

**INSTALLER AND INSPECTOR QUICK-REFERENCE:  
NRCA-ENV-02-F  
Fenestration**

**Purpose and Scope of the Test**

This test is to verify that an NFRC Label Certificate or the California Energy Commission (CEC) Fenestration Certificate (NRCC-ENV-E) is provided for each fenestration product being installed. These certificates identify the thermal performance of the fenestration product (e.g., U-factor, SHGC, and VT).

This test also verifies that the thermal performance of installed fenestration products matches the label certificate, energy compliance documentation, and plan specifications.

**Test trigger**

This test is required for newly installed fenestration, window film, and dynamic glazing in new construction, additions, and alterations for nonresidential, high-rise residential, and hotel/motel buildings.

**Relevant Energy Code References and Required Compliance Documents**

Title 24, Part 6 of the California Building Code, Building Energy Efficiency Standards (Energy Code) sections 110.6, 140.3(a)5, 141.0(b)2A; NA7.4.1, NA7.4.2, NA7.4.3; NRCC-ENV-E

**Who Can Perform the Test**

There are no restrictions.

**Required Tools**

This test visually verifies products are installed correctly, and according to specifications, and does not require special instrumentation.

**Estimated Time to Complete Test**

- Construction inspection: 0.25 to 0.5 hours (per fenestration/window film/dynamic glazing product)

**Potential Issues and Cautions**

For fenestration products that are not rated by NFRC, attach the NRCC-ENV-E to the certificate of acceptance. The NRCC-ENV-E should include the schedule of all installed fenestration products and include thermal performance requirements for nonrated fenestration products.

**INSTALLER AND INSPECTOR QUICK-REFERENCE:  
NRCA-ENV-02-F  
Fenestration**

**Inspection Enforcement**

Required:

- Verify that the certificate of installation NRCI-ENV-01-E is complete, and that the declaration statement is signed by the responsible person.
- Verify that the certificate of acceptance NRCA-ENV-02-F is complete, and that the declaration statement is signed by the responsible person.

**Acceptance Criteria**

For fenestration, verify the following:

- The thermal performance for each fenestration product matches the building plans, energy compliance documentation, and the label certificate.
- The delivery receipt or purchase order matches the delivered fenestration product(s).
- Verify the NFRC Label Certificate is filled out and includes an NFRC's Certified Product Directory (CPD) number and a Certificate Number (when the Component Modeling Approach Label is submitted).
- For non-rated fenestration verify Fenestration Certificate of Compliance (NRCC-ENV-E) is completely filled.
- The Certificate of Acceptance form is completed and signed.

For window film, verify:

- The window film(s) label on the box matches the Certificate of Installation and building plan's schedule, U-factor, SHGC, and VT for each of the installed window films.
- After window film inspection, complete all parts of the Certificate of Acceptance, including the signature of the Declaration Statements.

For dynamic glazing, verify:

- When controls are installed with the dynamic glazing, verify they meet the exact operation specifications of the dynamic glazing installation, functional and testing instructions.

Follow the **Construction Inspection** instruction on NRCA-ENV-02-F.

**INSTALLER AND INSPECTOR QUICK-REFERENCE:  
NRCA-ENV-03-F  
Daylighting Design Power Adjustment Factors**

**Purpose and Scope of the Test**

The purpose of the test is to ensure that clerestory windows, interior and exterior horizontal slats, and interior and exterior light shelves meet the daylighting design requirements in the Energy Code when claiming a power adjustment factor (PAF). These daylighting design features increase the amount of daylighting that can enter a space, thus reducing the need for electric lighting during the day. When used in conjunction with automatic daylighting controls, a significant amount of energy can be saved. Spaces that have clerestory windows, horizontal slats, or light shelves, and compliant automatic daylighting controls may receive a power adjustment factor if the daylighting feature meets the design criteria in the Energy Code.

**Test Trigger**

This test is required to qualify for PAFs for clearstory fenestration, interior and exterior horizontal slats, and interior and exterior light shelves in nonresidential, hotel/motel, and high-rise multifamily buildings.

**Relevant Energy Code References and Required Compliance Documents**

Title 24, Part 6 of the California Building Code, Building Energy Efficiency Standards sections 140.3(d), 140.6(a)2L, 110.6(a)6, Nonresidential Appendix NA7.4.4, NA7.4.5, NA7.4.6

Design Document: NRCC-ENV-E

**Who Can Perform the Test**

There are no restrictions. The installing contractor will typically perform this test.

**Required Tools**

A tape measure is necessary to measure the dimensions of the daylighting feature and to verify that the design criteria is met.

**Estimated Time to Complete Test**

Construction inspection: 0.25 to 0.5 hours (per daylighting feature)

**INSTALLER AND INSPECTOR QUICK-REFERENCE:  
NRCA-ENV-03-F  
Daylighting Design Power Adjustment Factors**

**Potential Issues and Cautions**

Each horizontal slat assembly should be accompanied with documentation of visible reflectance testing per ASTM E903 and may come with documentation of visible transmittance testing per ASTM E1175.

Each interior light shelf shall be provided with documentation of visible reflectance testing per ASTM E903. Exterior light shelves may be provided with documentation of visible reflectance testing per ASTM E903.

The documentation shall be located at the job site for verification by the ENFORCEMENT AGENCY.

**Inspection Enforcement**

Required:

- Verify that the certificate of installation NRCI-ENV-01-E is complete, and that the declaration statement is signed by the responsible person.
- Verify that the construction inspection and functional testing items on NRCA-ENV-03-F are marked with "Complies."
- Verify that all declaration statements on the last page of the NRCA-ENV-03-F are complete and that the document is signed.

**Acceptance Criteria**

The installation of the daylighting feature meets the manufacturer's instructions.

The installation of the daylighting feature matches the specifications shown on the building plans.

The daylighting feature is permanently mounted.

The installer has completed and signed the certificate of installation NRCI-ENV-01-E.

Clerestory fenestration:

- If operable shading is installed on the clerestory fenestration, it is controlled separately from other fenestration shading control.

Interior and exterior horizontal slats:

- There is a factory installed label permanently affixed and prominently located at a mounting point of the slat to the building.
- The visible reflectance on the ASTM E903 test results match the building plans.
- If the horizontal slat surfaces are not opaque and free of perforations, the horizontal slat ASTM E1175 test results match the building plans.

**INSTALLER AND INSPECTOR QUICK-REFERENCE:  
NRCA-ENV-03-F  
Daylighting Design Power Adjustment Factors**

**Acceptance Criteria (Cont.)**

- The horizontal slat assemblies extend the entire height of the window.
- The exterior horizontal slats are horizontal or slope downwards from the window and the interior horizontal slats are horizontal or slope upwards from the window.

Interior and exterior light shelves:

- The visible reflectance on the ASTM E903 test results of the interior light shelf matches the building plans.
- The visible reflectance on the ASTM E903 test results of the exterior light shelf matches the building plans if the exterior light shelf is less than two feet below the clerestory windowsill.
- The interior light shelves are horizontal.
- The exterior light shelf is horizontal or slopes downwards from the window.
- If operable shading is installed on the clerestory fenestration, it is controlled separately from other fenestration shading control.

Follow the **Construction Inspection** instruction on NRCA-ENV-03-F.

**INSTALLER AND INSPECTOR QUICK-REFERENCE:  
NRCA-LTI-02-A**

**Occupant Sensing Lighting Controls**

**Purpose and Scope of the Test**

The purpose of the test is to ensure that occupant sensing controls are functioning properly to achieve the desired lighting control.

Occupant sensing controls are used to automatically turn lights on when a space is occupied, and automatically reduce or turn lighting off when the space is vacated after a pre-set time delay. The time delay will prevent lights from rapidly cycling on and off when spaces are occupied frequently but temporarily. It also helps avoid false triggering when there is minimal occupant movement. Other types of occupant sensing controls include vacancy, partial-ON, and partial-OFF:

- Vacancy sensing controls automatically turn lighting off when a space is unoccupied but requires lights to be turned on manually when the space is occupied.
- Partial-ON occupant sensing controls automatically turn lighting off when a space is unoccupied and automatically turn on part of the lighting load when the space is occupied.
- Partial-OFF occupant sensing controls automatically reduce lighting load when the space is unoccupied and automatically turns lighting on when the space is occupied.

Occupant sensing controls reduce energy waste by ensuring that lighting is off or reduced when not needed.

**Test Trigger**

This test is required when occupant sensing controls are installed in nonresidential, high-rise residential, and hotel/motel buildings. All installed indoor lighting must be controlled by shut off controls. Sections 130.1(c)5-130.1(c)7 require occupant sensing controls for specified space types.

**Relevant Energy Code References and Required Compliance Documents**

Title 24, Part 6 of the California Building Code, Building Energy Efficiency Standards sections 130.1(c)1, 130.1(c)5-7, 130.4(a); NA7.6.2.2, NA7.6.2.3; NRCC-LTI-E

**Who Can Perform the Test**

This test must be performed by an acceptance test technician certified by a CEC-approved Acceptance Test Technician Certification Provider, using compliance document NRCA-LTI-02-A.

**INSTALLER AND INSPECTOR QUICK-REFERENCE:  
NRCA-LTI-02-A**

**Occupant Sensing Lighting Controls**

**Required Tools**

This test verifies the functionality of installed occupant sensing controls visually and does not require special instrumentation.

**Estimated Time to Complete Test**

Construction inspection: 0.25 to 0.5 hours (depending on visual and audible inspection requirements)

Functional testing: 0.5 to 1 hours (depending on necessity to adjust time delay or mask sensor to prevent false triggers)

**Potential Issues and Cautions**

It is important that the test be performed during a time when the acceptance test technician can have full control over the occupancy of the space.

The time delay can be adjusted to minimize test time, but the time delay setting must be reset upon completion of the test (not to exceed 20 minutes).

Detection of air movement from a heating, ventilation, and air conditioning (HVAC) diffuser or other source can cause the sensor to turn the lights on (this is most critical with ultrasonic sensors). This can be avoided by ensuring that the occupant sensing control is located away from diffusers per applicable manufacturer instructions.

If motion in an adjacent area is causing an unwanted trigger, the technician may adjust the coverage pattern intensity or mask the sensor with an opaque material.

**Inspection Enforcement**

Required:

- Verify that the construction inspection and functional testing items on NRCA-LTI-02-A are marked with "Complies."
- Verify the contact information of the acceptance test technician is complete with the acceptance test technician certification number.
- Verify that all declaration statements on the last page of the NRCA-LTI-02-A are complete and that the document is signed.

**INSTALLER AND INSPECTOR QUICK-REFERENCE:  
NRCA-LTI-02-A**

**Occupant Sensing Lighting Controls**

**Acceptance Criteria**

Occupant sensing lighting control is installed per manufacturer's instructions to minimize false triggering.

Status indicator or annunciator operates correctly.

When a space is occupied:

- Occupant sensing control turns controlled lighting ON immediately.
- Vacancy sensing control requires the occupant to manually switch controlled lighting on.
- Partial-ON occupant sensing control activates between 50-70 percent of the controlled lighting power and the occupant has the ability to manually activate 100 percent of the controlled lighting power.

When a space is unoccupied:

- Occupant sensing control reduces or turns controlled lighting OFF at the pre-set time delay.
- Partial-OFF occupant sensing controls reduce controlled lighting power by at least 50 percent.
- The programmed maximum time delay is not greater than 20 minutes.
- Occupant sensing lighting control is installed per manufacturer's instructions to minimize false triggering such as to install an occupancy sensor away from HVAC diffusers to avoid probable false triggering.

Follow the **Construction Inspection** and **Functional Testing** instruction on NRCA-LTI-02-A.



**INSTALLER AND INSPECTOR QUICK-REFERENCE:  
NRCA-LTI-02-A  
Automatic Time Switch Controls**

**Purpose and Scope of the Test**

This test ensures that indoor lighting controlled by an automatic time switch control turns lighting on and off according to a programmed schedule and that manual override controls turn lighting on during scheduled off periods. Turning lighting off during typically unoccupied periods prevents energy waste.

**Test Trigger**

This test is required when automatic time-switch lighting controls are installed for nonresidential, high-rise residential, and hotel/motel buildings. All installed indoor lighting must be controlled by shut off controls.

**Relevant Energy Code References and Required Compliance Documents**

Title 24, Part 6 of the California Building Code, Building Energy Efficiency Standards sections 130.1(c)1, 130.1(c)3, 130.1(c)4, 130.4(a); NA7.6.2; NRCC-LTI-E

**Who Can Perform the Test**

This test must be performed by an acceptance test technician certified by a CEC-approved Acceptance Test Technician Certification Provider, using compliance document NRCA-LTI-02-A.

**Required Tools**

This test verifies the functionality of installed automatic time switch controls visually and does not require special instrumentation.

**Estimated Time to Complete Test**

Construction inspection: 0.5 to 2 hours (depending on familiarity with lighting control programming language)  
Functional testing: 2 to 6 hours (depending on familiarity with lighting control programming language, number of lighting circuits and override switches to be tested, and programmed time delays between ON and OFF signals)

**Potential Issues and Cautions**

The manual override time limit can be adjusted to minimize test time, but the time limit setting must be reset upon completion of the test (not to exceed 2 hours). When possible, perform the test when the spaces are unoccupied. Turning the lights off when other occupants are present can cause problems and unsafe working conditions.

**INSTALLER AND INSPECTOR QUICK-REFERENCE:  
NRCA-LTI-02-A**

**Automatic Time Switch Controls**

**Inspection Enforcement**

Required:

- Verify that the construction inspection and functional testing items on NRCA-LTI-02-A are marked with "Complies."
- Verify the contact information of the acceptance test technician is complete with the acceptance test technician certification number.
- Verify that all declaration statements on the last page of the NRCA-LTI-02-A are complete and that the document is signed.

**Acceptance Criteria**

Automatic time switch controls are programmed with acceptable weekday, weekend, and holiday schedules, per building occupancy profile.

The correct date and time are set in the lighting controller.

Program backup capabilities are present to prevent the loss of the device's schedules for at least 7 days, and the device's time and date setting for at least 72 hours if power is interrupted.

All lights turn on during the occupied time schedule.

All lights turn off automatically at the scheduled times.

The manual override switch is functional and turns associated lights ON when activated.

Manual override time limit is no more than 2 hours, except for spaces that are exempt per section 130.1(c)3B.

Manual override switches remote from the area with controlled luminaires allow the user to see the controlled luminaires or have a visual signal or display showing the state of controlled luminaires.

Follow the **Construction Inspection** and **Functional Testing** instruction on NRCA-LTI-02-A.

**INSTALLER AND INSPECTOR QUICK-REFERENCE:  
NRCA-LTO-02-A  
Outdoor Lighting Controls**

**Purpose and Scope of the Test**

The purpose of these tests is to ensure that all outdoor lighting regulated by section 130.2(c) is controlled by a motion sensor, photocontrol, astronomical time-switch control, and automatic scheduling control, as required.

Outdoor lighting controls prevent energy waste by ensuring that lighting is automatically turned off during the day and reduced or turned off when not needed during nighttime hours.

**Test Trigger**

Applies to functional testing and verification of outdoor lighting controls which include photocontrols, motion sensors, astronomical time-switch controls, and scheduling controls for outdoor lighting systems. These controls are required for nonresidential, high-rise residential, and hotel/motel buildings.

Exceptions:

- Lighting that cannot be turned off or reduced due to a health or life safety statute, ordinance, or regulation.
- Lighting in tunnels required to always be on.

**Relevant Energy Code References and Required Compliance Documents**

Title 24, Part 6 of the California Building Code, Building Energy Efficiency Standards sections 130.2(c), 130.4(a)1; NA7.8; NRCC-LTO-E

**Who Can Perform the Test**

This test must be performed by an acceptance test technician certified by a CEC-approved Acceptance Test Technician Certification Provider, using compliance document NRCA-LTO-02-A.

**Required Tools**

This test verifies the functionality of installed automatic controls visually and does not require special instrumentation.

**Estimated Time to Complete Test**

Construction inspection: 0.5 to 2 hours (depending on familiarity with lighting control programming language)

Functional testing: 0.5 to 2 hours (depending on familiarity with lighting control programming language, number of lighting circuits to be tested)

**INSTALLER AND INSPECTOR QUICK-REFERENCE:  
NRCA-LTO-02-A**

**Outdoor Lighting Shut-off Controls**

**Potential Issues and Cautions**

No potential issues known.

**Inspection Enforcement**

Required:

- Verify that the construction inspection and functional testing items in NRCA-LTO-02-A are marked with "Complies."
- Verify the contact information of the acceptance test technician is complete with the acceptance test technician certification number.
- Verify that all declaration statements on the last page of the NRCA-LTO-02-A are complete and that the document is signed.

**Acceptance Criteria**

Lighting turns off when daylight is available.

Automatic scheduling controls:

- Lighting power reduces by at least 50 percent but no more than 90 percent.
- The correct date and time are set.
- The control is programmed with on and off schedules, including weekday, weekend, and holiday schedules.

Motion sensors:

- Reduce lighting power by at least 50 percent but no more than 90 percent.
- Reduce lighting to "dim" or off state no longer than 15 minutes after area has been vacated.
- Turn lighting on when area is occupied.

Follow the **Construction Inspection** and **Functional Testing** instruction on NRCA-LTO-02-E.

**INSTALLER AND INSPECTOR QUICK-REFERENCE:  
NRCA-LTI-03-A**

**Automatic Daylighting Control**

**Purpose and Scope of the Test**

The purpose of this test is to ensure automatic daylighting controls are installed and functioning as required by the Energy Code.

Automatic daylighting controls save energy only if they are functioning correctly. Controls passing the test provide adequate illuminance for all daylight conditions by automatically adjusting the electric lighting power in response to available daylight in the space. These controls can save a significant amount of lighting energy. If the control leaves the space too dark, visual quality is compromised and ultimately the control will be over-ridden resulting in no energy savings. If the control leaves lighting on at too high a level, the full savings from the control are not realized.

**Test Trigger**

This test is required when automatic daylighting controls are installed in nonresidential, high-rise residential, and hotel/motel buildings. General lighting within a daylit zone must be controlled by automatic daylighting controls.

Automatic daylighting controls are required if the combined total installed power of general lighting in a room's skylit and primary sidelit daylit zones is at least 120 watts and if the room has at least 24 square feet of glazing.

