NONRESIDENTIAL ~~ACM MANUAL~~ APPENDIX ~~NJ~~NA7

Appendix ~~NJ~~NA7 - 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 even if the equipment was not required by the standards.~~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 ensure:

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 to meet the intent of 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 make code compliance ~~can~~ effective~~ly improve code compliance~~ and help ~~determine whether equipment~~ meet~~s~~ 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 ensure 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 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

The building envelope shall meet the acceptance test requirements in the subsections that follow.

NA7.4.1 Fenestration

Acceptance Requirements include acceptance for site-built fenestration including operable and fixed windows, curtain walls, window walls, storefronts, skylights and ~~and unlabeled~~ glazed wall system ~~and for various vertical fenestration~~ were large amount of glass are being installed. Each specified fenestration product will require an NFRC Label certificate with CPD (Certified Product Directory) number matching NFRC's Certified Product Directory, delivery receipt or purchase order, and efficiency ratings match current building plans.

NA7.~~5~~4.1.1 Acceptance Requirements for Site-Built Fenestration

Prior to Acceptance Testing, verify and document the following:

The installing contractor, engineer of record, or owner's agent:

1. Verify building plans that are properly documented specifying ~~thermal~~ energy performance ratings (e.g. U-factor, Solar Heat Gain Coefficient, SHGC, and VT if applicable for daylighting) for each installed fenestration product. ~~and notes to assure the design meets energy compliance with the Energy Efficiency Standards.~~
2. Verifies receipt of delivery or purchase order ~~matches current building plans~~.
3. Verifies copies of the original NFRC Label Certificates or FC-1 or FC-2 are available for review.~~matches NFRC CPD number and~~ ~~purchase order~~
4. Verifies a copy(s) of the site-built fenestration Certificate of Acceptance Form is available to be filled out.~~must be completed by the installing contractor, engineer of record, or agent of the owner prior to receiving an occupancy permit or final permit from the building jurisdiction or designated enforcement agency.~~

NA7.~~5~~4.1.3 Required Documentation

- Fenestration Building Plans:

    - The building plans shall indicate the type and specifications of each fenestration product being installed and cross reference with the label certificates
- Purchase Order (PO) or Detailed Receipt:
    - A copy of the purchase order or a detailed receipt will be used to cross reference with NFRC Label Certificates Products using the Certified Products Directory or using Energy Commissions default values;
- NFRC Individual Product Label Certificate:
    - If installing one fenestration product only use the NFRC Individual Product Label Certificate or either FC-1or FC-2 or;
- NFRC Project Label Certificate and Product Listing:
    - If installing more than one fenestration product use NFRC Project Label Certificate to include the Product Listing sheet or;
- Fenestration Label Certificate-1 (FC-1) or Fenestration Label Certificate-2 (FC-2) to be use with Energy Commission's default values only:
    - If the installed Fenestration is not NFRC certified use FC-1 or FC-2. Use Energy Commission Default Values;
- Certificate of Acceptance Form:
    - The acceptance form, label certificates and purchase order shall be submitted to the building department or jurisdiction for final occupancy permit.

NA7.~~5~~4.1.4 Verification(Outline to be expanded with further details for the acceptance form)

Step 1: Verify that each fenestration product has a label certificate:

- The NFRC Individual Product Label Certificate shall be filled to contain;
    - Product Name, NFRC Certified Product Number (CPD), Operator Type, and Project Location
    - Certification Authorization;
        - Approved Calculation Entity, ACE ID
        - Window Data File Name
- NFRC Project Label Certificate and Product Listing
    - Product Name, NFRC Certified Product Number (CPD), Operator Type, and Project Location
    - Specifying Authority:
        - Company Name, Address, City, State, Zip Code
        - Contact Person, Title, Phone, Fax Number and E-mail
    - Certification Authorization;
        - Approved Calculation Entity, ACE ID
        - Window Data File Name
- Fenestration Label Certificate-1 (FC-1) or Fenestration Label Certificate-2 (FC-2):
    - To be used with Energy Commission's default values only:
    - Standards Default Values
    - Joint Appendices Default Values

- Purchase Order (PO) or Detailed Receipt:
  - PO or Receipt shall match NFRC Label Certificate CPD number and project location;
  - The detailed specifications on the Label Certificate, including U-factor, SHGC and VT, shall match the detailed specifications on the PO or Receipt and shall match the specifications on the building plans
- Fenestration Building Plans:
  - Building plans shall match PO or Receipt
- Acceptance Form:
  - The Acceptance Form shall be filled out and signed by the installing contractor, engineer of record, or individual taking responsibility.

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 Functional Testing

Step 1: If the system has an outdoor air economizer, engage the economizer high limit switch to force the economizer to the minimum position.

