DOCKETED	
Docket Number:	19-BSTD-03
Project Title:	2022 Energy Code Pre-Rulemaking
TN #:	237114
Document Title:	NLCAA-CET Comments - NLCAA comments DRAFT 2022 Reference Appendices
Description:	N/A
Filer:	System
Organization:	NLCAA-CET
Submitter Role:	Public
Submission Date:	3/9/2021 5:20:21 PM
Docketed Date:	3/10/2021

Comment Received From: NLCAA-CET
Submitted On: 3/9/2021
Docket Number: 19-BSTD-03

NLCAA comments DRAFT 2022 Reference Appendices

Additional submitted attachment is included below.

NA7.6*Indoor Lighting Controls ~~Control~~ Acceptance ~~Requirements~~Tests*

~~Lighting control acceptance testing shall be performed on:~~

~~(a) Automatic Daylighting Controls complying with Section 130.1(d).~~

~~(b) Shut-off Controls complying with Section 130.1(c).~~

~~(c) Demand Responsive Controls in accordance with Section 130.1(e).~~

Luminaires that fall in both a skylit and sidelit daylit zones are controlled as part of the skylit zone

NA7.6.1 Automatic Daylighting Controls Acceptance Tests

NA7.6.1.1 Construction Inspection

Prior to Functional testing, verify and document the following:

~~Verify that automatic daylighting controls qualify as one of the required control types, are installed, and fully functional in accordance with each applicable requirement in Section 130.1(d), and list each specific exception claimed, from Section 130.1(d).~~(a) The daylit zones are shown on plans documents.

(b) The general lighting in skylit daylit zones, primary sidelit daylit zones and secondary sidelit daylit zones is controlled by automatic daylighting controls. In parking garages, the general lighting in the combined primary and secondary sidelit daylit zones is controlled by automatic daylighting controls.

(c) The automatic daylighting controls provide separate control for luminaires in each type of daylit zone. Luminaires that fall in both a skylit and ~~primary~~ sidelit daylit zone are controlled as part of the skylit zone. Luminaires that fall in both a primary sidelit daylit zone and secondary sidelit daylit zone are controlled as part of the primary sidelit daylit zone.

(d) For photosensors located within a daylit zone, at least one photosensor is not readily accessible to unauthorized personnel, including inside a locked case or under a cover that requires a tool for access

No one should have access to make changes to any daylight sensors.
Should read "all photo sensors are not readily accessible....
NRCA-LTI-03-A (A)(e)

NA7.6.1.2 Functional Testing

All photocontrols serving more than 5,000 ft² of daylit area shall undergo functional testing. Photocontrols that are serving smaller spaces may be sampled as follows:

For buildings with up to five (5) photocontrols, all photocontrols shall be tested. For buildings with more than five (5) photocontrols, sampling may be done on spaces with similar sensors and cardinal orientations of glazing; sampling shall include a minimum of one (1) photocontrol for each group of up to five (5) additional photocontrols. If the first photocontrol in the sample group passes the functional test, the remaining ~~building spaces~~photocontrols in the sample group also pass. If the first photocontrol in the sample group fails the functional test, the rest of the photocontrols in the group shall be tested. If any tested photocontrol fails the functional test, it shall be repaired, replaced or adjusted until it passes the test.

For each photocontrol to be tested, ~~do the following:~~

~~Test~~test each group of lights controlled separately by the photocontrol according to the ~~following~~ protocol in NA7.6.1.2.1 and NA7.6.1.2.2. In all interior spaces other than parking garages, ~~a~~ separate tests ~~shall be~~are conducted for daylighting control of the primary sidelit daylit zone ~~separate from~~and for daylight control of the secondary sidelit daylit zone. In parking garages, the tests are conducted on daylighting controls that control the combined area of the primary and secondary sidelit daylit zone.

NA7.6.1.2.1 Continuous Dimming Control Systems Functional Testing

~~This requirement is for systems that have more than 10 levels of controlled light output in a given zone~~Continuous dimming control systems provide more than 10 levels of controlled light output per zone.

(a) **Reference Location**. Identify the minimum daylight~~ing~~ location in the controlled zone (Reference Location) for each daylit zone type (skylit, primary sidelit, and secondary sidelit) in the space. This can be identified using either the illuminance method or the distance method and will be used for illuminance measurements in subsequent tests. For parking garages, the reference location should always be the farthest edge of the secondary sidelit daylit zone away from the opening or glazing.