Automatic daylighting controls are required in parking garages if the total installed power of general lighting in the combined primary and secondary sidelit daylit zone is at least 60 watts and if the parking garage has at least 36 square feet of glazing or opening.

The lighting must have multiple stages of control that meet the uniformity requirements of Table 130.1-A and section 130.1(d)3A.

See section 130.1(d) for exceptions to automatic daylighting control requirements.

**Relevant Energy Code References and Required Compliance Documents**

Title 24, Part 6 of the California Building Code, Building Energy Efficiency Standards sections 130.1(d), 130.4(a); NA7.6.1; NRCC-LTI-E

**Who Can Perform the Test**

This test must be performed by an acceptance test technician certified by a CEC-approved Acceptance Test Technician Certification Provider, using compliance document NRCA-LTI-03-A.

**INSTALLER AND INSPECTOR QUICK-REFERENCE:  
NRCA-LTI-03-A**

**Automatic Daylighting Control**

**Required Tools**

To perform the test, it will be necessary to measure ambient light levels and validate overall power reduction. In most cases, the only instrumentation required is:

- Light meter (illuminance or foot-candle meter).

For dimming ballasts, a default illuminance/power relationship can be used to estimate power consumption.

Alternatively, the tester can choose to directly measure power or current or use the manufacturer's dimming performance data. If so, the following additional instrumentation or data may be needed:

- Hand-held amperage meter or power meter.
- Logging light meter or power meter.
- Manufacturer's light output versus power curve for continuous dimming and step dimming ballasts.

**Estimated Time to Complete Test**

Construction Inspection: 0.5 to 1 hours (depending on whether sensor calibration is necessary, familiarity with lighting control programming language, and availability of construction documentation – i.e., electrical drawings, material cut sheets, etc.)

Functional Testing: 1 to 3 hours (depending on ability to manipulate ambient light levels, familiarity with lighting control programming language, and method employed for verifying required power reduction)

**Potential Issues and Cautions**

Simulating bright conditions and achieving proper luminance to perform the test can be difficult. Therefore, it is recommended that the test be performed under natural bright light conditions. Bright conditions may also be simulated by shining a light into the photosensor.

For the no-daylight test, it may be necessary to conduct the test at night when daylight is not present, or cover fenestration to prevent daylight from entering the space.

**INSTALLER AND INSPECTOR QUICK-REFERENCE:  
NRCA-LTI-03-A**

**Automatic Daylighting Control**

**Inspection Enforcement**

Required:

- Verify that the construction inspection and functional testing items on NRCA-LTI-03-A are marked with "Complies."
- Verify the contact information of the acceptance test technician is complete with the acceptance test technician certification number.
- Verify that all declaration statements on the last page of the NRCA-LTI-03-A are complete and that the document is signed.

**Acceptance Criteria**

All daylit zones are shown on the plans.

Automatic daylighting controls provide separate control of general lighting in each type of daylit zone and separately from lighting outside the daylit zone.

In parking garages, automatic daylighting controls provide control of general lighting in the combined primary sidelit and secondary sidelit daylit zone and separately from lighting outside the daylit zone.

Photosensors are located so that they are not readily accessible to unauthorized personnel. "Readily accessible" is defined as capable of being reached quickly for operation, repair or inspection, without requiring climbing or removing obstacles, or resorting to access equipment.

The location where calibration adjustments are made to automatic daylighting controls is readily accessible to authorized personnel. This could be inside a locked case or under a cover which requires a tool for access.

Automatic daylighting controls provide multi-level control capability following the uniformity requirements in section 130.1(b).

Luminaires do not produce visible flicker at reduced light output.

Under partial daylight conditions:

- The combined daylight and electric lighting illuminance at the reference location is no less than the reference illuminance and no greater than 150 percent of the reference illuminance.
- Reference location is the task location that receives the least amount of daylight in a daylit zone. Usually this is a location that is furthest away from the windows or skylights but is still served by the controlled lighting equipment.

**INSTALLER AND INSPECTOR QUICK-REFERENCE:  
NRCA-LTI-03-A**

**Automatic Daylighting Control**

**Acceptance Criteria (cont.)**

- Reference illuminance is the illuminance from electric lighting when no daylight is available at the reference location.

Under no daylight conditions:

- The control system increases the light output of each fixture to the design light output. This may be full output, but in a space with institutional tuning controls, this could be commissioned to meet the design illuminance requirements.

Under full daylight conditions when daylight illuminance is greater than 150 percent of the reference illuminance:

- Lighting power of controlled luminaires is reduced to no greater than 35 percent of full-load power.
- For parking garages, lighting power of controlled luminaires is reduced by 100 percent (off).

Follow the **Construction Inspection** and **Functional Testing** instruction on NRCA-LTI-03-A.



**INSTALLER AND INSPECTOR QUICK-REFERENCE:  
NRCA-LTI-04-A  
Demand Responsive Lighting and Receptacle Control**

**Purpose and Scope of the Test**

The purpose of the test is to ensure that demand responsive controls can reduce lighting power of the building to at least 85 percent of full power. The test also confirms that the lighting system produces a uniform level of illumination during a demand response event. There are two methods that may be used to perform the test. Method 1 uses illuminance measurements to determine the reduction in lighting power for each controlled space. Method 2 uses current measurements to determine reduction in lighting power for each controlled space.

Demand responsive controls allow building loads to be managed automatically in response to grid or economic needs. The decision to employ demand response is up to the building owner or manager, in coordination with their utility company and/or a governing authority.

Demand responsive controls can help building owners save energy and reduce electricity bills by automatically reducing noncritical building loads when electricity demand is at a peak.

**Test Trigger**

This test is required when demand responsive lighting controls are installed in nonresidential, high-rise residential, and hotel/motel buildings. Demand responsive lighting controls are required for:

- Newly constructed buildings larger than 10,000 ft<sup>2</sup>.
- Lighting alterations and additions to buildings where the space altered or added is larger than 10,000 ft<sup>2</sup>.

Exception: Spaces where a health or life safety statute, ordinance, or regulation does not permit the general lighting to be reduced are not required to install demand responsive controls and do not count toward the 10,000 ft<sup>2</sup> threshold.

**Relevant Energy Code References and Required Compliance Documents**

Title 24, Part 6 of the California Building Code, Building Energy Efficiency Standards sections 110.12(a), 110.12(c), 130.1(e), 130.4(a); NA7.6.3; NRCC-LTI-E

**Who Can Perform the Test**

This test must be performed by an acceptance test technician certified by a CEC-approved Acceptance Test Technician Certification Provider, using compliance document NRCA-LTI-04-A.

<b>INSTALLER AND INSPECTOR QUICK-REFERENCE: NRCA-LTI-04-A Demand Responsive Lighting and Receptacle Control</b>	
<b>Required Tools</b>	
This test requires an illuminance meter or a power meter (with a current transformer and voltmeter). Alternatively, if the lighting system has an inbuilt method of measuring (not estimating) the lighting power being consumed, this inbuilt measurement may be used instead.	
<b>Estimated Time to Complete Test</b>	
Construction inspection: 0.25 to 0.5 hours Functional testing: 0.5 to 1 hours (depending on the number of controlled luminaires)	
<b>Potential Issues and Cautions</b>	
<p>If using method 1 (illuminance measurement), mark the exact locations in which the illuminance measurements were made, because even slight differences in the location of the illuminance meter, or the angle at which it is held, can affect the readings. If possible, take readings away from shadowed areas.</p> <p>If illuminance measurements or power measurements are taken in daylight areas with photocontrols, the values can change very significantly in just a few minutes, due to changes in daylight availability. Try to take measurements as far from sources of daylight as possible.</p>	
<b>Inspection Enforcement</b>	
<p>Required:</p> <ul style="list-style-type: none"> <li>• Verify that the construction inspection and functional testing items on NRCA-LTI-04-A are marked with "Complies."</li> <li>• Verify the contact information of the acceptance test technician is complete with the acceptance test technician certification number.</li> <li>• Verify that all declaration statements on the last page of the NRCA-LTI-04-A are complete and that the document is signed.</li> </ul>	

**INSTALLER AND INSPECTOR QUICK-REFERENCE:  
NRCA-LTI-04-A**

**Demand Responsive Lighting and Receptacle Control**

**Acceptance Criteria**

When a demand response signal is received, the control reduces lighting power to at least 85 percent of "full output." Full output is defined in the field test as being the output of the lighting system when all manual switches are on, but some luminaires may be dimmed or switched below their maximum output because they are controlled by automatic systems such as photocontrols and occupant/vacancy sensors.

The illuminance in the demand response condition must not be less than the illuminance of the lighting system set to minimum output condition. This will ensure that light levels do not go below any pre-set minimums that have been determined, for instance, by facilities managers. This is the purpose of the "minimum output test."

Follow the **Construction Inspection** and **Functional Testing** instruction on NRCA-LTI-04-A.

**INSTALLER AND INSPECTOR QUICK-REFERENCE:  
NRCA-LTI-05-A**

**Institutional Tuning Power Adjustment Factor**

**Purpose and Scope**

Institutional tuning is the process of adjusting the maximum light output of lighting systems to support visual needs or save energy. Institutional tuning differs from personal tuning in that the control strategy is implemented at the institutional rather than the individual user level, and maximum light level adjustments are available only to authorized personnel.

Completion of this acceptance test certifies that lighting systems receiving the institutional tuning PAF comply with section 140.6(a)2J and Reference Nonresidential Appendix NA7.7.5.

**Test Trigger**

This test is required when institutional tuning controls are installed to qualify for a PAF in nonresidential lighting systems.

**Relevant Energy Code References and Required Compliance Documents**

Title 24, Part 6 of the California Building Code, Building Energy Efficiency Standards sections 140.6(a)2J, 130.4(a); NA7.7.5; NRCC-LTI-E

**Who Can Perform the Test**

This test must be performed by an acceptance test technician certified by a CEC-approved Acceptance Test Technician Certification Provider, using compliance document NRCA-LTI-05-A.

**Required Tools**

- Light meter (luminance or foot-candle meter).
- Hand-held amperage meter or power meter.
- Logging light meter or power meter.

**Estimated Time to Complete Test**

Construction inspection: 0.25 to 0.5 hours  
Functional testing: 0.5 to 1 hours (depending on the number of controlled luminaires)

**INSTALLER AND INSPECTOR QUICK-REFERENCE:  
NRCA-LTI-05-A**

**Institutional Tuning Power Adjustment Factor**

**Potential Issues and Cautions**

Luminaries that qualify for other PAFs may also qualify for the institutional tuning PAF. However, PAFs may only be added together if permitted in Table 140.6-A of the Energy Code.

**Inspection Enforcement**

Required:

- Verify that the construction inspection and functional testing items in NRCA-LTI-05-A are marked with "Complies."
- Verify the contact information of the acceptance test technician is complete with the acceptance test technician certification number.
- Verify that all declaration statements on the last page of the NRCA-LTI-05-A are complete and that the document is signed.

**Acceptance Criteria**

To qualify for a PAF, the tuned lighting system shall comply with all of the following requirements:

- The lighting controls shall limit the maximum light output or maximum power draw of the controlled lighting to 85 percent or less of full light output or full power draw.
- The means of setting the limit is accessible only to authorized personnel.
- The setting of the limit is verified by the acceptance test.
- The construction documents specify which lighting systems shall have their maximum light output or maximum power draw set to no greater than 85 percent of full light output or full power draw.

Follow the **Construction Inspection** and **Functional Testing** instruction on NRCA-LTI-05-A.

<b>INSTALLER and INSPECTOR QUICK-REFERENCE: NRCA-MCH-02-A Variable Air Volume Systems Outdoor Air Acceptance</b>	
<b>Purpose and Scope of the Test</b>	
<p>This test ensures the provision of adequate outdoor air ventilation through the variable air volume air handling unit at two representative operating conditions. The test consists of measuring outdoor air values at maximum flow and at or near minimum flow. The test verifies the introduction of a minimum volume of outdoor air, in accordance with section 120.1(b)2, into the air handling unit and is within 10 percent of the required volume when the system is in occupied mode at these two conditions of supply airflow.</p> <p>Perform this test in conjunction with NA7.5.6 Supply Fan Variable Flow Controls Acceptance test procedures (NRCA-MCH-07-A) to reduce the overall system testing time as both tests use the same two conditions of airflow for their measurements. Related acceptance tests for these systems include:</p> <ul style="list-style-type: none"> <li>• NA7.5.4 Air Economizer Controls.</li> <li>• NA7.5.5 Demand Control Ventilation (DCV) Systems (if applicable).</li> <li>• NA7.5.6 Supply Fan Variable Flow Controls.</li> </ul>	
<b>Test trigger</b>	
Newly constructed and additions/alterations: Applies to new variable air volume (VAV) systems.	
<b>Relevant Energy Code References and Required Compliance Documents</b>	
Title 24, Part 6 of the California Building Code, Building Energy Efficiency Standards sections 120.1(b)2, 120.5(a)1; and NA 7.5.1.1, NA7.5.1.2	
<b>Who Can Perform the Test</b>	
This test must be performed by an acceptance test technician certified by a CEC-approved Acceptance Test Technician Certification Provider, using compliance document NRCA-MCH-02-A.	

<b>INSTALLER and INSPECTOR QUICK-REFERENCE: NRCA-MCH-02-A Variable Air Volume Systems Outdoor Air Acceptance</b>	
<b>Required Tools</b>	
<p>Performance of this test will require measuring outdoor air flow. When the system includes an airflow monitoring system (AFMS) on the outdoor air, then it may be used for the measurements if it has a calibration certificate or is field-calibrated. The instrumentation needed to perform the test may include, but is not limited to:</p> <ul style="list-style-type: none"> <li>• An airflow measurement probe (for example, hot-wire anemometer or velocity pressure probe).</li> <li>• A watch or some equivalent device to measure time in minutes.</li> </ul>	
<b>Estimated Time to Complete Test</b>	
<p>Construction Inspection: 0.5 to 2 hours, depending on complexity and difficulty in calibrating the "system" controlling outdoor air flow</p> <p>Functional testing: 1 to 3 hours, depending on the type of zone control and the number of zones</p>	
<b>Potential Issues and Cautions</b>	
<ul style="list-style-type: none"> <li>• Use caution when performing test during winter months in cold climates. Since outdoor airflow must remain constant with reduced supply fan flow, total supply flow can approach 100 percent outdoor air. Be sure that all freeze protection and heating coil controls are functioning before performing test.</li> <li>• Coordinate test procedures with the controls contractor who may assist with manipulation of the building automation system (BAS) to achieve the desired operating conditions.</li> <li>• Ensure disabling of economizer and demand-controlled ventilation controls before performing the test.</li> </ul>	
<b>Inspection Enforcement</b>	
<p>Prior to functional testing, verify and document the following:</p> <ul style="list-style-type: none"> <li>• Reference the supporting documentation as needed. Reference NRCC-MCH-03-E or the mechanical equipment schedules to determine the total required outdoor airflow for the system.</li> <li>• Indicate method and equipment used to measure airflow during the functional test (for example, hot-wire anemometer) on the acceptance document. Note calibration date; calibration date must be within one year.</li> </ul>	

**INSTALLER and INSPECTOR QUICK-REFERENCE:  
NRCA-MCH-02-A**

**Variable Air Volume Systems Outdoor Air Acceptance**

**Inspection Enforcement (cont.)**

- Check that the sensors used to control outside air (OSA) flow is either factory- or field-calibrated. Attach the calibration certificate or field calibration results to the acceptance test document NRCA-MCH-02-A.
- Check that a fixed minimum damper set point is not controlling OSA. The field technician shall review the operation sequences to ensure the system performs dynamic control of minimum outdoor air and reviews the installation to confirm all of the devices of that sequence are present.
- Indicate the dynamic control method used to control OSA in the system. There are several means to dynamically control minimum OSA for VAV systems, and many ways for the designer to specify an active ventilation air control "system" intended to maintain a constant outdoor air flow rate as supply fan flow rate decreases. For example, an installed flow station measures outdoor air flow rate and modulates the outdoor air dampers accordingly. Or perhaps dampers are modulated to maintain a constant differential pressure across a dedicated outdoor air damper assembly. The sensors, equipment, and control strategy necessary to achieve the desired control shall be calibrated as a "system," regardless of the control method of the outdoor airflow.
- Indicate the method used to deliver outside air to the unit (for example, duct, return air plenum). For systems using return air plenums to distribute outside air to a zonal heating or cooling unit, confirm that outside air supply connects either:
  - Within 5 feet of the unit.
  - Within 15 feet of the unit, with the air directed substantially toward the unit, and with a discharge velocity of at least 500 feet per minute.
- Confirm the system program includes a pre-occupancy purge for the 1-hour period immediately before normal occupancy of the building per the Energy Code. This confirmation is most easily accomplished by scheduling the unit to start one hour before actual occupancy. The purge amount must be the lesser of the minimum outdoor air rate or three complete building air changes (ACH).



**INSTALLER and INSPECTOR QUICK-REFERENCE:  
NRCA-MCH-02-A  
Variable Air Volume Systems Outdoor Air Acceptance**

**Acceptance Criteria**

Field- or factory-calibrated sensor controlling outdoor air flow with documentation attached.

Measured outdoor airflow reading is within 10 percent of the total value found on the Energy Code Mechanical Plan Check document NRCC-MCH-03-E, under the following conditions:

- Minimum system airflow or 30 percent of total design flow; 20 percent if the system has Direct Digital Controls (DDC).
- Design supply airflow.

Follow the **Construction Inspection** and **Functional Testing** instruction on NRCA-MCH-02-A.

**INSTALLER and INSPECTOR QUICK-REFERENCE:  
NRCA-MCH-03-A**

**Constant Volume, Single-Zone, Unitary (Packaged and Split) Air  
Conditioner and Heat Pumps Systems**

**Purpose and Scope of the Test**

This test verifies the components of a constant volume, single-zone, unitary air conditioner, and heat pump system function correctly, including thermostat installation and programming, supply fan, heating, cooling, and damper operation.

**Test trigger**

Newly Constructed and Additions/Alterations: Applies only to new constant-volume, single-zone, and unitary units with direct expansion (DX) cooling. These units may be cooling only or heating and cooling.