Step 2: ~~Drive all VAV boxes~~ Adjust supply airflow to ~~the greater of~~ the sum of the minimum zone airflows, the minimum supply fan speed,~~-~~ 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).~~
- Outside air (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: Release all overrides, restore setpoints and restore the system to automatic control.

~~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~~ a means of maintaining the~~a~~ minimum outdoor air damper position.

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

Step 1: If the system has an outdoor air economizer, engage the economizer high limit switch to force the economizer to the minimum position ~~(e.g., for a fixed drybulb 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)~~.

Step 2: Release all overrides, restore setpoints and restore the system to automatic control.

~~NJ.4~~NA7.5.2 Constant-Volume~~Packaged HVAC~~, Single-Zone, Unitary Air Conditioners and Heat Pumps[1]

~~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-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).
- ~~No h~~Heating is provided by the unit ~~Gas-fired furnace, heat pump or electric heater, if applicable, stages on~~~~The unit provides heating~~.
- 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.~~The unit provides cooling
- 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: Release all overrides, restore setpoints and restore the system to automatic control.

~~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~~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~~NA5.

~~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 ~~call for~~ 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 enable the economizer. Verify the following:

- The economizer is at minimum position

Step 5: Release all overrides, restore setpoints and restore the system to automatic control.

~~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.8~~NA7.5.5.~~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.8~~NA7.5.5.~~1~~.2 ~~Equipment Testing~~Functional Testing

Step 1: Disable economizer controls

Step ~~1~~2: 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 open~~s~~ ~~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 ~~2~~3: ~~Continue from Step 1 and d~~Simulate a low CO_2 signal~~isable 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 value~~to minimum position~~.
- For multiple zone units, either outdoor air damper or zone damper modulates to satisfy the reduced zone ventilation requirements.

Step 3: Release all overrides, restore setpoints and restore the system to automatic control.

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.9NA7.5.6.1.2 Equipment TestingFunctional 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 stabilizes within a reasonable amount of time 5 minute periodafter 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.
- 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: Release all overrides, restore setpoints and restore the system to automatic control.

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 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: Release all overrides, restore setpoints and restore the system to automatic control.

~~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.~~[2]
- ~~Installed sensors comply with specifications.~~[3]

~~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: Release all overrides, restore setpoints and restore the system to automatic control.

~~NJ.10.4 Water-loop Heat Pump Controls~~[4]

~~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.
- The pressure sensor location, setpoint and reset control meets the requirements of Standard Section 144(j)6B
- ~~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[5] 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 closedto 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)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.

Step 3: Release all overrides, restore setpoints and restore the system to automatic control.

NA7.5.10. Automatic Demand Shed Control Acceptance

NA7.5.10.1 Construction Inspection

Prior to Functional Testing, verify and document the following:

- The control system has one or more signals that can be used for automatic demand shed.

NA7.5.10.2 Functional Testing

Step 1: Engage the automatic demand shed signal. Verify and document the following:

- That the cooling and heating setpoints in non-critical spaces increase
- That the cooling and heating setpoints in critical spaces do not change

Step 2: Disengage the automatic demand shed signal. Verify and document the following:

- That the cooling and heating setpoints in non-critical spaces return to their original values
- That the cooling and heating setpoints in critical spaces do not change

Step 3: Release all overrides, restore setpoints and restore the system to automatic control.

NA7.6 Lighting Control Systems[6]

Lighting control testing is performed on:

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

NA7.6.1 Automatic Daylighting Controls Acceptance

NJNA7.6.1.1 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~~NA7.6.1.2 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~~NA7.6.2 Occupancy Sensor Acceptance

~~NJ~~NA7.6.2.1 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~~NA7.6.2.2 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 s*ensor 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, 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~~NA7.6.3.2 Equipment 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~~NA7.6.4 Automatic Time Switch Control Acceptance

~~NJ~~NA7.6.4.1 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~~NA7.6.4.2 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.

End Notes

The following notes are an explanation of the changes that have been made. These notes are not part of the Standard.

[1] Title changed from Constant Volume Packaged HVAC Systems to Constant-Volume Unitary Systems to refer to direct-expansion (DX) equipment. This change was made to make it clear that the tests do not apply to systems without modulating outside air dampers, such as water-loop heat pumps and packaged terminal air conditioners.

[2] Statement to be moved to Compliance Manual.

[3] Statement to be moved to Compliance Manual.

[4] Water loop heat pump controls are covered by the “Hydronic Systems Variable Flow Controls” section.

[5] This is redundant. The statement “control valves” will cover 2-position valves at heat pumps as well as both heating and cooling coil valves.

[6] Revisions to lighting acceptance requirements will be covered at a later workshop. This section was reordered to keep mechanical system acceptance requirements together, but is otherwise unchanged from T24-2005.