Illuminance Method

~~Turn OFF controlled lighting and measure daylight illuminance within zones illuminated by controlled luminaires.~~

~~Identify the~~The Reference Location ~~; this~~ is the task location with lowest daylight illuminance in the zone illuminated by controlled luminaires.

Turn off controlled lighting and measure daylight illuminance within zones illuminated by controlled luminaires. (Note: turn the controlled lighting back on before proceeding to the No Daylight Test)

~~This location will be used for illuminance measurements in subsequent tests.~~

Distance Method

~~Identify~~ The Reference Location is the task location within the zone illuminated by controlled luminaires that is farthest away from daylight sources. ~~This is the Reference Location and will be used for illuminance measurements in subsequent tests.~~

No ~~daylight~~ Daylight ~~test~~Test. Simulate or provide conditions without daylight. Verify and document the following:

1. Document the reference illuminance at the Reference Location, which is the electric lighting illuminance level at the Reference Location (identified in NA7.6.1.2.1(a)).
2. Automatic daylight control system ~~provides appropriate control so that electric lighting system is providing~~turns on all controlled lighting to full light output unless it has been documented, such as in design documents, that continuous dimming luminaires have been intentionally tuned to less than full light output~~otherwise specified by design documents~~. For lighting system with institutional tuning of

Full output or full design output? Full output would require bypassing controls or programming like high end trim. NRCA-LTI-03-A(B-1)(c) does not specify to override any controls (changed in 2019). ATTs may not be made aware of any design comments or the controls may have been programmed according to an OPR not available to the ATT. Here the NA's and the NRCA's don't align.

NA7.6.4

~~NA7.7.5.2,~~ include documentation for luminaires claiming the power adjustment factors (PAF) for institutional tuning.

~~3. Document the reference illuminance, which is the electric lighting illuminance level at the reference location identified in Step 1.~~

4. Light output is stable with no ~~discernable~~ visible flicker.

Change to " power reduction is 100 percent under fully dimmed conditions." Cleaner language

(c) **Full ~~daylight~~ Daylight ~~test~~Test**. ~~Simulate or p~~Simulate or provide bright conditions when the daylight illuminance is greater than 150 percent of the reference illuminance (measured during the No Daylight Test from NA7.6.1.2.2(b)). Alternatively, provide simulated bright conditions by shining a bright light into the daylight sensor. Verify and document the following:

1. The controlled ~~l~~lighting power reduction is at least ~~65~~ 90 percent under fully dimmed conditions for non-parking garage locations. For parking garages, the controlled lighting power is zero under fully dimmed conditions.

~~2. and light output is stable with no discernable flicker.~~

3. Only luminaires in daylit zones are affected by daylight control~~.~~. If the daylighting control systems controls ~~lighting~~ luminaires outside of the daylight zones including those behind obstructions ~~as described in Section 130.1(d)1~~, the control system is not compliant.

4. ~~If a Power Adjustment Factor is claimed for Daylight Dimming plus OFF controls in accordance with Section 140.6(a)2H, compliant systems shall automatically turn OFF the luminaires that are receiving this credit. This portion of the full daylight test does not apply to lighting systems that are not claiming a Power Adjustment Factor for Daylight Dimming plus OFF controls.~~If a Power Adjustment Factor (PAF) is claimed for daylight dimming plus off controls in accordance with Section 140.6(a)2H; a complaint system shall automatically turn off the luminaires in order to pass the Full Daylight Test for daylight dimming plus off controls. This portion of the Full Daylight Test does not apply to lighting systems that are not claiming a PAF for daylight dimming plus off controls.

(d) **Partial ~~daylight~~ Daylight ~~test~~Test**. Simulate or provide daylight conditions where illuminance ~~(fc)~~ ~~from~~ provided only by daylight only at the Reference Location is between 60 and 95 percent of Reference Illuminance measured during the No Daylight Test from NA7.6.1.2.2(b)~~(fc) documented in Step 2~~. Verify and document the following:

1. Measure that the combined ~~illuminance of~~ daylight and controlled electric lighting ~~(fc)~~illuminance at the ~~reference~~ Reference ~~location~~ Location is no less than the ~~electric lighting illuminance (fc)~~reference illuminance measured at this location during the ~~no~~ No D~~d~~aylight ~~test~~ Test~~documented in Step (d)2~~.

2. ~~Measure~~ Verify that the combined ~~illuminance of~~ daylight and controlled electric lighting ~~(fc)~~ illuminance at the Reference Location is no greater than 150 percent of the reference illuminance ~~(fc) documented in Step (d)2~~.