**Relevant Energy Code References and Required Compliance Documents**

Title 24, Part 6 of the California Building Code, Building Energy Efficiency Standards sections 120.5(a)2, 141.0(a), 141.0(b)2, 141.0(b)3; and NA7.5.2

Testing of the economizer, outdoor air ventilation, and demand-controlled ventilation are located in the following sections of the Reference Appendices:

- NA7.5.1.2 Constant Volume System Outdoor Air Acceptance.
- NA7.5.4 Air Economizer Controls (if applicable).
- NA7.5.5 DCV Systems (if applicable).

**Who Can Perform the Test**

This test must be performed by an acceptance test technician certified by a CEC-approved Acceptance Test Technician Certification Provider, using compliance document NRCA-MCH-03-A.

**Required Tools**

Tools to perform the test include a temperature meter and an amp meter.

**Estimated Time to Complete Test**

- Construction inspection: 0.5 to 1 hours, depending on familiarity with thermostat programming
- Functional testing: 1 to 2 hours

**Potential Issues and Cautions**

- Ensure that the supply fan runs continuously in occupied mode and cycles appropriately in unoccupied mode. Cycling refers to the supply fan running only when heating or cooling is enabled.

**INSTALLER and INSPECTOR QUICK-REFERENCE:  
NRCA-MCH-03-A**

**Constant Volume, Single-Zone, Unitary (Packaged and Split) Air  
Conditioner and Heat Pumps Systems**

**Potential Issues and Cautions (cont.)**

- When testing the manual override, adjust the length of the override period to minimize test time. Be sure to reset the override period back to the correct length of time.
- Tip: Overall test time may be reduced (especially for rooftop HVAC units controlled by thermostats) if two people perform the test – one to manipulate the thermostat while someone else verifies operation at the packaged unit.
- The Energy Code does not mandate the actual differential between occupied and unoccupied setpoints, only that the system must be adjustable down to 55°F for heating and up to 85°F for cooling and that the thermostat can be set for a 5°F dead band.
- Setback control is only required for climates where the winter median of extremes is less than or equal to 32°F.
- Setup control is only required for climates where the 0.5 percent summer design dry-bulb temperature is greater than or equal to 100°F.

**Inspection Enforcement**

**Required:**

Verify the inspector is in receipt of one NRCA-MCH-03-A for EACH air conditioner and heat pump system constructed or modified.

**Optional Equipment Check:**

Verify that the acceptance test technician has access to the following equipment:

- Temperature meter.
- Amp meter.

**Acceptance Criteria**

The following are verified through inspection:

- Thermostat is located within the space conditioning zone that is served by the respective HVAC system.
- Thermostat meets the temperature adjustment and dead band requirements of section 120.2(b).
- Occupied, unoccupied, and holiday schedules have been programmed per the schedule of the facility.
- Preoccupancy purge has been programmed to meet the requirements of section 120.1(d)2.

**INSTALLER and INSPECTOR QUICK-REFERENCE:  
NRCA-MCH-03-A**

**Constant Volume, Single-Zone, Unitary (Packaged and Split) Air  
Conditioner and Heat Pumps Systems**

**Acceptance Criteria (cont.)**

The following modes of operation function correctly:

- Occupied heating mode operation: The supply fan operates continuously, all heating stages operate, cooling is not enabled, and the outdoor air damper is at minimum position.
- Occupied operation with no heating or cooling load: The supply fan operates continuously, heating or cooling is not enabled, and the outdoor air damper is at minimum position.
- Occupied cooling mode operation: The supply fan operates continuously, all cooling stages operate, heating is not enabled, and outside damper is at minimum position.
- Unoccupied operation with no heating or cooling load: The supply fan shuts off, heating or cooling is not enabled, and the outdoor air damper is closed.
- Unoccupied operation with heating load: The supply cycles ON, heating is enabled, cooling is not enabled, and the outdoor air damper is either closed or at minimum position.
- Unoccupied cooling mode operation: The supply cycles ON, cooling is enabled, heating is not enabled, and the outdoor air damper is at minimum position.
- Manual override mode: System reverts to occupied mode, the supply fan turns ON for duration of override, heating or cooling is enabled as necessary, and the outdoor air damper opens to minimum position.

Follow the **Construction Inspection** and **Functional Testing** instruction on the NRCA-MCH-03-A.

**INSTALLER and INSPECTOR QUICK-REFERENCE:  
NRCA-MCH-04a-A & NRCA-MCH-04b-A  
Air Distribution System Acceptance Testing**

**Purpose and Scope of the Test**

This test verifies all duct work associated with all nonexempt constant volume, single-zone HVAC units (i.e., air conditioners, heat pumps, and furnaces) meet the material, installation, insulation R-values, and leakage requirements specified by the Energy Code.

**Test trigger**

This test is only for single-zone units serving less than 5,000 ft<sup>2</sup> of floor area where 25 percent or more of the duct surface area is in one of the following spaces:

- Outdoors.
- In a space directly under a roof where the U-factor of the roof is greater than the U-factor of the ceiling.
- In a space directly under a roof with fixed vents or openings to the outside or unconditioned spaces.
- In an unconditioned crawlspace.
- In other unconditioned spaces.

Within these criteria, this test applies to both new duct systems and existing duct systems that are either being extended, or the space conditioning system is altered by the installation or replacement of space conditioning equipment. This includes the replacement of the air handler, outdoor condensing unit of a split-system air conditioner or heat pump, cooling or heating coil, or the furnace heat exchanger.

**Relevant Energy Code References and Required Compliance Documents**

Title 24, Part 6 of the California Building Code, Building Energy Efficiency Standards sections 120.4, 140.4(l), 141.0(b)2D, 141.0(b)2E, and NA 2.1.

**Who Can Perform the Test**

The Responsible Person (i.e., architect, engineer, or contractor of record) will apply to the authority having jurisdiction during the permit application process regarding which of the following two options to use on the project.

1. Unless required by the authority having jurisdiction, the test can be performed by the installing technician and verified (sampled 1 in 7) by a HERS Rater certified by a HERS Provider that has been approved by the CEC, using compliance document NRCA-MCH-04a-H.
2. At the request of the authority having jurisdiction, the test must be performed by an acceptance test technician certified by a CEC-approved Acceptance Test Technician Certification Provider, using compliance document NRCA-MCH-04b-A.

**INSTALLER and INSPECTOR QUICK-REFERENCE:  
NRCA-MCH-04a-A & NRCA-MCH-04b-A  
Air Distribution System Acceptance Testing**

**Required Tools**

- Performance of this test will require measuring duct leakage equipment:
  - Fan flowmeter (a fan with a calibrated orifice used to pressurize the ducts) accuracy within 3 percent of measured flow.
  - Digital manometer (pressure meter) accuracy within 0.2 pascals.

**Estimated Time to Complete Test**

Construction inspection: 0.5 to 2 hours, depending on duct access for visual inspections and availability of construction material documentation (designs, cut sheets, and the NRCC-MCH-E as approved by the authority having jurisdiction).

Functional testing: 3 to 6 hours, depending on how long it takes to seal all supply diffusers and return grilles.

**Potential Issues and Cautions**

- Existing duct systems do not have to be tested if they are insulated or sealed with asbestos.
- Visual inspections of flex duct installation can be made as they are installed to ensure that they are not constructed beyond what the Energy Code allows.
- If this test is to be applied to existing duct systems that are having alterations made to the ducts or the HVAC equipment attached to the ducts, test the system leakage before making the alterations.
- Ensure all the supply and return diffusers/grilles are sealed tightly, all access panels are in place, and duct ends are sealed tightly before leakage testing.
- After the test, remember to remove all blockages from the supply and return ducts (that is, where the supply and return ducts at the HVAC unit were blanked off). Seal any holes drilled in the supply and return ducts for the static pressure probes.
- If a certified California HERS Rater must also verify duct leakage performance, it may be prudent to coordinate this test with the HERS Rater so that the HERS Rater can witness/verify the test simultaneously.

**Caution!**

If performing the **smoke test**, contact the local fire department and arrange to have the smoke detection and fire suppression system for the building taken off-line and the entire building evacuated of personnel prior to implementing the test. Following the conclusion of the test and working with the local fire department, ensure that the system is returned to on-line and operational status.

**INSTALLER and INSPECTOR QUICK-REFERENCE:  
NRCA-MCH-04a-A & NRCA-MCH-04b-A  
Air Distribution System Acceptance Testing**

**Inspection Enforcement**

**Required:**

Verify one of the following:

- The HERS rater is in receipt of one NRCA-MCH-04a-A for EACH duct system constructed or modified.
- The inspector is in receipt of one NRCA-MCH-04b-A for EACH duct system constructed or modified.

**Optional Equipment Check:**

Verify that the installing technician or acceptance test technician has access to the following equipment:

- Fan flowmeter (a fan with a calibrated orifice used to pressurize the ducts) accuracy within 3 percent of measured flow.
- Digital manometer (pressure meter) accuracy within 0.2 pascals.

**Acceptance Criteria**

- Duct connections, flexible duct installations, and all duct R-Values are consistent with approved designs and Energy Code requirements.
- Based on total fan system flow rate:
  - Newly installed ducts do not leak more than 6 percent.
  - Existing ducts do not leak more than 15 percent.
- Obtain HERS Rater field verification if not using an acceptance test technician.

Follow the **Construction Inspection** and **Functional Testing** instruction on either NRCA-MCH-04a-A (HERS rater) or NRCA-MCH-04b-A (Acceptance Test Technician).

**INSTALLER and INSPECTOR QUICK-REFERENCE:  
NRCA-MCH-05-A  
Air Economizer Controls Acceptance Testing**

**Purpose and Scope of the Test**

Functionally Testing an air economizer cycle verifies that an HVAC system uses outdoor air to satisfy space-cooling loads. There are two types of economizer controls: stand-alone packages and DDC controls. The stand-alone packages are commonly associated with small unitary rooftop HVAC equipment. DDC controls are typically associated with built-up or large packaged air handling systems.

Cooling fan systems > 54,000 Btu/hr may use an economizer to comply with prescriptive requirements in the Energy Code. Air economizers must be able to provide 100 percent of the design supply air with outside air; water economizers must be able to provide 100 percent of the design n cooling load at 50°F dry-bulb and 45°F wet-bulb.

**Test trigger**

Newly Constructed and Additions/Alterations: All new equipment with air economizer controls must comply unless they meet the condition below.

The in-field economizer functional tests do not have to be conducted for units that are factory-installed and certified operational by the manufacturer to the CEC’s economizer quality control requirements. The conditions to be a certified “factory installed and calibrated economizer” and how to apply for CEC approval of a certification program are described in the Energy Code and on the [CEC website \(http://www.energy.ca.gov/title24/equipment\\_cert/\)](http://www.energy.ca.gov/title24/equipment_cert/).

**Relevant Energy Code References and Required Compliance Documents**

Title 24, Part 6 of the California Building Code, Building Energy Efficiency Standards sections 140.4(e)2Diii, Table 140.4-B, 140.4(e), 140.4(e)3, 140.4(e)4, and NA7.5.4

**Who Can Perform the Test**

This test must be performed by an acceptance test technician certified by a CEC-approved Acceptance Test Technician Certification Provider, using compliance document NRCA-MCH-05-A.

**Required Tools**

- Hand-held temperature probe (must be calibrated within the past year).
- Device capable of calculating enthalpy (must be calibrated within the past year).
- 1.2 kOhm resistor (when specified by the manufacturer).
- 620 Ohm resistor (when specified by the manufacturer).



**INSTALLER and INSPECTOR QUICK-REFERENCE:  
NRCA-MCH-05-A  
Air Economizer Controls Acceptance Testing**

**Estimated Time to Complete Test**

Construction Inspection: 0.5 to 1 hours (depending on familiarity with the controls)  
Functional Testing: 0.5 to 2 hours (depending on familiarity with the controls and issues that arise during testing)

**Potential Issues and Cautions**

If conditions are below freezing when the test is performed, coil(s) may freeze when operating at 100 percent outdoor air.

Outdoor air and relief dampers should be closed when the system is in unoccupied and warm-up modes, preventing problems with unconditioned air entering the building during unoccupied hours.

If the damper interlocks fail and the outdoor air damper does not open before the return damper closes, damage to the air handling unit or associated duct work may occur.

Air economizers with poor mixing can have excessively stratified air streams that can cause comfort problems or freeze stat trips.<sup>1</sup> Mixing problems are more likely to occur as the VAV system reduces flow, leading to reduced velocities in the mixing box and through the dampers.

Check for exterior doors standing open and other signs of building over pressurization when all units are on full economizer cooling (100 percent OSA).

A freeze stat protects water coils in rooftop HVAC units from freezing. When a freeze stat trips it opens the hot water valve (either to full or partial) to remove the danger of damage from freezing water within the system. Typically freeze stats must be reset by hand. Poorly functioning air economizers can cause freeze stats to falsely trip or some cases may actually cause freezing conditions.

**INSTALLER and INSPECTOR QUICK-REFERENCE:  
NRCA-MCH-05-A  
Air Economizer Controls Acceptance Testing**

**Inspection Enforcement**

**Required:**

For projects permitted prior to October 1, 2021, the NRCA-MCH-05-A form may be completed by the installing technician, contractor, or other qualified person. The form will be a PDF fillable form with the CEC logo at the top.

For projects permitted on or after October 1, 2021, the NRCA-MCH-05-A may only be completed by a certified acceptance test technician. The form will include a watermark from an approved Acceptance Test Technician Certification Provider.

**Optional:**

Instruct the acceptance test technician to show the high limit setting on the economizer as compared to item 2 (Table 140.4-E) of the construction inspection portion of the NRCA-MCH-05-A form.

**Acceptance Criteria**

This is an operational controls pass-fail test, all required functional tests must pass. A copy of the manufacturer's certificate must be attached to the NRCA-MCH-05-A. Regardless of whether the economizer is field- or factory-installed, complete the construction inspection, including the compliance with high temperature lockout temperature setpoints.

Follow the **Construction Inspection** and **Functional Testing** instruction on either NRCA-MCH-05-A.

**INSTALLER and INSPECTOR QUICK-REFERENCE:**

**NRCA-MCH-06-A**

**Demand Control Ventilation (DCV) Systems**

**Purpose and Scope of the Test**

The purpose of the test is to verify that systems required to employ demand controlled ventilation as required by the Energy Code can vary outside ventilation flow rates based on maintaining interior carbon dioxide (CO<sub>2</sub>) concentration setpoints. Demand Controlled ventilation refers to an HVAC system's ability to reduce outdoor air ventilation flow below design values when the space served is at less than design occupancy. CO<sub>2</sub> is a good indicator of occupancy load and is the basis used for modulating ventilation flow rates.

**Test trigger**

Newly Constructed and Additions/Alterations: All new DCV controls installed on new or existing HVAC systems must be tested.

DCV systems are required on all spaces with a design occupancy of 40 square feet/person or less and includes at least one of the following:

- Air economizer.
- Modulating outside air control.
- Design outdoor airflow rate > 3,000 cfm.

Exceptions:

- The space exhaust is greater than the ventilation rate – 0.2 cfm/ft<sup>2</sup>.
- Spaces that have processes or operations that generate dusts, fumes, vapors, or gases and do not have local exhaust.
- Spaces with an area less than 150 ft<sup>2</sup> or design occupancy < 10 people.

**Relevant Energy Code References and Required Compliance Documents**

Title 24, Part 6 of the California Building Code, Building Energy Efficiency Standards sections 120.1, 120.1(d)3, 120.1(d)4, 120.1(d)5, Nonresidential Appendix NA7.5.5, Design Document NRCC-MCH-E Tables I and J

**Who Can Perform the Test**

This test must be performed by an acceptance test technician certified by a CEC-approved Acceptance Test Technician Certification Provider, using compliance document NRCA-MCH-06-A.

**INSTALLER and INSPECTOR QUICK-REFERENCE:  
NRCA-MCH-06-A  
Demand Control Ventilation (DCV) Systems**

**Required Tools**

To perform the test, it may be necessary to vary and possibly measure (if calibration is necessary) ambient CO<sub>2</sub> levels. The instrumentation needed to perform the test may include, but is not limited to:

- Hand-held reference CO<sub>2</sub> probe calibrated to ±10 ppm.
- Manufacturer's calibration kit.
- Calibrated CO<sub>2</sub>/air mixtures.

**Estimated Time to Complete Test**

Construction Inspection: 0.5 to 1 hours (depending on CO<sub>2</sub> sensor calibration)

Functional testing: 1 to 2 hours (depending on how ambient CO<sub>2</sub> concentration levels are manipulated, system response time to variations in CO<sub>2</sub>)

**Potential Issues and Cautions**

Lock out the economizer control during the test. Outdoor air damper may not modulate correctly if the economizer control strategy is controlling damper operation.

Overall test time may be reduced (especially for rooftop HVAC units) if two people perform the test – one to vary the CO<sub>2</sub> concentration while someone else verifies operation of the outdoor air dampers.

During the testing of the DCV controls, the outside damper will modulate open. Care should be taken to prevent freezing of coils if testing with cold temperatures outside.

**Inspection Enforcement**

**Required:**

Interior CO<sub>2</sub> concentration setpoint is ≤ 600 ppm plus outdoor air CO<sub>2</sub> value if outside concentration is measured dynamically. Otherwise, setpoint is ≤ 1000 ppm. Outdoor air CO<sub>2</sub> concentration can be determined by three methods:

1. Assume a value of 400 ppm without any direct measurement.
2. Measure outside concentration dynamically to continually adjust interior concentration setpoint.
3. Measure outside concentration one time during system checkout and use this value continually to determine inside concentration setpoint.

## **INSTALLER and INSPECTOR QUICK-REFERENCE:**

### **NRCA-MCH-06-A**

#### **Demand Control Ventilation (DCV) Systems**

##### **Acceptance Criteria**

- Each CO<sub>2</sub> sensor is factory calibrated (with calibration certificate) or field calibrated.
- Each CO<sub>2</sub> sensor is wired correctly to the controls to ensure proper control of the outdoor air damper.
- Each CO<sub>2</sub> sensor is located correctly within the space 3 to 6 feet above the floor.
- Interior CO<sub>2</sub> concentration setpoint is  $\leq 600$  ppm plus outdoor air CO<sub>2</sub> value if dynamically measured or  $\leq 1000$  ppm if no OSA sensor is provided.
- A minimum OSA setting is provided whenever the system is in Occupied mode regardless of space CO<sub>2</sub> readings.
- A maximum OSA damper position for DCV control can be established, regardless of space CO<sub>2</sub> readings.
- The outdoor air damper modulates open when the CO<sub>2</sub> concentration within the space exceeds setpoint.
- The outdoor air damper modulates closed (toward minimum position) when the CO<sub>2</sub> concentration within the space is below setpoint.

