document the following:

- Lights controlled by motion sensors turn off within a maximum of 30 minutes from the start of an unoccupied condition per Standard Section 119(d).
- The occupant sensor does not trigger a false "on" from movement outside of the controlled area
- Signal sensitivity is adequate to achieve desired control.

NA7.7.2 Outdoor Lighting Shut-off Controls

NA7.7.2.1 Construction Inspection

Prior to Functional testing, verify and document the following:

- Controls to turn off lights during daytime hours are installed
- Astronomical and standard time switch control is programmed with acceptable weekday, weekend, and holiday (if applicable) schedules.
- Document for the owner time switch programming including weekday, weekend, holiday schedules as well as all set-up and preference program settings.
- Lighting systems that meet the criteria of Section 132(c)2 shall have a scheduling control (time switch) installed which is able to schedule separately:
  - a reduction in outdoor lighting power by 50 to 80%
  - turning off all outdoor lighting covered by Section 132(c)2
- Verify the correct time and date is properly set in the standard and astronomical time switch.
- Verify that the correct latitude, longitude and time zone are set in the astronomical time switch.
- Verify the battery back-up (if applicable) is installed and energized in the standard and astronomical time switch.

NA7.7.2.3 Outdoor Photocontrol Functional testing

Note photocontrol must be used in conjunction with time switch or motion sensor to met requirements of Section 132(c)2.

Step 1: Night time test. Simulate or provide conditions without daylight. Verify and document:

- Controlled lights turn on.

Step 2: Sunrise test: Provide between 10 and 30 horizontal footcandles (fc) to photosensor. Verify and document the following:

- Controlled lights turn off

NA7.7.2.4 Astronomical Time Switch Functional testing

Step 1: Power off test. Program control with location information, local date and time and schedules. Disconnect control from power source for at least 1 hour. Verify and document:

- Control retains all programmed settings and local date and time

Step 2: Night schedule ON test. Simulate or provide times when the sun has set and lights are scheduled to be ON. Verify and document:

- Controlled lights turn on

Step 3: Night schedule OFF test. Simulate or provide times when the sun has set and lights are scheduled to be OFF. Verify and document:

- Controlled lights turn off

Step 4: Sunrise test: Simulate or provide the programmed offset time after the time of local sunrise.

- Controlled lights turn off

NA7.7.2.5 Standard (non-astronomical) Time Switch Functional Testing

Note this control must be used in conjunction with a photocontrol to meet requirements of Section 132(c).

Step 1: Power off test. Program control with local date and time and schedules. Disconnect control from power source for at least 1 hour. Verify and document:

- Control retains all programmed schedules and local date and time

Step 2: On schedule test. Simulate or provide times when lights are scheduled to be ON. Verify and document:

- Controlled lights turn on

Step 3: Schedule test. Simulate or provide times when the sun has set and lights are scheduled to be OFF. Verify and document:

- Controlled lights turn off

NA7.8 Sign Lighting Acceptance Tests

Reserved For Future Use