3. Light output is stable with no ~~discernable~~ visible flicker.

Redundant, see NA7.6.1.1(b)

(Note: only luminaires in daylit zones are affected by daylight control)

(e) **Alternate Partial Daylight Test**. Outdoor horizontal illuminance is at least 4,000 fc and where illuminance from daylight only at the Reference Location (Partial Daylight Illuminance) is no greater than 80 percent of Reference Illuminance measured at this location during the ...t Test. Measure the outdoor horizontal illuminance level and the daylight ...e level, and do not proceed until the aforementioned illuminance criteria are met.

Add "When" before outdoor.

Need placement clarification of the light meter, e.g.. adjacent to the glazing, in direct view of the sun light, within XX feet of the glazing.

...document the following:

1. Measure the Partial Daylight Illuminance at the Reference Location. This can be measured by turning the electric lighting off. (Turn the electric lighting back on before proceeding to next step.)
2. Measure the combined daylight and controlled electric lighting at the Reference Location.
3. This alternate partial daylight test is passed if the measured illuminance value (from Step 2) is no less than the Reference Illuminance measured at this location during the no daylight test and no greater than Partial Daylight Combined Illuminance Maximum (PDCIM).

   In other words, the measured value must be within the following range in order to pass this test.

   Reference Illuminance (from the no daylight test) ≤ measured illuminance value (from Step 2) ≤ PDCIM,

   where PDCIM = Reference Illuminance (from the no daylight test) + 0.40 x Daylight Illuminance (from Step 1)

4. Light output is stable with no visible flicker.
5. Only luminaires in daylit zones are affected by daylight control.

NA7.6.1.2.2 Stepped Switching or Stepped Dimming Control Systems Functional Testing

~~This requirement is for systems that have~~Stepped switching or stepped dimming control systems provide no more than 10 discrete steps of control of light output.

~~If the control has 3 steps of control or less, conduct the following tests for all steps of control. If the control has more than 3 steps of control, testing 3 steps of control is sufficient for showing compliance.~~

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

~~*Illuminance Method*~~

~~Turn OFF controlled lighting and measure daylight illuminances within a zone illuminated by controlled luminaires.~~

~~Identify the reference location; this is the task location with lowest daylight illuminance in the zone illuminated by controlled luminaires. This location will be used for illuminance measurements in subsequent tests.~~

~~Turn controlled lights back ON.~~

~~*Distance Method*~~

~~Identify the task location within the zone illuminated by controlled luminaires that is farthest away from daylight sources. This is the reference location and will be used for illuminance measurements in subsequent tests.~~

(a) **Reference Location**. Identify the minimum daylight location in the controlled zone (Reference Location) for each daylit zone type (skylit, primary sidelit, and secondary sidelit) in the space. This can be identified using either the illuminance method or the distance method and will be used for illuminance measurements in subsequent tests. For parking garages, the reference location should always be the farthest edge of the secondary sidelit daylit zone away from the opening or glazing.

Illuminance Method

The Reference Location is the task location with lowest daylight illuminance in the zone illuminated by controlled luminaires.

Turn off controlled lighting and measure daylight illuminance within zones illuminated by controlled luminaires. (Note: turn the controlled lighting back on before proceeding to the No Daylight Test)

Distance Method

The Reference Location is the task location within the zone illuminated by controlled luminaires that is farthest away from daylight sources

(b) **No daylight test**. Simulate or provide conditions without daylight ~~for a stepped switching or stepped dimming control system~~. Verify and document the following:

1. Document the reference illuminance, which is the electric lighting illuminance level at the Reference Location (identified in NA7.6.1.2.2(a)).

~~2. If the control is manually adjusted (not self commissioning), make note of the time delay and override time delay or set time delay to minimum setting. This condition shall be in effect through step 4.~~

~~3. Automatic daylight control system turns ON all stages of controlled lights unless it is documented that multi-level luminaires have been "tuned" to less than full output and providing design illuminance (fc) levels.~~

~~4. Stepped dimming control system provides reduced flicker over the entire operating range as specified by §110.9.~~

5. ~~Document the reference illuminance which is the electric lighting illuminance level measured at the reference location identified in Step 1.~~ Automatic daylight control system turns on all stages of controlled lighting to full light output unless it has been documented, such as in design documents, that continuous dimming luminaires have been intentionally tuned to less than full light output. For lighting system with institutional tuning of NA7.7.5.2, include documentation for luminaires claiming the power adjustment factors (PAF) for institutional tuning.