**INSTALLER and INSPECTOR QUICK-REFERENCE:  
NRCA-MCH-07-A  
Supply Fan Variable Flow Controls Systems**

**Purpose and Scope of the Test**

The purpose of the test is to ensure that the supply fan in a variable air volume application modulates to meet system airflow demand. In most applications, the individual VAV boxes serving each space will modulate the amount of air delivered to the space based on heating and cooling requirements. As a result, the total supply airflow provided by the central air handling unit must also vary to maintain sufficient airflow through each VAV box. Airflow is typically controlled using a variable frequency drive (VFD) to modulate supply fan speed and vary system airflow. The most common strategy for controlling the VFD is to measure and maintain static pressure within the duct.

**Test trigger**

Newly Constructed and Additions/Alterations: All new fan systems with a total fan horsepower at design conditions greater than 5 horsepower are required to have VAV systems. Fan controls installed on new or existing systems must be tested.

**Relevant Energy Code References and Required Compliance Documents**

Title 24, Part 6 of the California Building Code, Building Energy Efficiency Standards section 140.4(c)2, Nonresidential Appendix NA7.5.6  
Design Document: NRCC-MCH-E Table H  
Related acceptance tests for these systems include the following:

- NA7.5.1.1 Variable Air Volume Systems Outdoor Air Acceptance.

**Who Can Perform the Test**

This test must be performed by an acceptance test technician certified by a CEC-approved Acceptance Test Technician Certification Provider, using compliance document NRCA-MCH-07-A.

**Required Tools**

The instrumentation needed to perform the test may include, but is not limited to:

- Differential pressure gauge (must be calibrated within the past year).
- Pitot tube.
- Drill.

**INSTALLER and INSPECTOR QUICK-REFERENCE:  
NRCA-MCH-07-A  
Supply Fan Variable Flow Controls Systems**

**Estimated Time to Complete Test**

Construction Inspection: 0.5 to 1.5 hours (depending on sensor calibration and minimum VFD speed verification)

Functional testing: 1 to 2 hours (depending on how total fan power at design airflow is determined and system control stability)

**Potential Issues and Cautions**

Ensure that all disabled reset sequences are enabled upon completion of this test.

Coordinate test procedures with the controls contractor since they may be needed to assist with manipulation of the BAS to achieve the desired operating conditions.

**Inspection Enforcement**

- Check that the static pressure sensor location, setpoint, and reset control meet the requirements of section 140.4(c)2, as follows:
  - Location: For a multi-zone system with a static pressure sensor located downstream of major duct splits, multiple sensors must be installed in each major branch while controlling fan capacity to satisfy the sensor furthest below its setpoint.
  - Setpoint: Setpoint must be no greater than one-third of the total design fan static pressure. Note the design total static pressure and the setpoint in I.W.C. on the NRCA-MCH-07-A document.
  - Setpoint Reset Control: For systems with direct digital control of individual zone boxes reporting to the central control panel, static pressure set points shall be reset based on the zone requiring the most pressure, i.e., the set point is reset lower until one zone damper is nearly wide open.
- Verify that the supply fan includes a means to modulate airflow such as a variable speed drive.

**INSTALLER and INSPECTOR QUICK-REFERENCE:  
NRCA-MCH-07-A  
Supply Fan Variable Flow Controls Systems**

**Inspection Enforcement (cont.)**

- Discharge static pressure sensor(s) shall be field calibrated. Performing a field calibration check requires measuring static pressure as close to the existing sensor as possible using a calibrated hand-held measuring device and comparing the field measured value to the value measured by the BAS. When the value measured by the BAS is within 10 percent of the field-measured value, the sensor is calibrated. Attach supporting documentation to the NRCA-MCH-07-A document.

**Acceptance Criteria**

Static pressure sensor(s) is field calibrated to within 10 percent of reference sensor, with differential pressure gauge and pitot tube.

For systems without DDC controls to the zone level the pressure sensor setpoint is less than 1/3 of the supply fan design static pressure.

For systems with DDC controls with VAV boxes reporting to the central control panel, the pressure setpoint is reset by zone demand (box damper position or a trim and respond algorithm or other method that dynamically reduces duct static pressure setpoint as low as possible while maintaining adequate pressure at the VAV box zone(s) of greatest demand).

At full flow:

- Supply fan maintains discharge static pressure within  $\pm 10$  percent of the current operating control static pressure setpoint.
- Supply fan control stabilizes within 5 minute period.

At minimum flow (at least 30 percent of total design flow):

- Supply fan controls modulate to decrease capacity.
- Current operating setpoint has decreased (for systems with DDC to the zone level).

Supply fan maintains discharge static pressure within  $\pm 10$  percent of the current operating setpoint.



## **INSTALLER and INSPECTOR QUICK-REFERENCE:**

### **NRCA-MCH-08-A**

#### **Valve Leakage Acceptance**

##### **Purpose and Scope of the Test**

This test ensures that control valves serving variable flow systems are designed to withstand the pump pressure over the full range of operation. Valves with insufficient actuators will lift under certain conditions causing water to leak and loss of flow control. This test applies to the variable flow systems covered by section 140.4(k)1 chilled and hot-water variable flow systems, section 140.4(k)2 chiller isolation valves, section 140.4(k)3 boiler isolation valves, and section 140.4(k)5 water-cooled air conditioner and hydronic heat pump systems.

##### **Test trigger**

Newly Constructed and Additions/Alterations: Applies to chilled and hot water systems that are designed for variable flow. It also applies to new boilers and chillers where there is more than one boiler or chiller in the plant and the primary pumps are connected to a common header.

This test is required for systems that are designed with variable flow for HVAC chilled and hot water pumping that include more than three control valves, and a total of more than 1.5 horsepower. The test addresses chiller isolation valves, boiler isolation valves, and water-cooled air conditioner and hydronic heat pump systems.

##### **Relevant Energy Code References and Required Compliance Documents**

Title 24, Part 6 of the California Building Code, Building Energy Efficiency Standards sections 140.4(k)1, 140.4(k)2, 140.4(k)3, 140.4(k)5; NA7.5.7; NRCC-MCH-E Tables F and G

Related acceptance tests for these systems include the following:

- NA7.5.9 Hydronic System Variable Flow Controls Acceptance.

Testing time will be greatly reduced if these acceptance tests are done simultaneously.

##### **Who Can Perform the Test**

This test must be performed by an acceptance test technician certified by a CEC-approved Acceptance Test Technician Certification Provider, using compliance document NRCA-MCH-08-A.

**INSTALLER and INSPECTOR QUICK-REFERENCE:**

**NRCA-MCH-08-A**

**Valve Leakage Acceptance**

**Required Tools**

Performance of this test will require measuring differential pressure across pumps. The instrumentation needed to perform the test may include, but is not limited to either a:

- Differential pressure gauge.
- Handheld hydronic manometer.

For accurate comparison with the pump curves, measure using the taps on the pump casing. Taps on the inlet and discharge piping to the pumps will not correlate to the pump curves.

**Estimated Time to Complete Test**

Construction Inspection: 0.5 to 2 hours (depending on availability of construction documentation and complexity of the system.)

Functional testing: 0.5 to 3 hours (depending on the complexity of the system and the number of valves).

**Potential Issues and Cautions**

The Acceptance Agent will likely need access to the energy management control system (EMCS) during testing

Running a pump in a "dead head" condition (no flow) for more than 5 minutes can damage the pump seals or motor. Care must be taken to set up the test so that the pump only needs to run for 5 minutes or less.

If balance valves are used for isolation of three-way valves or pumps, their initial position must be noted prior to using them for shutting off flow so that they can be returned to their initial position at the end of the test.

**INSTALLER and INSPECTOR QUICK-REFERENCE:**

**NRCA-MCH-08-A**

**Valve Leakage Acceptance**

**Inspection Enforcement**

**Required:**

The whole hydronic system must be complete - all coils, control valves, and pumps installed; all piping is pressure tested, flushed, cleaned, filled with water; and EMCS controls, if applicable.

All equipment start-up procedures are complete, per manufacturer's recommendations.

Document the initial conditions before overrides or manipulation of the BAS. All systems must be returned to normal at the end of the test.

**Acceptance Criteria**

- Provisions have been made for variable flow.
- System has no flow when all coils are closed, and the pump is turned on.

**INSTALLER and INSPECTOR QUICK-REFERENCE:  
NRCA-MCH-09-A**

**Supply Water Temperature Reset Controls**

**Purpose and Scope of the Test**

This test ensures that both the chilled water and hot water supply temperatures are automatically reset based on either building loads or outdoor air temperature, as indicated in the control sequences. Many HVAC systems are served by central chilled and heating hot water plants. The supply water operating temperatures must meet peak loads when the system is operating at design conditions. As the loads vary, the supply water temperatures can be adjusted to satisfy the new operating conditions. Typically, the chilled water supply temperature can be raised as the cooling load decreases and heating hot water supply temperature can be lowered as the heating load decreases.

This requirement only applies to chilled and hot water systems that are not designed for variable flow and that have a design capacity greater than or equal to 500,000 Btu/hr, according to the Energy Code.

**Test trigger**

Newly Constructed and Additions/Alterations: Applies to chilled or hot water systems that have a supply temperature reset control strategy programmed into the building automation system.

**Relevant Energy Code References and Required Compliance Documents**

Title 24, Part 6 of the California Building Code, Building Energy Efficiency Standards sections 120.5(a)9, 140.4(k)4, and NA7.5.8

**Who Can Perform the Test**

This test must be performed by an acceptance test technician certified by a CEC-approved Acceptance Test Technician Certification Provider, using compliance document NRCA-MCH-09-A.

**Required Tools**

Tools to perform the test include air and water temperature meters.

**INSTALLER and INSPECTOR QUICK-REFERENCE:  
NRCA-MCH-09-A**

**Supply Water Temperature Reset Controls**

**Estimated Time to Complete Test**

Construction inspection: 0.5 to 1 hours [depending on availability of construction documentation (i.e., plumbing drawings, material cut sheets, specifications, etc.) as well as sensor calibration]

Functional testing: 1 to 2 hours (depending on familiarity with BAS, method employed to vary operating parameters, and time interval between control command and system response)

**Potential Issues and Cautions**

If the hot water temperature reset tests when there is minimal heating load, make sure to test the low end of the reset first (coldest hot water supply temperature). If the hottest supply water temperature is tested first, it may be difficult to dissipate the heat in the hot water loop without artificially creating a heating load. Waiting for a small heating load to dissipate the heat in the loop could add significant time to the test procedure.

Where humidity control is required, chilled water supply water reset is not recommended.

**Inspection Enforcement**

**Required:**

Verify the inspector is in receipt of the NRCA-MCH-09-A for EACH system that must demonstrate compliance.

**Optional Equipment Check:**

Verify that the acceptance test technician has access to the following equipment:

- Temperature meters.

**INSTALLER and INSPECTOR QUICK-REFERENCE:  
NRCA-MCH-09-A**

**Supply Water Temperature Reset Controls**

**Acceptance Criteria**

The following are verified through inspection:

- Supply water temperature sensors must be field calibrated to within one percent of a calibrated reference sensor. Supporting documentation should be attached to the NRCA-MCH-09-A.
- Sensor performance complies with the specifications on the construction documentation.
- Supply water reset works according to the control schedule and the measured water temperature is within 2 percent of control setpoint.

Follow the **Construction Inspection** and **Functional Testing** instruction on the NRCA-MCH-09-A.

**INSTALLER and INSPECTOR QUICK-REFERENCE:**

**NRCA-MCH-10-A**

**Hydronic System Variable Flow Control Acceptance**

**Purpose and Scope of the Test**

All hydronic variable flow chilled water and water-loop heat pump systems with total circulating pump power larger than 5 horsepower shall vary system flow rate by modulating pump speed using either a VFD or equivalent according to section 140.4(k)6. Pump speed and flow must be controlled as a function of differential pressure, and pump motor demand must be no more than 30 percent design wattage at 50 percent design flow.

As the loads within the building fluctuate, control valves should modulate the amount of water passing through each coil and add or remove the desired amount of energy from the air stream to satisfy the load. In the case of water-loop heat pumps, each two-way control valve associated with a heat pump closes when not operating. The purpose of the test is to ensure that, as each control valve modulates, the pump VFD responds accordingly to meet system requirements.

**Test trigger**

Newly Constructed and Additions/Alterations: Applies to any water system that has individual pumps serving variable flow systems and having a motor horsepower exceeding 5 horsepower.

Note that this is not required on heating hot water systems with variable flow designs or for condensing water serving only water cooled chillers.

Section 140.4(k)6 permits two general variable flow control strategies:

- (1) Supply pressure reset by coil demand for systems with DDC controls to the coil level.
- (2) Fixed pressure setpoint control.

**Relevant Energy Code References and Required Compliance Documents**

Title 24, Part 6 of the California Building Code, Building Energy Efficiency Standards section 140.4(k)6; NA7.5.9; NRCC-MCH-E Tables F and G

The related acceptance test for this system is:

NA7.5.7 Valve Leakage Test – NRCA-MCH-08-A (if applicable)

**Who Can Perform the Test**

This test must be performed by an acceptance test technician certified by a CEC-approved Acceptance Test Technician Certification Provider, using compliance document NRCA-MCH-10-A.

**INSTALLER and INSPECTOR QUICK-REFERENCE:  
NRCA-MCH-10-A  
Hydronic System Variable Flow Control Acceptance**

**Required Tools**

Performance of this test will require measuring motor amps, water temperatures as well as possibly air temperatures. The instrumentation needed to perform the test may include, but is not limited to a clamp-on amp meter, hand-held temperature probes for ice water or drywell bath. Devices must be calibrated within the last year.

**Estimated Time to Complete Test**

Construction Inspection: 0.5 to 1 hours (depending on availability of construction documentation – i.e., plumbing drawings, material cut sheets, specifications, sensor calibration, etc.)

Functional testing: 2 to 4 hours (depending on familiarity with BAS, method used to vary operating parameters, verification method for system flow and VFD power)

**Potential Issues and Cautions**

Difficulties could be encountered with manipulating the control system if not familiar with the programming language. Therefore, a controls contractor should be on-site to assist with adjusting system operation and overriding controls.

**Inspection Enforcement**

**Required:**

To perform the test, use the control system to manipulate system operation to achieve the desired control. At a minimum, control system programming for the operation of the central equipment, control valves, and pumps must include, but not be limited to:

- Equipment start-stop control.
- Installed and calibrated control sensors.
- Tuned control loops.

All systems must be installed and ready for system operation, including:

- Heat pumps, cooling towers, boilers, pumps, control valves, piping, etc.
- Control sensors (temperature, flow, pressure, etc.).

Verify all piping is pressure tested, flushed, cleaned, and filled with water. Verify electrical power supply to all equipment. Confirm start-up procedures for all pieces of equipment are complete, per manufacturer's recommendations.



**INSTALLER and INSPECTOR QUICK-REFERENCE:  
NRCA-MCH-10-A  
Hydronic System Variable Flow Control Acceptance**

**Inspection Enforcement (cont.)**

Document the initial conditions before overrides or manipulation of the BAS. Return all systems to their initial condition after test.

**Acceptance Criteria**

Differential pressure sensor(s) are field calibrated.

For systems without DDC to individual coils, pressure sensor(s) are located at or near the most remote HX or control valve, or the HX requiring the greatest differential pressure.

For systems with DDC to individual coils, the pressure sensor(s) has no location restriction, but are reset according to the valve requiring the greatest pressure and shall be no less than 80 percent open.

System is stable when controlling to the setpoint.

**INSTALLER and INSPECTOR QUICK-REFERENCE:**

**NRCA-MCH-11-A**

**Automatic Demand Shed Control Acceptance**

**Purpose and Scope of the Test**

If the building has DDC to the zone level, the HVAC control system must be capable receiving a Demand Response Signal and automatically initiating a control strategy once the signal is received. This acceptance test confirms that the HVAC control system is programmed so that it is capable of initiating the control strategy specified in the Energy Code. That is, modify the temperature setpoints in non-critical zones up by 4°F if the system is cooling the space or down by 4°F if the system is heating the space. The building owner or occupant has the option of selecting another control strategy than the one tested here if they choose to enroll in a demand response program.

**Test trigger**

Newly Constructed and Additions/Alterations: Applies to construction inspection of the HVAC control system interface shed controls and testing.

**Relevant Energy Code References and Required Compliance Documents**

Title 24, Part 6 of the California Building Code, Building Energy Efficiency Standards section 110.12(b), Nonresidential Appendix NA7.5.10, NRCC-MCH-E Table I

**Who Can Perform the Test**

This test must be performed by an acceptance test technician certified by a CEC-approved Acceptance Test Technician Certification Provider, using compliance document NRCA-MCH-11-A.

**Required Tools**

The instrumentation needed to perform the test may include, but is not limited to:

- Access to the HVAC control system to manually simulate the receipt of a Demand Response Signal.

**Estimated Time to Complete Test**

Construction Inspection: 0.5 hour to review the HVAC control system  
Functional testing: 0.5 to 1 hours (depending on familiarity with the HVAC control system)

**INSTALLER and INSPECTOR QUICK-REFERENCE:**

**NRCA-MCH-11-A**

**Automatic Demand Shed Control Acceptance**

**Potential Issues and Cautions**

Difficulties could be encountered with manipulating the control system if not familiar with the programming language. Therefore, a controls contractor should be on site to assist with the testing.

**Inspection Enforcement**

**Required:**

Prior to functional testing, verify and document the following that the EMCS interface enables activation of the central demand shed controls.

**Acceptance Criteria**

The control system changes the setpoints of non-critical zones on manually simulating an occasion where the HVAC control system receives a Demand Response signal. Then the system restores the initial setpoints when the point is released.

<b>INSTALLER and INSPECTOR QUICK-REFERENCE:</b> <b>NRCA-MCH-12-A-FDD-F</b> <b>Fault Detection and Diagnostics (FDD) for Packaged Direct-Expansion (DX) Units Acceptance</b>	
<b>Purpose and Scope of the Test</b>	
<p>The purpose of this test is to verify proper fault detection and reporting for automated fault detection and diagnostics systems for packaged DX units. Automated Fault Detection and Diagnostics (FDD) systems ensure proper equipment operation by identifying and diagnosing common equipment problems such as temperature sensor faults, low airflow, or faulty economizer operation.</p> <p>FDD systems help to maintain equipment efficiency closer to rated conditions over the life of the equipment.</p>	
<b>Test trigger</b>	
<p>Newly Constructed and Additions/Alterations: Applies to any FDD system installed on a packaged DX unit.</p> <p>FDD systems are required on newly installed air handlers with a mechanical cooling capacity greater than 54,000 Btu/hr and an installed air economizer.</p>	
<b>Relevant Energy Code References and Required Compliance Documents</b>	
<p>Title 24, Part 6 of the California Building Code, Building Energy Efficiency Standards section 120.2(i), Nonresidential Appendix NA7.5.11, Design Document NRCC-MCH-E Tables H and I</p> <ul style="list-style-type: none"> <li>• Coordinate this Test with NRCA-MCH-2-A Outdoor Air.</li> </ul>	
<b>Who Can Perform the Test</b>	
<p>This test must be performed by an acceptance test technician certified by a CEC-approved Acceptance Test Technician Certification Provider, using compliance document NRCA-MCH-08-A.</p>	
<b>Required Tools</b>	
<p>The system test for refrigerant charge requires a calibrated refrigerant gauge with an accuracy of plus or minus 3 percent.</p>	

**INSTALLER and INSPECTOR QUICK-REFERENCE:  
NRCA-MCH-12-A-FDD-F  
Fault Detection and Diagnostics (FDD) for Packaged Direct-  
Expansion (DX) Units Acceptance**

**Estimated Time to Complete Test**

Construction Inspection: 0.5 hours

Functional testing: 1 to 2 hours

FDD systems have the capability to report alarms to a remote server; accessible via a Web interface. It may be helpful to have two people conducting the test – one to perform testing on the unit and a second to verify reporting of the alarm to the remote interface.

**Potential Issues and Cautions**

Compared to the pressure sensors, the temperature sensors can have a longer response time to reach a steady-state condition. Therefore, the FDD algorithms may have trouble working properly during transitional states – for example, when the fan or compressor first turns on. The tester should be aware of the potential for false alarms.

**Inspection Enforcement**

**Required:**

Verify that the installed FDD has been certified to the CEC and is listed on the CEC's website ([http://www.energy.ca.gov/title24/equipment\\_cert/](http://www.energy.ca.gov/title24/equipment_cert/)).

**Acceptance Criteria**

- The FDD system is able to detect a disconnected outside air temperature sensor and report the fault.
- The FDD system is able to detect excess outside air and report the fault.
- The FDD system is able to detect a stuck outdoor air economizer damper and report the fault.
- The saturated discharge and saturated suction temperatures must be measured within 5°F of a calibrated refrigerant gauge.

**INSTALLER and INSPECTOR QUICK-REFERENCE:**

**NRCA-MCH-13-A-FDD-F**

**Automatic Fault Detection Diagnostics (FDD) for Air Handling Units and Zone Terminal Units Acceptance**

**Purpose and Scope of the Test**

Fault Detection and Diagnostics (FDD) can also be used to detect common faults with air handling units and zone terminal units. Many FDD tools are standalone software products that process trend data offline. Maintenance problems with built-up air handlers and variable air volume boxes are often not detected by energy management systems because the required data and analytical tools are not available. Performing the FDD analysis within the distributed unit controllers is more practical because of the large volume of data.

The acceptance tests are designed to verify that the system detects common faults in air handling units and terminal units. FDD systems for air handling units and zone terminal units require DDC controls to the zone level. Successful completion of this test provides a compliance credit when using the performance approach. An FDD system that does not pass this test may still be installed, but no compliance credit will be given.

**Test trigger**

Newly Constructed and Additions/Alterations: Applies to any FDD system installed on an air handling unit or a zone terminal unit. A minimum of 5 percent of the terminal boxes (VAV box) shall be tested.

**Relevant Energy Code References and Required Compliance Documents**

Title 24, Part 6 of the California Building Code, Building Energy Efficiency Standards section 120.2(i), Nonresidential Appendix NA7.5.12, NRCC-MCH-E Tables H and I

**Who Can Perform the Test**

This test must be performed by an acceptance test technician certified by a CEC-approved Acceptance Test Technician Certification Provider, using compliance document NRCA-MCH-13-A-FDD-F.

**Required Tools**

FDD tests for air handling units and zone terminal units require no additional instrumentation for testing since control algorithms are embedded in unit controllers.

**INSTALLER and INSPECTOR QUICK-REFERENCE:**

**NRCA-MCH-13-A-FDD-F**

**Automatic Fault Detection Diagnostics (FDD) for Air Handling Units and Zone Terminal Units Acceptance**

**Estimated Time to Complete Test**

Construction Inspection: 0.5 hours

Functional testing: Acceptance tests will take 1 to 2 hours for each air handler. Time for acceptance testing for terminal units depends on the number of boxes to be tested.

**Potential Issues and Cautions**

Difficulties could be encountered with manipulating the control system if not familiar with the programming language. Therefore, a controls contractor should be on site to assist with the testing.

**Inspection Enforcement**

**Required:**

- Verify on the Certificate of Compliance and Certificate of Installation or sensor specifications that locally installed supply air, outside air, and return air (if applicable) temperature sensors have an accuracy of  $\pm 2^{\circ}\text{F}$  over the range of  $40^{\circ}\text{F}$  to  $80^{\circ}\text{F}$ .

**Acceptance Criteria**

- The system is able to detect common faults with air handling units, such as sensor failures, damper failures, actuator failures, or improper operating modes.
- The system is able to detect and report common faults with zone terminal units, such as damper failure, actuator failure, or a control tuning issue.

<b>INSTALLER and INSPECTOR QUICK-REFERENCE: NRCA-MCH-14-A Distributed Energy Storage Direct Expansion (DX) Air Conditioning Acceptance</b>	
<b>Purpose and Scope of the Test</b>	
This test verifies proper operation of distributed energy storage DX systems. Distributed energy systems reduce peak demand by operating during off peak hours and storing cooling, usually in the form of ice. During peak cooling hours the ice is melted to avoid compressor operation.	
<b>Test trigger</b>	
Newly Constructed and Additions/Alterations: Applies to constant and variable volume, direct expansion systems with distributed energy storage (DES/DXAC). This acceptance requirement is an addition to economizer and packaged equipment acceptance.	
<b>Relevant Energy Code References and Required Compliance Documents</b>	
Title 24, Part 6 of the California Building Code, Building Energy Efficiency Standards Nonresidential Appendix NA7.5.13	
<b>Who Can Perform the Test</b>	
This test must be performed by an acceptance test technician certified by a CEC-approved Acceptance Test Technician Certification Provider, using compliance document NRCA-MCH-14-A.	
<b>Required Tools</b>	
Distributed energy storage acceptance tests require no additional instrumentation for testing.	
<b>Estimated Time to Complete Test</b>	
Construction Inspection: 0.5 hours Functional testing: 2 hours	



**INSTALLER and INSPECTOR QUICK-REFERENCE:**

**NRCA-MCH-14-A**

**Distributed Energy Storage Direct Expansion (DX) Air Conditioning Acceptance**

**Potential Issues and Cautions**

These tests only apply to systems with storage capacity less than 100 ton-hours. Systems with storage above 100 ton-hours should be modeled using the thermal energy storage compliance option. Be sure the water tank is filled to the proper level indicated by the manufacturer prior to the start of the tests. The tests require override of the system controller programming. Be sure to record the system settings prior to the start of the testing, and restore the system settings to their original values upon completion of the tests.

**Inspection Enforcement**

**Required:**

The distributed energy storage system third party submittal form should be verified, which contains the following information: testing laboratory, address, phone number, contact person, date tested, tracking number, model number, and manufacturer.

The following performance information should be recorded and reported on the document NRCA-MCH-14-A.

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

**Acceptance Criteria**

- Verify nighttime ice making operation.
- Verify that tank discharges during on-peak cooling periods.
- Verify that the compressor does not run, and the tank does not discharge when there is no cooling demand during on-peak periods.
- Verify that the system does not operate during a morning shoulder period when there is no cooling demand.
- Verify system is stable when controlling to the setpoint.

**INSTALLER and INSPECTOR QUICK-REFERENCE:  
NRCA-MCH-15-A  
Thermal Energy Storage (TES) System Acceptance**

**Purpose and Scope of the Test**

This test verifies proper operation of thermal energy storage (TES) systems. TES systems reduce energy consumption during peak demand periods by shifting energy consumption to nighttime. Operation of the thermal energy storage compressor during the night produces cooling energy, which is stored in the form of cooled fluid or ice in tanks. During peak cooling hours the thermal storage is used for cooling to prevent the need for chiller operation.

The test will ensure that the TES system is able to charge the storage tank during off-peak hours and conversely discharge the storage tank during on peak hours. Since the chiller may operate more efficiently at night when ambient temperatures are lower, the system may save cooling energy in some climate zones.

**Test trigger**

Newly Constructed and Additions/Alterations: Applies to thermal energy storage systems used in conjunction with chilled water air conditioning systems.

**Relevant Energy Code References and Required Compliance Documents**

Title 24, Part 6 of the California Building Code, Building Energy Efficiency Standards sections 120.5(a)14 and NA7.5.14

**Who Can Perform the Test**

This test must be performed by an acceptance test technician certified by a CEC-approved Acceptance Test Technician Certification Provider, using compliance document NRCA-MCH-15-A.

**Required Tools**

No additional instrumentation is required for testing.

**Estimated Time to Complete Test**

- Construction inspection: 0.5 hours
- Functional testing: 2 hours

**Potential Issues and Cautions**

Potential damage to the chiller, pumps, storage tanks, etc., by improper manipulation of the control system.

Perform this test with the assistance of the control system vendor or facility operator.

**INSTALLER and INSPECTOR QUICK-REFERENCE:  
NRCA-MCH-15-A**

**Thermal Energy Storage (TES) System Acceptance**

**Inspection Enforcement**

**Required:**

Verify the inspector is in receipt of one NRCA-MCH-15-A for EACH system that must demonstrate compliance.

**Optional Equipment Check:**

- None. No specialized tools are required for this test.

**Acceptance Criteria**

The TES system and the chilled water plant is controlled and monitored by an EMCS.

Verify:

- The TES system stores energy in storage/charge mode.
- The storage charging stops when an end of charge signal is generated.
- The TES system starts discharging with the compressor(s) in discharge mode.
- The TES does not discharge, and the cooling load is met by the compressor(s) in mechanical cooling only mode.
- The TES discharges with the chiller sharing the load during discharge and mechanical cooling mode.
- Storage does not discharge, and all compressors are off during the off/storage-secure mode.
- When applicable, tanks can be charged while serving in active cooling mode during charge-plus cooling mode.

Follow the **Construction Inspection** and **Functional Testing** instruction on the NRCA-MCH-15-A.

**INSTALLER and INSPECTOR QUICK-REFERENCE:  
NRCA-MCH-16-A  
Supply Air Temperature Reset Controls**

**Purpose and Scope of the Test**

The purpose of the test is to ensure that the supply air temperature in a constant or variable air volume application serving multiple zones, according to section 140.4(f), modulates to meet system heating and cooling loads.

Space conditioning systems must have zone level controls to avoid reheat, re-cool, and simultaneous cooling and heating [section 140.4(d)]; or, must have controls to reset supply air temperature (SAT) by at least 25 percent of the difference between the design supply-air temperature and the design room air temperature [section 140.4(f)2].

Air distribution systems serving zones with constant loads shall be designed for the air flows resulting from the fully reset (e.g., lowest/highest) supply air temperature. The requirements for SAT reset apply to both CAV and VAV systems. Exceptions include:

- Systems with specific humidity needs for exempt process loads (computer rooms or spaces serving only IT equipment are not exempt).
- Zones served by space conditioning systems in which at least 75 percent of the energy for reheating, or providing warm air in mixing systems, is provided from a site-recovered or site-solar energy source.
- Systems in which supply air temperature reset would increase overall building energy use.
- Systems with controls to prevent reheat, re-cool, and/or simultaneous cooling and heating.

Supply air temperature may be reset in response to building loads, zone temperature, outside air temperature, or any other appropriate variable.

**Test trigger**

Newly Constructed and Additions/Alterations: All new supply air temperature reset controls installed on new or existing systems must be tested.

**Relevant Energy Code References and Required Compliance Documents**

Title 24, Part 6 of the California Building Code, Building Energy Efficiency Standards sections 120.5(a)15, 140.4(f), and NA7.5.15

**Who Can Perform the Test**

This test must be performed by an acceptance test technician certified by a CEC-approved Acceptance Test Technician Certification Provider, using compliance document NRCA-MCH-16-A.

**INSTALLER and INSPECTOR QUICK-REFERENCE:  
NRCA-MCH-16-A**

**Supply Air Temperature Reset Controls**

**Required Tools**

Instrumentation to perform this test may include a hand-held temperature probe or temperature data logger. Instrumentation used should be calibrated within the last year with date of calibration noted on the NRCA-MCH-16-A.

**Estimated Time to Complete Test**

- Construction inspection: 0.5 to 1 hours (depending on sensor calibration)
- Functional testing: 0.5 to 1 hours (depending on system control stability)

**Potential Issues and Cautions**

- Coordinate test procedures with the controls contractor and building staff, if possible, since they may be needed to assist with manipulation of the BAS to achieve the desired operating conditions.
- Check to make sure that chilled / hot water coils, if used, are not already fully open and calling for maximum cooling / heating. In this case, reverse Steps 1 and 2 and change the set point range as necessary to allow system to operate within acceptable bounds.
- In general, take care to avoid demand peaks exceeding what would be encountered during the normal operation of the building.
- Ensure that all disabled reset sequences are enabled upon completion of this test.

**Inspection Enforcement**

**Required:**

Verify the inspector is in receipt of one NRCA-MCH-16-A for EACH system that must demonstrate compliance.

**Optional Equipment Check:**

Verify that the acceptance test technician has access to the following equipment:

- A hand-held temperature probe.
- A temperature data logger.

**INSTALLER and INSPECTOR QUICK-REFERENCE:  
NRCA-MCH-16-A**

**Supply Air Temperature Reset Controls**

**Acceptance Criteria**

Construction Inspection Criteria:

- The temperature sensor(s) must be factory calibrated, field calibrated by a TAB technician, or field checked by test technician with a calibrated standard.
- Calibration certificate or other supporting documentation must be provided.

Functional Testing: For each system, the test criteria include:

- Supply air temperature controls modulate as intended.
- Actual supply air temperature decreases to meet the new set point within +/- 2°F.
- Supply air temperature stabilizes within 15 minutes. Supply air temperature and temperature setpoint must be documented on the NRCA-MCH-16-A.

Follow the **Construction Inspection** and **Functional Testing** instruction on the NRCA-MCH-16-A.

**INSTALLER and INSPECTOR QUICK-REFERENCE:  
NRCA-MCH-17-A  
Condenser Water Supply Temperature Reset Controls**

**Purpose and Scope of the Test**

The intent of the test is to verify that the condenser water supply (entering condenser water) temperature is automatically reset as indicated in the control sequences; based upon building loads, outdoor air wet-bulb temperature, or another appropriate control variable. All cooling tower system components (e.g., fans, spray pumps) should operate per the control sequences to maintain the proper condenser water temperature and pressure set points.

Chilled water plants serve many buildings, responding to the varying cooling loads throughout the year. As the loads vary, the chilled water supply temperatures adjust to satisfy the new operating conditions. Often, water-cooled chilled water plants can decrease the condenser water temperature in times of low cooling load. This occurrence can be demonstrated by running the cooling tower fans at a higher speed, staging on additional fans, or varying water distribution across the tower fill by closing and opening bypass valves. As a result, the cooling tower produces an energy penalty; however, the chiller efficiency and the overall plant efficiency improves.

The purpose of this test is not to evaluate whether a particular control sequence is the most appropriate for the facility, but whether the system follows the intended control sequence.

**Test trigger**

Newly Constructed and Additions/Alterations: All new condenser water temperature reset controls installed on new or existing chilled water systems with a cooling tower must be tested.

There is no code requirement that chilled water plants employ this type of control. However, if condenser water temperature reset is implemented, then it must be tested per the Energy Code.

**Relevant Energy Code References and Required Compliance Documents**

Title 24, Part 6 of the California Building Code, Building Energy Efficiency Standards sections 140.4(k)4 and NA 7.5.16

**Who Can Perform the Test**

This test must be performed by an acceptance test technician certified by a CEC-approved Acceptance Test Technician Certification Provider, using compliance document NRCA-MCH-17-A.

**INSTALLER and INSPECTOR QUICK-REFERENCE:  
NRCA-MCH-17-A  
Condenser Water Supply Temperature Reset Controls**

**Required Tools**

Performance of this test will require measuring water temperatures, and possibly air temperature, relative humidity, system pressures, and system flow rates. The instrumentation needed to perform the test may include, but is not limited to:

- Hand-held temperature probe to calibrate or check existing sensors.
- Humidity sensor or wet bulb temperature probe / psychrometer.

Installed sensors should be checked for accuracy and may be used for testing where appropriate. Any instruments used for testing or checking other sensors must have been calibrated within the past year, with date of calibration noted on the Acceptance Document.

**Estimated Time to Complete Test**

Construction Inspection: 1 to 3 hours (depending on availability of construction documentation – i.e., plumbing drawings, material cut sheets, specifications, etc. – as well as sensor calibration records)

Functional testing: 2 to 5 hours (depending on familiarity with BAS, method employed to vary operating parameters, ambient conditions, building loads, and time interval between control command and system response)

**Potential Issues and Cautions**

Condenser water temperature reset is most effective on a moderately warm day. When testing during cold weather conditions, make sure that freeze protection controls are installed and functional to prevent equipment damage. Also ensure the conditioned spaces do not fall below safe temperatures, as this may cause discomfort or unsafe working conditions.

If conducting this test during hot weather conditions, make sure the chiller load amps don't increase as the condenser water temperature decreases. If so, you will need to conduct this test on a cooler day. Likewise, stop the test if the chiller begins to surge.