6. Light output is stable with no visible flicker.

(c) **Full daylight test**. Simulate or provide bright conditions where the daylight illuminance is greater than 150 percent of the reference illuminance (measured during the No Daylight Test from NA7.6.1.2.1(b)). Alternatively, provide simulated bright conditions by shining a bright light into the daylight sensor. Verify and document the following:

1. When daylight illuminance is greater than 150 percent of the design illuminance, lighting power reduction is at least 90 percent under fully dimmed conditions for non-parking garage locations. For parking garages, the lighting power reduction is 100 percent under fully dimmed conditions

2. (Light output is stable with no visible flicker.)

3. Only luminaires in daylit zones are affected by daylight control. If the daylighting control system controls luminaires outside of the daylight zones including those behind obstructions, the control system is not compliant.

4. If a Power Adjustment Factor (PAF) is claimed for daylight dimming plus off controls in accordance with Section 140.6(a)2H; a complaint system shall automatically turn off the luminaires in order to pass the Full Daylight Test for daylight dimming plus off controls. This portion of the Full Daylight Test does not apply to lighting systems that are not claiming a PAF for daylight dimming plus off controls

~~**1. Lighting power reduction of controlled luminaires is at least 65 percent.**~~

~~**2. Only luminaires in daylit zones (toplit zone, primary sidelit zone and secondary sidelit zone) are affected by daylight control. If the daylighting controls control lighting outside of the daylight zones including those behind obstructions as described in Section 130.1(d)1, the control system is not compliant.**~~

(d) **Partial daylight test**. If the control system has one (1) to three (3) steps of control between on and off, test all control steps between on and off. If the control system has more than three (3) steps between on and off, testing three (3) control steps between on and off is sufficient to demonstrate compliance. If the control system has zero (0) steps between on and off, the partial daylight test is not necessary. For stepped switching control systems, steps in a controlled zone are achieved by turning some luminaires or groups of luminaires on or off without any steps between on and off.

For each control stage that is tested in this step, the control stages with lower setpoints than the stage tested are left ON and those stages of control with higher setpoints are

dimmed or controlled off. Simulate or provide conditions so that each control stage turns on and off or dims. Verify and document the following for each control stage:

~~1. Document the total daylight and electric lighting illuminance level measured at its reference location just after the stage of control dims or shuts off a stage of lighting:~~

2. Measure that the combined daylight and controlled electric lighting illuminance at the Reference Location is no less than the reference illuminance measured at this location during the No Daylight Test.

3. Verify that the combined daylight and controlled electric lighting illuminance at the Reference Location is no greater than 150 percent of the reference illuminance.

~~4.~~ Light output is stable with no visible flicker.(Note: only luminaires in daylit zones are affected by daylight control) ~~The total measured illumination shall be no less than the reference illuminance measured at this location during the no daylight test documented in Step 2.~~

~~A. The total measured illumination shall be no greater than 150 percent of the reference illuminance.~~

5. The control stage shall not cycle on and off or cycle between dim and undimmed while daylight illuminance remains constant.

~~**6. Only luminaires in daylit zones (toplit zone, primary sidelit zone, and secondary sidelit zone) are affected by daylight control.**~~

~~**(e) Verify time delay.**~~

~~**1. Verify that time delay automatically resets to normal mode within 60 minutes.**~~

~~**2. Set normal mode time delay to at least three minutes.**~~

~~**3. Confirm that there is a time delay of at least 3 minutes between the time when illuminance exceeds the setpoint for a given dimming stage and when the control dims or switches off the controlled lights.**~~

NA7.6.2 Shut-off Controls Acceptance Tests

NA7.6.2.1 ~~General Requirements~~

~~Verify that the shut-off control qualifies as one of the required control types, is installed, and is fully functional in accordance with each applicable requirement in Section 130.1(c), or that the application meets one of the exceptions. List each specific exception claimed, from Section 130.1(c).~~

NA7.6.2.2 ~~Occupancy~~Occupant Sensing Lighting Control<u>s Construction Inspection</u>

~~**NA7.6.2.2.1 Construction Inspection**~~

Prior to Functional testing, verify and document the following:

(a) The occupant sensing lighting controls are shown on plan documents and are installed.

(b) ~~Occupancy sensor has been located to minimize false signals:~~.

(c) Occupant sensing lighting control is ~~No closer than four (4) feet~~installed per manufacturer's instructions to minimize false triggering- such as to install an occupancy sensor away from ~~a~~ HVAC diffusers to avoid probable false triggering.