This test does not require operation of the plant equipment across all operating stages, so it is not necessary, nor desirable, that the system experience peak load conditions. However, the system cooling load must be sufficiently high to run the test. If necessary, artificially increase the load to perform the functional tests, or wait until a time of stable chiller operation. If necessary, reverse Steps 1 & 2 in the functional test based on atmospheric conditions and building loads.



**INSTALLER and INSPECTOR QUICK-REFERENCE:  
NRCA-MCH-17-A  
Condenser Water Supply Temperature Reset Controls**

**Potential Issues and Cautions (cont.)**

If the system is designed to employ variable flow simultaneously with temperature reset, allow the system to operate as programmed but take care that the water flow rate stays within the minimum and maximum flow rate limits for the chiller(s) and cooling tower(s). Minimum flow through a cooling tower is important to provide even water distribution and full wetting of the fill to prevent scaling.

Exemption: There is an important exemption associated with this functional test to provide flexibility given the range of chilled water plant operations, as follows: If the control sequence differs significantly from that implied by the tests, and / or has already been tested during the building commissioning process, attach a description of the control sequence, a description of the tests that were done to verify the system operates according to the sequence, the test results, and a plot of any associated trend data.

**Inspection Enforcement**

- Check if the condenser water supply system and control system are installed per the system design, as documented on the building plans or as-builts.
- Check if condenser water supply temperature control sequence, including condenser water supply high and low limits, are available and documented in the building documents.
- Check if all cooling tower fan motors are operational, cooling tower fan speed controls are installed, operational, and connected to cooling tower fan motors per OEM start-up manuals and sequence of operation.
- Check if cooling tower fan control sequence, including tower design wetbulb temperature and approach, are available and documented in the building documents.
- Check if the following temperature sensors are installed per plans: outdoor air drybulb and wetbulb, entering condenser water, and leaving chilled water. Note any discrepancies on the Acceptance Document.
- All ambient dry bulb temperature, and relative humidity/wet bulb sensors used by controller must be factory calibrated (with certificate), field calibrated by TAB technician or other technician (with calibration results), or field checked against a calibrated reference standard by test technician (with results). Attach supporting documentation to the Acceptance Document.

**INSTALLER and INSPECTOR QUICK-REFERENCE:  
NRCA-MCH-17-A  
Condenser Water Supply Temperature Reset Controls**

**Inspection Enforcement (cont.)**

- When field calibrating temperature sensors, it is recommended that you perform a “through system” calibration that compares the reference reading to the reading at the EMCS front end or inside the controller (e.g., it includes any signal degradation due to wiring and transducer error).
- Document the following from the control system or using test sensors.
  - Current outdoor air dry bulb and wet bulb temperatures.
  - Current entering condenser water supply temperature.
  - Current leaving chilled water temperature.

**Acceptance Criteria**

Construction Inspection: All ambient temperature and relative humidity sensors used by the controller must be either calibrated (manufacturer calibrated with calibration certificates or field calibrated by TAB technician), or field checked against a calibrated sensor by the person performing the test.

Functional Test: System must meet the following criteria during the test:

- Condenser water temperature controls modulate as intended.
- Actual condenser water supply temperature decreases to meet new set point within  $\pm 2^{\circ}\text{F}$ .
- Cooling tower fan(s) stage properly and/or adjust speed accordingly to meet lower set point.
- Chiller load amps decrease.

Follow the **Construction Inspection** and **Functional Testing** instruction on NRCA-MCH-17-A.

**INSTALLER and INSPECTOR QUICK-REFERENCE:**

**NRCA-MCH-18-A**

**Energy Management Control System Acceptance**

**Purpose and Scope of the Test**

The purpose of this acceptance test is to ensure that when an EMCS is installed for the purpose of compliance with the Energy Code, it is properly installed, operational, and is in compliance with the relevant requirements in the Energy Code.

**Test trigger**

Newly Constructed and Additions/Alterations: Non-Residential Spaces with Energy Management Control Systems to address the requirements for multi-level lighting controls, automatic lighting shut-off controls, automatic daylighting controls, lighting demand response controls, or cooling tower water quality controls.

The NRCA-MCH-11 (Automatic Demand Shed Control) must be completed prior to performing this test.

**Relevant Energy Code References and Required Compliance Documents**

Title 24, Part 6 of the California Building Code, Building Energy Efficiency Standards sections 110.2(e), 120.2(h), 120.5(a)17, 130.1(b), 130.1(c), 130.1(d), 130.1(f), 130.4(b), 130.5, Nonresidential Appendix NA7.7.2

**Who Can Perform the Test**

This test must be performed by an acceptance test technician certified by a CEC-approved Acceptance Test Technician Certification Provider, using compliance document NRCA-MCH-18-A.

**Required Tools**

No additional instrumentation required for testing.

**Estimated Time to Complete Test**

Construction Inspection: 2 hours

**INSTALLER and INSPECTOR QUICK-REFERENCE:**

**NRCA-MCH-18-A**

**Energy Management Control System Acceptance**

**Potential Issues and Cautions**

IF the EMCS is used as a fault management application for an anemometer failure detection on an exhaust fan system serving a laboratory or factory greater than 10,000 CFM, THEN verify that NRCA-PRC-14-F is completed.

IF the EMCS is used as a fault management application for a contaminant sensor failure detection on an exhaust fan system serving a laboratory or factory greater than 10,000 CFM, THEN verify that NRCA-PRC-14-F is completed.

**Inspection Enforcement**

**Required:**

- Verify that the room (or zone) is installed with an occupancy sensor that is tied into both the lighting controls (section 130.1(c)) and HVAC controls (section 120.2(e)3). Refer to the ENFORCEMENT AGENCY approved designs, Compliance Documentation NRCC..., NRCI....
- Verify that the occupancy sensor is placed so that it can detect occupants in the room (or zone) without obstruction.
- Confirm that the mechanical system is served by an independent signal than the lighting controls.
- Verify that the room (or zone) is designated as eligible to shut-off ventilation while in occupied-standby mode for ventilation on Table 120.1-A (indicated by an "F" on the Table).

**Acceptance Criteria**

- The room (or zone) must pass the functional tests outlined on the NRCA-MCH-18-A.

**INSTALLER and INSPECTOR QUICK-REFERENCE:  
NRCA-MCH-19-A  
Nonresidential Occupancy Sensor Acceptance Testing**

**Purpose and Scope of the Test**

This test verifies that an installed occupancy sensor is functional and in compliance with the approved project designs and the Energy Code. The technician must submit one Certificate of Acceptance for each occupancy sensor installed.

**Test trigger**

Performed on newly installed occupancy sensors in newly constructed buildings, or additions and alterations to existing buildings.

**Relevant Energy Code References and Required Compliance Documents**

Title 24, Part 6 of the California Building Code, Building Energy Efficiency Standards sections 110.9(b)4, 120.1(c)3, 120.1(d)5, 120.2(e)3, 120.2(e)3Bi, 130.1(c)5, Table 120.1-A Note F, and NA 7.5.17.1

**Who Can Perform the Test**

This test must be performed by an acceptance test technician certified by a CEC-approved Acceptance Test Technician Certification Provider, using compliance document NRCA-MCH-08-A.

**Required Tools**

- Airflow Hood (forced or ventilation, powered or non-powered).
  - The CEC has a list of approved airflow hoods for residential applications that are also suitable for many nonresidential applications.
  - CEC Approved [Airflow Hoods](https://www.energy.ca.gov/rules-and-regulations/building-energy-efficiency/manufacture-certification-building-equipment) (<https://www.energy.ca.gov/rules-and-regulations/building-energy-efficiency/manufacture-certification-building-equipment>).

**Estimated Time to Complete Test**

Construction Inspection: 0.5 hours  
Functional testing: 0.5 hours

**INSTALLER and INSPECTOR QUICK-REFERENCE:  
NRCA-MCH-19-A  
Nonresidential Occupancy Sensor Acceptance Testing**

**Potential Issues and Cautions**

- A zone with multiple distribution registers will require that each register is tested for airflow and the total entered into the NRCA-MCH-19-A form.
- The NRCA-MCH-02-A (Outside Air) acceptance test is typically performed with the NRCA-MCH-19-A. However, in the rare instance when the NRCA-MCH-02 is not triggered, outside air flow measurements will be needed to complete the NRCA-MCH-19-A acceptance test.
- The HVAC control system is required to perform a pre-occupancy purge as part of the NRCA-MCH-02-A acceptance test.
- When a single zone damper or a single zone system serves multiple rooms, there must be an occupancy sensor in each room and the zone is not considered vacant until all rooms in the zone are vacant.

**Inspection Enforcement**

**Required:**

For projects permitted prior to October 1, 2021, the NRCA-MCH-19-A form may be completed by the installing technician, contractor, or other qualified person. The form will be a PDF fillable form with the CEC logo at the top.

For projects permitted on or after October 1, 2021, the NRCA-MCH-19-A may only be completed by a certified acceptance test technician. The form will include a watermark from an approved Acceptance Test Technician Certification Provider.

**Optional Equipment Check:**

The acceptance test technician should be able to produce and demonstrate the operation of the air flow hood required to perform this acceptance test.

**Acceptance Criteria**

This is a pass/fail acceptance test. All functional test steps must pass in order for the occupancy sensor to pass acceptance testing.

Follow the **Construction Inspection** and **Functional Testing** instruction on form NRCA-MCH-19-A.

**INSTALLER and INSPECTOR QUICK-REFERENCE:  
NRCA-MCH-20-H  
Multifamily Dwelling Unit Continuous Ventilation Acceptance  
Test**

**Purpose and Scope of the Test**

This test verifies that the continuous ventilation airflow (supply, exhaust, or balanced) and the kitchen exhaust fan conforms to the requirements of the Energy Code and ANSI/ASHRAE Standards 62.2-2016. If using supply-only or exhaust-only ventilation, Certificate of Acceptance NRCA-MCH-21-H must be completed prior to beginning this acceptance test. Submit one Certificate of Acceptance for each dwelling unit to the HERS Rater.

NOTE: HERS Verification required.

**Test trigger**

All newly constructed multifamily dwelling units with continuous ventilation must be tested.

**Relevant Energy Code References and Required Compliance Documents**

Title 24, Part 6 of the California Building Code, Building Energy Efficiency Standards sections 120.1(b)2, NA7.18.1.1, NA2.2, and ANSI/ASHRAE Standards 62.2-2016

**Who Can Perform the Test**

There are no restrictions on who can perform the test; however, the test must be verified by a HERS rater.

**Required Tools**

A pressure measurement instrumentation that complies with all of the following:

- Accurate to plus or minus 0.2 Pa or plus or minus 1 percent of the pressure reading.
- Includes a sensor plus data acquisition system.
- Makes use of a static pressure probe.

Ventilation system airflow rate measurement apparatus that complies with all of the following:

- Listed on the CEC website:  
[https://ww2.energy.ca.gov/title24/equipment\\_cert/ama\\_vs/index.html](https://ww2.energy.ca.gov/title24/equipment_cert/ama_vs/index.html).
- Calibrated according to the manufacturer procedures.

**INSTALLER and INSPECTOR QUICK-REFERENCE:  
NRCA-MCH-20-H  
Multifamily Dwelling Unit Continuous Ventilation Acceptance  
Test**

**Estimated Time to Complete Test**

Construction Inspection: 0.5 hours  
Functional Test: 0.5 to 1.5 hours

**Potential Issues and Cautions**

If multiple fans are specified to operate simultaneously to provide the total required ventilation airflow, the measurements within this functional test must be made with all applicable fans operating simultaneously.

**Inspection Enforcement**

Required:

- Verify that the system uses a fixed minimum setting for outside air when the unit is operating.
- Document the ventilation system type.
- Document the method of control.
- Document balancing system used for central ventilation systems serving multiple dwelling units.
- Verify kitchen range hood is ventilated to the outside.
- Document kitchen hood make and model.
- Verify kitchen range hood is HVI certified.
- Verify that a manual On/Off switch associated with the dwelling unit ventilation system is operational and labeled per code requirements.

Optional Equipment Check:

Have the technician demonstrate the use of the ventilation system airflow rate measurement apparatus.

**Acceptance Criteria**

This is a pass-fail test based on the air flow rates of the ventilation system (including the kitchen fan), all required functional tests must pass.

Follow the Construction Inspection and Functional Testing instruction on either NRCA-MCH-20-H.



**INSTALLER and INSPECTOR QUICK-REFERENCE:  
NRCA-MCH-21-H  
Multifamily Dwelling Unit Envelope Leakage  
Acceptance Testing**

**Purpose and Scope of the Test**

This acceptance test is used to verify that the envelope leakage rate for multifamily dwelling units conforms to the requirements of the Energy Code. Submit one certificate of acceptance for each dwelling unit to be tested to the HERS Rater.

NOTE: HERS Verification required.

**Test trigger**

Newly constructed multifamily dwelling units with supply-only or exhaust-only ventilation. Dwelling units using balanced ventilation are not required to be test.

**Relevant Energy Code References and Required Compliance Documents**

Title 24, Part 6 of the California Building Code, Building Energy Efficiency Standards sections 120.1(b), NA7.18.2, NA2.3, ANSI/RESNET/ICC 380-216, and ASTM E779-10 (2015)

**Who Can Perform the Test**

There are no restrictions on who can perform the test; however, the test must be verified by a HERS rater.

**Required Tools**

The equipment listed must have their calibrations checked at the manufacturer's recommended interval, and at least annually if no time is specified.

- Air-Moving Fan. Capable of moving air into or out of the unit to achieve target pressure differences with the exterior.
- Manometer. Capable of measuring pressure differences within a maximum error of 1 percent of reading or 25Pa (0.001 in. H<sub>2</sub>O).
- Airflow Meter. Capable of measuring volumetric airflow with a maximum error of 5 percent of measured flow.
- Thermometer. Capable a measuring air temperature within an accuracy of ± 1°C (2°F).
- Blower Door. A device that combines the Air-Moving Fan, Airflow Meter, and a cover to integrate into a fenestration.

NOTE: It is highly recommended that the assemblage of the blower door system also integrates the Manometer and include manufacturer software that will correct CFM measurements for altitude and air temperature (i.e., air viscosity and density). Otherwise, these corrections must be made manually.

**INSTALLER and INSPECTOR QUICK-REFERENCE:  
NRCA-MCH-21-H  
Multifamily Dwelling Unit Envelope Leakage Acceptance Testing**

**Estimated Time to Complete Test**

Construction Inspection: 5 minutes  
Preparation for functional testing: 0.5 to 1 hours  
Installation of functional testing equipment: 0.25 hours  
Functional Testing: 0.5 to 1 hours

**Potential Issues and Cautions**

- This acceptance test requires that the model number and serial number of the testing equipment be recorded.
- Automated calibration of the blower door is highly recommended. Otherwise the technician will be required to follow the procedures in ASTM E779-10 (2015), section 9, Equation 4 (RESNET 380 §3.4.1.5) to make the manual calibration changes.
- This test must be performed prior to NRCA-MCH-20-H acceptance test.
- The complexity of the dwelling unit and the ability of the technician to establish the boundary of the dwelling unit can greatly affect the test results. Using an experienced test technician is highly recommended.

**Inspection Enforcement**

**Required:**

This acceptance test must be performed by the technician or other qualified person (not the HERS Rater). The technician is required to complete the certificate of acceptance and submit it to the HERS Rater. The HERS Rater will perform a verification of the acceptance test using a sample-group method (one in seven). The HERS Rater will submit the verification to the inspector. The HERS Rater verification will be watermarked and produced from a HERS Provider data registry.

**Optional Check:**

Ask to see the technician acceptance tests that were given to the HERS Rater and compare the results to the HERS verification. If the HERS Rater did not receive any acceptance tests from a technician, then sampling is not permitted – all dwelling units must be tested by the HERS Rater.

**Acceptance Criteria**

The dwelling envelope passes if the calculated leakage rate (CFM50/ft<sup>2</sup>) is equal to or less than 0.3 CFM/ft<sup>2</sup> (Title 24, Part 6, section 120.1(b)2AivB2).

Follow the **Construction Inspection** and **Functional Testing** instruction on either NRCA-MCH-21-H.

**INSTALLER AND INSPECTOR QUICK-REFERENCE:  
NRCA-PRC-01-F  
Compressed Air Systems**

**Purpose and Scope of the Test**

The purpose of functionally testing the controls of a compressed air system is to confirm that the controls are set up in a compliant manner. A compliant system will choose the most efficient combination of compressors, given the current air demand as measured by a sensor, according to the Energy Code. This test is designed for flexibility, as this covers both newer compressed air systems designed with controls and older systems retrofitted with controls for the first time.

**Test trigger**

Newly Constructed and Additions/Alterations: All new compressed air systems, and all additions or alterations of compressed air systems, where the total combined online horsepower of the compressor(s) is 25 horsepower or more, must be tested.

**Relevant Energy Code References and Required Compliance Documents**

Title 24, Part 6 of the California Building Code, Building Energy Efficiency Standards section 120.6(e) and NA7.13

**Who Can Perform the Test**

There are no restrictions.

**Required Tools**

Instrumentation to perform the test includes:

- Power meter(s) for each compressor.
- Pressure transducer(s) for each compressor.
- Sensor or set of sensors to measure or infer current air demand, including but not limited to:
  - Flow meter.
  - Set of pressure transducers.
  - Pressure transducers and power meters.

**Estimated Time to Complete Test**

Construction inspection: 1 to 1.5 hours (depending on complexity of the system)  
Functional testing: 1 to 3 hours (depending on familiarity with the controls and issues that arise during testing)

**INSTALLER AND INSPECTOR QUICK-REFERENCE:  
NRCA-PRC-01-F  
Compressed Air Systems**

**Potential Issues and Cautions**

For older systems, it may not be feasible to run at a steady demand for 10 minutes. In these cases, still observe the compressors to ensure that the controls are operating efficiently.

**Inspection Enforcement**

Prior to the functional test, the system and compressor specifications must be documented. In addition, the method for determining the current air demand and the state of each of the compressors must also be documented. Having this documented will assist in determining if the controls are working properly.

**Required:**

NRCA-PRC-01-F must be completed by the installing technician or another qualified person.

**Acceptance Criteria**

The states of each compressor will be observed throughout the duration of the test. By the end of the 10-minute duration, each compressor must not exhibit short-cycling or blow-off.

For new compressed air systems, the trim compressors are the only compressors that can be partially loaded. All base compressors must be either fully loaded or off by the end of the test.

**INSTALLER and INSPECTOR QUICK-REFERENCE:  
NRCA-PRC-02-F  
Commercial Kitchen Exhaust Systems**

**Purpose and Scope of the Test**

The following acceptance tests apply to commercial kitchen exhaust systems with Type I exhaust hoods. All Type I exhaust hoods used in commercial kitchens shall be tested.

**Test trigger**

Newly Constructed and Additions/Alterations: For kitchens with Type I and Type II kitchen hood exhausts with a total exhaust rate greater than 5,000 cfm; each Type I kitchen hood exhaust must be tested.

**Relevant Energy Code References and Required Compliance Documents**

Title 24, Part 6 of the California Building Code, Building Energy Efficiency Standards section 140.9(b)1, Table 140.9-A, NA7.11, NRCC-PRC-E Table N

**Who Can Perform the Test**

There are no restrictions.

**Required Tools**

Smoke candles or smoke puffers (smoke bombs are not permitted), actual cooking at the normal production rate is also a reliable method of generating smoke.

Space differential pressure sensor.

Recording Analog Manometer with Pitot Tube and VelGrid.

**Estimated Time to Complete Test**

Construction Inspection: 0.5 hours

Functional testing: 1 hours (for each system)

**Potential Issues and Cautions**

Coordinate test procedures with the facility supervisor since they may be needed to assist with the manipulation of the control system.

Note that air currents from any HVAC system could interfere with the hood's ability to capture correctly ensure that all makeup air, and nearby space conditioning equipment are running at full volume during test.

**INSTALLER and INSPECTOR QUICK-REFERENCE:  
NRCA-PRC-02-F  
Commercial Kitchen Exhaust Systems**

**Inspection Enforcement**

**Required:**

- Verify exhaust and replacement air systems are installed, power is supplied and the control systems such as demand control ventilation are calibrated.
- For kitchen/dining facilities having total Type I and Type II kitchen hood exhaust airflow rates greater than 5,000 cfm, calculate the maximum allowable exhaust rate for each Type I hood per the Energy Code.
- *Note that the contractor can complete the test, and ATTCP certification is not required for this test at this time.*

**Acceptance Criteria**

- Smoke was fully captured.
- All Type I hoods are drawing exhaust at less than or equal to the values in the Energy Code.
- Demand Control Ventilation (DCV) and Makeup Air (MUA) system respond.
- Timed override works.
- DCV and MUA systems respond to full load conditions (all Yes).

**INSTALLER AND INSPECTOR QUICK-REFERENCE:  
NRCA-PRC-03-F  
Parking Garage Exhaust**

**Purpose and Scope of the Test**

Verify that airside economizers function properly and CO levels are maintained in a healthy range.

**Test trigger**

Newly Constructed and Additions/Alterations: All newly installed parking garage ventilation systems with carbon monoxide control must be tested.

**Relevant Energy Code References and Required Compliance Documents**

Title 24, Part 6 of the California Building Code, Building Energy Efficiency Standards section 120.6(c) and NA7.12, NRCC-PRC-E Table H

**Who Can Perform the Test**

There are no restrictions.

**Required Tools**

The instrumentation needed to perform the test may include, but is not limited to:

- Space differential pressure sensor.
- CO span gas with a concentration of 30 ppm (+/- 2 percent).

**Estimated Time to Complete Test**

Construction inspection: 1 hours  
Functional testing: 2 hours

**Potential Issues and Cautions**

Coordinate test procedures with the facility supervisor since they may be needed to assist with the manipulation of the control system.

**Inspection Enforcement**

- Carbon monoxide control sensor is factory-calibrated per §120.6(c).
- The sensor is located in the highest expected concentration location in its zone per §120.6(c).
- Control setpoint is at or below the CO concentration permitted by §120.6(c).
- *Note that the contractor can complete the test, and ATTCP certification is not required for this test at this time.*

**INSTALLER and INSPECTOR QUICK-REFERENCE:  
NRCA-PRC-03-F**

**Parking Garage Exhaust**

**Acceptance Criteria**

During a time of low activity:

- All sensors active and reading a setpoint of <25ppm
- Exhaust fans are running at minimum speed.
- Exhaust fans are drawing <30 rated power.

Applied required CO span gas testing:

- All sensors active and reading a setpoint of between 25 and 35ppm
- Exhaust fans are running at maximum speed.
- Exhaust fans go back to minimum speed when span gas is removed.
- Temporary override of the programmed sensor calibration/replacement; observation that fans ramp to full speed and an EMCS alarm is set.
- System in unoccupied mode: observation that fans ramp to full speed and an alarm is received by the facility operators.

Programmed occupied sensor proximity zone alarm differential; observation that fans ramp to full speed and an alarm is received by the facility operators.



## **INSTALLER and INSPECTOR QUICK-REFERENCE:**

### **NRCA-PRC-04-F**

#### **Evaporator Fan Motor Controls**

##### **Purpose and Scope of the Test**

This test ensures that the evaporator fans modulate their speed in response to either the space temperature or humidity, as required per the Energy Code.

Note that control strategies using humidity are very uncommon and accordingly only methods based on temperature will be described below. If humidity is included in the control logic, the design engineer should be involved in designing the test method.

##### **Test trigger**

Newly Constructed Buildings: Applies to functional testing and verification of evaporator motor fan motor variable speed controls.

Evaporator fan motor controls are required for new, or altered refrigerated warehouses that are 3,000 square feet or more and refrigerated spaces with a sum total of 3,000 square feet that are served by the same refrigeration system

Exceptions:

- Addition, alteration or replacement of less than all of the evaporators in an existing refrigerated space that does not have speed-controlled evaporators.
- Coolers within refrigerated warehouses that maintain a controlled atmosphere per the designer's requirements.
- Areas within refrigerated warehouses that are designed solely for the purpose of quick chilling/freezing of products.

##### **Relevant Energy Code References and Required Compliance Documents**

Title 24, Part 6 of the California Building Code, Building Energy Efficiency Standards section 120.6(a)3B; NA7.10.2; NRCC-PRC-E Table F

##### **Who Can Perform the Test**

There are no restrictions. The test is typically performed by the startup technician responsible for programming the setpoints in the control system.

##### **Required Tools**

Performance of this test will require measuring the temperature of the space served by the evaporators under test. The instrumentation needed to perform the test may include, but is not limited to a temperature calibrated to +/- 0.7°F between -30°F and 200°F.

**INSTALLER and INSPECTOR QUICK-REFERENCE:**

**NRCA-PRC-04-F**

**Evaporator Fan Motor Controls**

**Estimated Time to Complete Test**

Construction Inspection: 2 hours (for one system)

Functional testing: 4 hours (for one system)

**Potential Issues and Cautions**

Coordinate test procedures with the refrigeration or controls contractor, or the facility supervisor since they may be needed to assist with the manipulation of the control system. Fan speeds change slowly in normal operation, so the test requires adequate time to allow response.

**Inspection Enforcement**

**Required:**

- All temperature and sensors have been calibrated and read accurately.
- All sensors are mounted in a location away from direct discharge air drafts.
- All evaporator motors are operational and rotate in the correct direction.
- Fan speed control is operational and connected to evaporator fan motors.
- All speed controls are in "auto" mode.
- Records showing calibration was performed, what offsets or control system calibration values were used, and documentation of the instrumentation used for calibration.

**Acceptance Criteria**

- Evaporator fan controls modulate to increase fan speed, and evaporator fan speed increases in response to controls, when the test temperature setpoint is lowered in 1 degree increments below any control dead band range.
- Evaporator fan controls modulate to decrease fan speed, and evaporator fan speed decreases in response to controls, when the test temperature setpoint is raised in 1 degree increments below any control dead band range until fans go to minimum speed.

**INSTALLER and INSPECTOR QUICK-REFERENCE:  
NRCA-PRC-05-F  
Evaporative Condenser and Adiabatic Condenser Fan Motor  
Variable Speed Controls**

**Purpose and Scope of the Test**

This test ensures that the condensing temperature setpoint of the condenser is reset in response to ambient wet-bulb temperature, per the Energy Code.

This test ensures that the condenser fan speed is continuously variable, and the condenser fans are controlled in unison per the Energy Code.

This test ensures that the minimum condensing temperature control setpoint is 70°F or lower, per the Energy Code.

**Test trigger**

Newly Constructed Buildings: Applies to functional testing and verification of fan motor variable speed control for evaporative and adiabatic condensers.

Condenser fan motor controls are required on any new evaporative or adiabatic condensers installed on new refrigeration systems.

Exceptions:

- Systems for which more than 20 percent of the total design load is for quick chilling, freezing or process refrigeration.

**Relevant Energy Code References and Required Compliance Documents**

Title 24, Part 6 of the California Building Code, Building Energy Efficiency Standards sections 120.6(a)4A, 120.6(a)4C, 120.6(a)4E, 120.6(a)4F; NA7.10.3.1, and NA7.10.3.3; NRCC-PRC-E Table F

**Who Can Perform the Test**

There are no restrictions. The test is typically performed by the startup technician responsible for programming the setpoints in the control system.

**Required Tools**

Performance of this test will require measuring the ambient wet-bulb temperature, relative humidity, and condenser operating pressure. The instrumentation needed to perform the test may include, but is not limited to:

- A temperature sensor calibrated to +/- 0.7°F between -30°F and 200°F.
- A relative humidity (RH) sensor calibrated to +/- 1 percent between 5 percent and 90 percent RH.
- A pressure sensor shall be calibrated to +/- 2.5 psi between 0 and 500 psig.

**INSTALLER and INSPECTOR QUICK-REFERENCE:  
NRCA-PRC-05-F  
Evaporative Condenser and Adiabatic Condenser Fan Motor  
Variable Speed Controls**

**Estimated Time to Complete Test**

Construction Inspection: 1 hours (for one evaporative condenser)

Functional testing: 3 hours (for one evaporative condenser)

**Potential Issues and Cautions**

Coordinate test procedures with the refrigeration or controls contractor, or the facility supervisor since they may be needed to assist with the manipulation of the control system.

To ensure proper overall system operation, make sure that the system pressure is not held at excessively low or high values for an extended period of time when varying the saturated condensing temperature (SCT) control setpoint. Avoid abrupt changes in pressure. Coordinate with facility operator or refrigeration contractor.

**Inspection Enforcement**

**Required:**

- The minimum SCT control setpoint is at or below 70°F.
- The SCT value used by the control system is the temperature equivalent reading of the condenser pressure sensor.
- All drain leg pressure regulator valves (if used) are set below the minimum condensing temperature/pressure setpoint, and all receiver pressurization valves, such as the outlet pressure regulator (OPR), are set lower than the drain leg pressure regulator valve setting. This ensures that the pressure regulator valve and receiver pressurization valve settings do not force the actual condensing temperature to be higher than the minimum condensing temperature setpoint. (Note: These regulators are only used on small systems and rarely with evaporative condensers.)
- All pressure, temperatures, and humidity sensors have been calibrated and read accurately.
- Temperature and humidity sensors are mounted in a location away from direct sunlight.

**INSTALLER and INSPECTOR QUICK-REFERENCE:  
NRCA-PRC-05-F  
Evaporative Condenser and Adiabatic Condenser Fan Motor  
Variable Speed Controls**

**Inspection Enforcement (cont.)**

- All sensor readings used by the condenser controller convert or calculate to the correct conversion units at the controller (e.g., saturated pressure reading is correctly converted to appropriate saturated temperature; dry-bulb and relative humidity sensor readings are correctly converted to wetbulb temperature, etc.).
- All condenser motors are operational and rotate in the correct direction.
- All condenser fan speed controls are operational and connected to condenser fan motors, and not in bypass.
- All speed controls are in "auto" mode.
- Records showing calibration was performed, what offsets or control system calibration values were used, and documentation of the instrumentation used for calibration.

**Acceptance Criteria**

- The evaporative condenser minimum condensing temperature control setpoint is 70°F or lower.
- The target condensing temperature is reset in response to ambient wet-bulb temperature, by using a temperature difference (TD) between the condensing temperature and the ambient wet-bulb temperature.
- The condenser fan speed is continuously variable, and the condenser fans are controlled in unison – varying the speed of all fans serving a common high-side at the same time.

<b>INSTALLER and INSPECTOR QUICK-REFERENCE: NRCA-PRC-06-F Air-Cooled Condenser Fan Motor Variable Speed Controls</b>	
<b>Purpose and Scope of the Test</b>	
This test ensures that the condenser fan speed is continuously variable, that the condenser fans are controlled in unison, the minimum condensing temperature control setpoint is 70°F or lower, and that the condensing temperature of the condenser is reset in response to ambient dry-bulb temperature, per the Energy Code.	
<b>Test trigger</b>	
<p>Newly Constructed Buildings: Applies to functional testing and verification of fan motor variable speed control for air-cooled condensers.</p> <p>Condenser fan motor controls are required on any new air-cooled condensers installed on new refrigeration systems.</p> <p>Exceptions:</p> <ul style="list-style-type: none"> <li>• Systems for which more than 20 percent of the total design load is for quick chilling, freezing, or process refrigeration.</li> </ul>	
<b>Relevant Energy Code References and Required Compliance Documents</b>	
Title 24, Part 6 of the California Building Code, Building Energy Efficiency Standards sections 120.6(a)4D, 120.6(a)4E, 120.6(a)4F; NA7.10.3.2; NRCC-PRC-E Table F	
<b>Who Can Perform the Test</b>	
There are no restrictions. The test is typically performed by the startup technician responsible for programming the setpoints in the control system.	
<b>Required Tools</b>	
<p>Performance of this test will require measuring the ambient wet-bulb temperature, relative humidity, and condenser operating pressure. The instrumentation needed to perform the test may include, but is not limited to:</p> <ul style="list-style-type: none"> <li>• A temperature sensor calibrated to +/- 0.7°F between -30°F and 200°F.</li> <li>• A pressure sensor shall be calibrated to +/- 2.5 psi between 0 and 500 psig.</li> </ul>	
<b>Estimated Time to Complete Test</b>	
<p>Construction Inspection: 1 hours (for one condenser)</p> <p>Functional testing: 3 hours (for one condenser)</p>	

**INSTALLER and INSPECTOR QUICK-REFERENCE:  
NRCA-PRC-06-F  
Air-Cooled Condenser Fan Motor Variable Speed Controls**

**Potential Issues and Cautions**

Coordinate test procedures with the refrigeration or controls contractor, or the facility supervisor since they may be needed to assist with the manipulation of the control system.

To ensure proper overall system operation, make sure that the system pressure is not held at excessively low or high values for an extended period of time when varying the SCT control setpoint. Avoid abrupt changes in pressure. Coordinate with facility operator or refrigeration contractor.

**Inspection Enforcement**

- The minimum SCT control setpoint is at or below 70°F.
- The SCT value used by the control system is the temperature equivalent reading of the condenser pressure sensor.
- All drain leg pressure regulator valves (if used) are set below the minimum condensing temperature/pressure setpoint, and all receiver pressurization valves, such as the OPR, are set lower than the drain leg pressure regulator valve setting. This ensures that the pressure regulator valve and receiver pressurization valve settings do not force the actual condensing temperature to be higher than the minimum condensing temperature setpoint. (Note: These regulators are only used on small systems and rarely with evaporative condensers.)
- All pressure, temperatures, and humidity sensors have been calibrated and read accurately.
- Temperature and humidity sensors are mounted in a location away from direct sunlight.
- All sensor readings used by the condenser controller convert or calculate to the correct conversion units at the controller (e.g., saturated pressure reading is correctly converted to appropriate saturated temperature).
- All condenser motors are operational and rotate in the correct direction.
- All condenser fan speed controls are operational and connected to condenser fan motors, and not in bypass.

**INSTALLER and INSPECTOR QUICK-REFERENCE:  
NRCA-PRC-06-F  
Air-Cooled Condenser Fan Motor Variable Speed Controls**

**Inspection Enforcement (cont.)**

- All speed controls are in "auto" mode.
- Records showing calibration was performed, what offsets or control system calibration values were used, and documentation of the instrumentation used for calibration.

**Acceptance Criteria**

- The evaporative condenser minimum condensing temperature control setpoint is 70°F or lower.
- The target condensing temperature is reset in response to ambient dry-bulb temperature, by using a TD between the condensing temperature and the ambient dry-bulb temperature.
- The condenser fan speed is continuously variable, and the condenser fans are controlled in unison – varying the speed of all fans serving a common high-side at the same time.



**INSTALLER and INSPECTOR QUICK-REFERENCE:**

**NRCA-PRC-07-F**

**Variable Speed Compressor Controls**

**Purpose and Scope of the Test**

The test ensures that the applicable compressors control compressor speed in response to the refrigeration load per the Energy Code.

**Test trigger**

Newly Constructed Buildings: Applies to functional testing and verification of compressor variable speed controls.

Compressor variable speed controls are required on any new refrigeration systems.

Exceptions:

- Systems serving a refrigerated warehouse with less than 3,000 square feet of combined area.
- New open-drive screw compressors with more than one dedicated compressor per suction group.
- New open-drive screw compressors on a refrigeration system for which more than 20 percent of the total design refrigeration load is for quick chilling or freezing or process refrigeration cooling for other than a refrigerated space.

**Relevant Energy Code References and Required Compliance Documents**

Title 24, Part 6 of the California Building Code, Building Energy Efficiency Standards sections 120.6(a)5, 120.6(a)7; NA7.10.4; NRCC-PRC-E Table F

**Who Can Perform the Test**

There are no restrictions. The test is typically performed by the startup technician responsible for programming the setpoints in the control system.

**Required Tools**

To perform the test, it will be necessary to override the normal operation of the controls. The control system for the compressor must be complete, including:

- Variable speed drive on all applicable screw compressors.
- Controls to control the compressor motor speed.

## **INSTALLER and INSPECTOR QUICK-REFERENCE:**

### **NRCA-PRC-07-F**

#### **Variable Speed Compressor Controls**

##### **Estimated Time to Complete Test**

Construction Inspection: 1 hours (for one condenser)

Functional testing: 2 hours (for one condenser)

##### **Potential Issues and Cautions**

The system cooling load must be sufficiently high for the test, but the compressor should be not operating at fully capacity. Artificially increase the load by decreasing the zone setpoint, or decrease the load by increasing the zone setpoint or turning off evaporators as needed to perform the Functional Testing.

Coordinate test procedures with the refrigeration or controls contractor, or the facility supervisor since they may be needed to assist with the manipulation of the control system.

##### **Inspection Enforcement**

###### **Required:**

- All applicable single open-drive screw compressors dedicated to a suction group have variable speed control.
- All pressure and temperature sensors have been calibrated and read accurately.
- All sensor readings used by the compressor controller convert or calculate to the correct units at the controller (e.g., saturated suction pressure reading is correctly converted to appropriate saturated suction temperature (SST)).
- All compressor motor speed controls are operational and connected to compressor motors.
- All speed controls are in "auto" mode.
- Compressor panel control readings for "RPMs," "percent speed," "kW," and "amps" match the readings from the controller or other control systems.
- Compressor data is correctly entered into the PLC or other control system, to the extent required for proper control (e.g., minimum speed).
- Records showing calibration was performed, what offsets or control system calibration values were used, and documentation of the instrumentation used for calibration.

**INSTALLER and INSPECTOR QUICK-REFERENCE:**

**NRCA-PRC-07-F**

**Variable Speed Compressor Controls**

**Acceptance Criteria**

- Compressor speed decreases with decrease in load, and the slide valve (or other unloading means) are held at 100 percent capacity until the compressor speed reaches the minimum allowable setpoint.
- With an increase in load, the compressor slide valve (or other unloading means) should load to 100 percent capacity, and then the compressor speed should start in increase.

## **INSTALLER and INSPECTOR QUICK-REFERENCE:**

### **NRCA-PRC-08-F**

#### **Supply Fan Variable Flow Controls Systems**

##### **Purpose and Scope of the Test**

This test ensures that any heated slab that uses an electric resistance heating system is thermostatically controlled to prevent excess heat from entering the refrigerated space and that its load is shed during the summer on-peak period defined by the electric utility provider, as required per the Energy Code. The test verifies that the electric resistance heater is controlled according to the underfloor temperature and is forced off during the summer on-peak period.

##### **Test trigger**

This test is required when any concrete slab that utilizes electric resistance heating is installed within a refrigerated warehouse.

Exceptions: Refrigerated warehouses smaller than 3,000 square feet.

##### **Relevant Energy Code References and Required Compliance Documents**

Title 24, Part 6 of the California Building Code, Building Energy Efficiency Standards section 120.6(a)2; NA7.10.1; NRCC-PRC-E Table F

##### **Who Can Perform the Test**

There are no restrictions. The test is typically performed by the startup technician responsible for programming the setpoints in the control system.

##### **Required Tools**

Performance of this test will require measuring the amperage of the electrical circuit(s) powering the underfloor heating system. The instrumentation needed to perform the test may include, but is not limited to:

- A clamp-on amp meter.
- A device capable of accessing and manipulating the energy management system settings. (Can be a dedicated terminal at the building.)

##### **Estimated Time to Complete Test**

Construction Inspection: 2 hours (for one system)

Functional testing: 4 hours (for one system)

**INSTALLER and INSPECTOR QUICK-REFERENCE:**

**NRCA-PRC-08-F**

**Supply Fan Variable Flow Controls Systems**

**Potential Issues and Cautions**

Coordinate test procedures with the refrigeration or controls contractor or the facility supervisor since they may be needed to assist with manipulation of the control system.

Energizing the heating system prior to the slab completing its recommended cure time could compromise some of the intended qualities. Verify with the concrete manufacturer and/or slab designer that the slab has had adequate cure time before activating heaters.

**Inspection Enforcement**

**Required:**

- Verify that each of the functional testing items on NRCA-PRC-08-F are marked as passing, and that Step 4 is marked with "Complies."
- Verify that the contact information of the technician is complete on page 2 of the form.
- *Note that the contractor can complete the test, and ATTCP certification is not required for this test at this time.*

**Acceptance Criteria**

The underfloor electric resistance heater must do the following:

- De-energize when the underfloor temperature setpoint is higher, or equal to than the underfloor temperature setting (including any dead band or offset).
- Automatically turn off (and remain off) if the date and time of the control system falls within the summer on-peak period of the electric utility provider, regardless of the underfloor temperature.

**INSTALLER AND INSPECTOR QUICK-REFERENCE:  
NRCA-PRC-12-F**

**Elevator Lighting and Ventilation Controls**

**Purpose and Scope of the Test**

This test is to ensure that shut off controls installed in an elevator cab turn lighting and ventilation fans off when the elevator is not occupied for more than 15 minutes, and on when elevator cab operation resumes.

The control system must also be able to detect occupancy, and keep the lighting and ventilation fan on, in the event that someone is occupying the elevator cabin and the elevator conveyance or doors malfunction.

Shut off controls save energy by turning off unnecessary lighting and ventilation in the elevator cab while it is not operating.

**Test Trigger**

This test is required for newly installed elevators in nonresidential, high-rise residential, and hotel/motel buildings.

Exception: Elevators located in healthcare facilities.

**Relevant Energy Code References and Required Compliance Documents**

Title 24, Part 6 of the California Building Code, Building Energy Efficiency Standards section 120.6(f); NA7.14; NRCC-PRC-E Table K

**Who Can Perform the Test**

There are no restrictions. The installing contractor will typically perform this test.

**Required Tools**

This test verifies the functionality of installed automatic controls visually after a prolonged period of time. A clock or stopwatch will be needed.

**Estimated Time to Complete Test**

Construction inspection: 0.25 hours (per system)

Functional testing: 1 hours (per system)

**INSTALLER AND INSPECTOR QUICK-REFERENCE:  
NRCA-PRC-12-F**

**Elevator Lighting and Ventilation Controls**

**Potential Issues and Cautions**

The test will be performed by varying the control parameters used by the elevator lighting and ventilation fan control system. Therefore, the elevator lighting and ventilation fan control system must be installed and operating, including completion of all start-up procedures per manufacturer's or designer's recommendations, to perform the test.

Some elevators use weight sensors to provide occupancy sensing instead of occupant sensing controls. In this case, document that the elevator uses weight sensors to provide occupancy sensing control of lighting and ventilation fans.

**Inspection Enforcement**

- Verify that the construction inspection and functional testing items on NRCA-PRC-12-F are marked with "Complies."
- Verify that all declaration statements on the last page of the NRCA-PRC-12-F are complete and that the document is signed.
- *Note that the contractor can complete the test, and ATTCP certification is not required for this test at this time.*

**Acceptance Criteria**

The occupancy sensor has been located to minimize false signals, and the elevator cab does not have any obstructions that could adversely affect the sensor's performance.

For passive infrared sensors, the sensor pattern does not enter into the elevator lobby.

For ultrasonic sensors, the sensor does not emit an audible sound.

The signal sensitivity is adequate to achieve desired control. The sensor should not detect motion in the elevator lobby.

While the elevator cabin is unoccupied, the lighting and ventilation fan turn off after 15 minutes of the door closing. The lighting and ventilation fan turn on immediately upon door opening.

While the elevator cabin is occupied, the lighting and ventilation remain on.

Follow the **Construction Inspection** and **Functional Testing** instruction on NRCA-PRC-12-F.

**INSTALLER AND INSPECTOR QUICK-REFERENCE:  
NRCA-PRC-13-F  
Escalator & Moving Walkways Speed Control**

**Purpose and Scope of the Test**

This test is to ensure that the speed of the escalator or moving walkway slows when unoccupied and speeds up when passengers approach.

The control system must be able to detect occupancy and approaching pedestrians in either direction.

Speed controls save energy by reducing the speed of escalators and moving walkways when not in use.

**Test Trigger**

This test is required for newly installed escalators and moving walkways located in airports, hotels, and transportation function areas.

**Relevant Energy Code References and Required Compliance Documents**

Title 24, Part 6 of the California Building Code, Building Energy Efficiency Standards section 120.6(g); NA7.15; NRCC-PRC-E Table L

**Who Can Perform the Test**

There are no restrictions. The installing contractor will typically perform this test.

**Required Tools**

This test verifies the functionality of installed automatic controls visually after a prolonged period of time. A clock or stopwatch and calculator will be needed.

**Estimated Time to Complete Test**

Construction inspection: 0.5 hours (per system)

Functional testing: 1 hours (per system)

**Potential Issues and Cautions**

The test will be performed by varying the control parameters used by the escalator or moving walkway control system. Therefore, the escalator or moving walkway must be installed and operating, including completion of all start-up procedures per manufacturer's or designer's recommendations, to perform the test.



**INSTALLER AND INSPECTOR QUICK-REFERENCE:  
NRCA-PRC-13-F  
Escalator & Moving Walkways Speed Control**

**Inspection Enforcement**

Required:

- Verify that sensors are located in an unobstructed location.
- Verify that the construction inspection and functional testing items on NRCA-PRC-13-F are marked with "Complies."
- Verify that all declaration statements on the last page of the NRCA-PRC-13-F are complete and that the document is signed.
- *Note that the contractor can complete the test, and ATTCP certification is not required for this test at this time.*

**Acceptance Criteria**

The control systems must do the following:

- Occupant sensing controls are located to minimize false signals and do not trigger from pedestrians on adjacent escalators.
- Reduce speed to 10 feet per minute (ft/min) when passengers are not detected.
- Ramp up speed to 100 ft/min when the controls detect an approaching passenger.
- Acceleration and deceleration of the conveyance does not exceed 1 feet per second squared.
- Sound an alarm if a pedestrian is approaching the conveyance in the wrong direction.

Follow the **Construction Inspection** and **Functional Testing** instruction on NRCA-PRC-13-F.

**INSTALLER and INSPECTOR QUICK-REFERENCE:  
NRCA-PRC-14-F  
Lab Exhaust Ventilation System Controls**

**Purpose and Scope of the Test**

Verify the design and installation of the laboratory exhaust system in operation to limit excessive energy use, without sacrificing operator safety.

**Test trigger**

Newly Constructed Laboratory and Factory Exhaust Systems with airflow greater than 10,000 cubic feet per minute (cfm).

**Relevant Energy Code References and Required Compliance Documents**

Title 24, Part 6 of the California Building Code, Building Energy Efficiency Standards section 140.9(c); NA7.16.1, and NA7.16.2; NRCC-PRC-E Table O

**Who Can Perform the Test**

There are no restrictions. The test is typically performed by the startup technician responsible for programming the setpoints in the control system.

**Required Tools**

Stack flowrate monitoring equipment: S-pilot tube, 2-D or 3-D pilot tube.

Wind speed/direction measurement: handheld anemometer.

- Optional: simulation of wind speed on monitor: fan with variable speed control (must hold a simulated wind speed within 2 percent of target speed for the duration of the test).

**Estimated Time to Complete Test**

Construction Inspection: 1 hours

Functional testing: 2 hours

**Potential Issues and Cautions**

The most difficult issue will be the air dispersion modeling that must be completed prior to testing the system.

**Inspection Enforcement**

**Required:**

- Wind speed and direction sensor is factory-calibrated (with calibration certificate) or field calibrated, as specified by the Energy Code.

**INSTALLER and INSPECTOR QUICK-REFERENCE:  
NRCA-PRC-14-F  
Lab Exhaust Ventilation System Controls**

**Inspection Enforcement (cont.)**

- The sensor is located in a location and at a height that is outside the wake region of nearby structures and experiences similar wind conditions to the free stream environment above the exhaust stacks as specified by the Energy Code.
- The sensor is installed in close proximity to the fan that it will control so that it captures a representative wind speed/direction reading.
- The sensor is wired correctly to ensure proper control of volume flow rate.
- Wind speed/direction look-up table has been established and matches dispersion analysis results.
- Verify the methodology to measure volume flow rate at the stack:
  - a. Airflow sensor.
  - b. Static pressure as proxy.
  - c. Fan speed to volume flow rate curve.
  - d. Other.
- *Note that the contractor can complete the test, and ATTCP certification is not required for this test at this time.*

**Acceptance Criteria**

Wind Speed Directional Control Option:

- Upon detection of sensor and/or signal failure, the system shall reset the exhaust volume flow rate to the value needed to maintain downwind concentrations below health and odor limits for all detectable contaminants at worst-case wind conditions.
- Or
- Upon detection of sensor and/or signal failure, the system shall reset the exhaust volume flow rate to the value needed to maintain downwind concentrations below health and odor limits for all detectable contaminants at worst-case wind conditions.

**INSTALLER and INSPECTOR QUICK-REFERENCE:  
NRCA-PRC-15-F  
Fume Hood Automatic Sash Closure System**

**Purpose and Scope of the Test**

Verify that the manual and automated controls of the fume hood and sash operate in compliance with the Energy Code and the ENFORCEMENT AGENCY approved design.

**Test Trigger**

Newly constructed laboratory fume hoods with vertical only sashes, located in fume hood intensive laboratories, as defined in the Energy Code.

**Relevant Energy Code References and Required Compliance Documents**

Title 24, Part 6 of the California Building Code, Building Energy Efficiency Standards section 140.9(c)4, Nonresidential Appendix NA7.17, NRCC-PRC-E Table O

**Who Can Perform the Test**

There are no restrictions. The test is typically performed by the startup technician responsible for programming the setpoints in the control system.

**Required Tools**

- Scale small enough to be placed in the path of the closing sash capable of measuring a 10 lbs. force.

**Estimated Time to Complete Test**

Construction Inspection: 0.25 hours per hood  
Functional testing: 5 minutes per hood

**Potential Issues and Cautions**

None.

**Inspection Enforcement**

**Required:**

- The fume hood sash zone presence sensor has a valid factory calibration certificate.
- Each fume hood sash obstruction sensor has a valid factory calibration certificate.
- Presence sensor has been located and adjusted to minimize false signals
- Sash obstruction sensor has been installed per manufacturer instructions.
- Presence sensor has been installed per manufacturer instructions.

**INSTALLER and INSPECTOR QUICK-REFERENCE:  
NRCA-PRC-15-F  
Fume Hood Automatic Sash Closure System**

**Inspection Enforcement (cont.)**

- *Note that the contractor can complete the test, and ATTCP certification is not required for this test at this time.*

**Acceptance Criteria**

The fume hood automatic sash closure system passes if found to satisfy all of the following:

- The automatic sash closure system shall have a dedicated zone presence sensor that detects people in the area near the fume hood sash and automatically closes the sash within 5 minutes of no detection.
- The automatic sash closure system shall have controls to prevent the sash from automatic closing when a force of no more than 10 lbs is detected.
- The automatic sash closure system shall be equipped with an obstruction sensor that prevents the sash from automatic closing with obstructions in the sash opening. Obstruction sensor shall be capable of sensing transparent materials such as laboratory glassware.
- The automatic sash closure system shall be capable of being configured in a manual open mode where once the sash is closed, detection of people in the area near the fume hood by the zone presence sensor does not open the fume hood sash.

**INSTALLER and INSPECTOR QUICK-REFERENCE:  
NRCA-PRC-16-F  
Adiabatic Condenser Fan Motor Variable Speed Controls**

**Purpose and Scope of the Test**

Verify the proper operation of the adiabatic condensers to reject the design total heat of rejection of a refrigeration system assuming dry mode performance.

**Test trigger**

Newly Constructed Buildings: Applies to functional testing and verification of fan motor variable speed control for adiabatic condensers.

Condenser fan motor controls are required on any new adiabatic condensers installed on new refrigeration systems.

Exceptions:

- Systems for which more than 20 percent of the total design load is for quick chilling, freezing or process refrigeration.

**Relevant Energy Code References and Required Compliance Documents**

Title 24, Part 6 of the California Building Code, Building Energy Efficiency Standards sections 120.6(a)4C, 120.6(a)7E; NA7.10.3.3; NRCC-PRC-E Table F

**Who Can Perform the Test**

There are no restrictions. The test is typically performed by the startup technician responsible for programming the setpoints in the control system.

**Required Tools**

Performance of this test will require measuring the ambient wet-bulb temperature, relative humidity, and condenser operating pressure. The instrumentation needed to perform the test may include, but is not limited to:

- A temperature sensor calibrated to +/- 0.7°F between -30°F and 200°F.
- A pressure sensor shall be calibrated to +/- 2.5 psi between 0 and 500 psig.

**Estimated Time to Complete Test**

Construction Inspection: 1 hours (for one condenser)

Functional testing: 3 hours (for one condenser)

**INSTALLER and INSPECTOR QUICK-REFERENCE:  
NRCA-PRC-16-F  
Adiabatic Condenser Fan Motor Variable Speed Controls**

**Potential Issues and Cautions**

Coordinate test procedures with the refrigeration or controls contractor, or the facility supervisor for assistance with the manipulation of the control system.

To ensure proper overall system operation, make sure that the system pressure is not held at excessively low or high values for an extended period of time when varying the SCT control setpoint. Avoid abrupt changes in pressure. Coordinate with facility operator or refrigeration contractor.

**Inspection Enforcement**

**Required:**

- Verify that the minimum condensing temperature control setpoint is at or below 70°F.
- Verify that the master system controller saturated condensing temperature input is the temperature equivalent reading of the condenser pressure sensor.
- Verify all drain leg pressure regulator valves are set below the minimum condensing temperature/pressure setpoint.
- Verify all receiver pressurization valves, such as the OPR, are set lower than the drain leg pressure regulator valve setting.
- Verify all condenser inlet and outlet pressure sensors read accurately (or provide an appropriate offset) using a pressure standard.
- Verify all ambient dry bulb temperature sensors used by controller read accurately (or provide an appropriate offset) using temperature standard.
- Verify all temperature sensors used by the controller are mounted in a location that is not exposed to direct sunlight.
- Verify that all sensor readings used by the condenser controller convert or calculate to the correct conversion units (e.g., saturated pressure reading is correctly converted to appropriate saturated temperature, etc.).
- Verify that all fan motors are operational and rotating in the correct direction.
- Verify that all condenser fan speed controls are operational and connected to condenser fan motors serving a common condenser loop in unison.
- Verify that all speed controls are in "auto" mode.
- *Note that the contractor can complete the test, and ATTCP certification is not required for this test at this time.*

**INSTALLER and INSPECTOR QUICK-REFERENCE:  
NRCA-PRC-16-F  
Adiabatic Condenser Fan Motor Variable Speed Controls**

**Acceptance Criteria**

The saturated condensing temperature necessary for adiabatic condensers to reject the design total heat of rejection of a refrigeration system assuming dry mode performance shall be less than or equal to:

- The design drybulb temperature plus 20°F for systems serving freezers.
- The design drybulb temperature plus 30°F for systems serving coolers.