~~(d) Passive infrared sensor pattern does not enter into adjacent zones.~~

~~(e) Occupancy sensors do not encounter any obstructions that could adversely affect desired performance.~~

(f) Passive infrared sensor pattern does not enter into adjacent zones.

This would be a functional test. There is no way to check if the PIR unless doing the functional test.

(g) Ultrasonic ~~occupancy~~ occupant sensors do not emit audible sound.

NA7.6.2.3 Occupant Sensing Lighting Controls Functional Testing - General

Do ultrasonic O/S that meet code exist that emit sound? Does this question need to remain?

~~NA7.6.2.3.1 Occupancy Sensing Lighting Control Functional testing~~

For buildings with up to seven (7) ~~occupancy~~ occupant sensors, all occupant ~~occupancy~~ sensors shall be tested. For buildings with more than seven (7) occupant ~~occupancy~~ sensors, sampling may be done on spaces with similar sensors and space geometries; sampling shall include a minimum of 1 occupant ~~occupancy~~ sensor for each group of up to 7 additional occupant ~~occupancy~~ sensors. If the first occupant ~~occupancy~~ sensor in the sample group passes the acceptance test, the remaining building spaces in the sample group also pass. If the first occupant ~~occupancy~~ sensor in the sample group fails the acceptance test the rest of the occupant ~~occupancy~~ sensors in that group must be tested. If any tested occupant ~~occupancy~~ sensor fails it shall be repaired, replaced or adjusted until it passes the test.

For buildings with up to seven multi-zone occupant sensors, all occupant sensors shall be tested. For buildings with more than seven multi-zone occupant sensors, sampling may be done on the space to choose up seven multi-zone occupant sensors from the space and all seven multi-zone occupant sensors shall be tested.

NA7.6.2.3.2 Occupant Sensing Lighting Controls Functional Testing

This requirement applies to areas where occupant sensing controls are required to comply with Section 130.1(c) with the exception of Section 130.1(c)6D.

For each sensor to be tested do the following:

(a) **Unoccupied Test**. ~~For a representative sample of building spaces, s~~Simulate an unoccupied condition in the controlled space. Verify and document the following:

1. ~~Lights controlled by~~The ~~occupancy~~ occupant ~~sensors~~ sensing control turn the controlled lighting off or partially-off within a maximum of 20 minutes from the start of an unoccupied condition. In addition:

a. For partial-on occupant sensing controls, occupant sensing controls and vacancy sensing controls, the controlled lighting is turned off in unoccupied condition.

b. In the partially off state, partial off occupant sensing controls automatically reduce lighting power by at least 50 percent, or automatically reduce in one of the following:

i. For warehouses with metal halide or high pressure sodium lighting, reduce lighting power by at least 40 percent;

ii. For aisle ways and open areas in warehouses in which the installed lighting power is 80 percent or less of the value allowed under the Area Category Method, reduce lighting power by at least 40 percent;

iii. For corridors and stairwells that provide access to guestrooms and dwelling units of high-rise residential buildings and hotel/motels in which the installed lighting power is 80 percent or less of the valued allowed under the Area Category Method, reduce lighting power by at least 40 percent.

c. For occupant sensing controls in parking garages, parking areas, and loading and unloading areas, the control has at least one control step between 20 to 50 percent of the design lighting power, or the controls has at least one control step between 20 to 60 percent of the design lighting power - for the controls serving metal halide luminaires with a lamp plus ballast mean system efficacy of 75 lumens per watt. In the partially off state, partial off occupant sensing controls automatically reduce lighting power by one control step.

~~**i.**~~

~~**2. The occupant sensor does not trigger a false "on" from movement in an area adjacent to the space containing the controlled luminaires or from HVAC operation.**~~

~~**3. Signal sensitivity is adequate to achieve desired control.**~~

(b) **Occupied Test.** ~~For a representative sample of building spaces, s~~Simulate an occupied condition in the controlled space. Verify and document the following:

1. Status indicator or annunciator operates correctly.

2. ~~Lights controlled by occupancy sensors turn on i~~Immediately upon an occupied condition:

a. The occupant sensing control or partial off occupant sensing control turns on controlled lighting; or

b. The vacancy sensing control indicate a space is occupied and the controlled lighting can be turned~~, OR sensor indicates space is "occupied" and lights are turned~~ on manually ~~(automatic OFF and manual ON control strategy)~~; or~~.~~

c. The partial-on occupant sensing control automatically turns on the controlled lighting at between 50 to 70 percent of controlled lighting

power. After the partial-on stage, manual switches can be activated to turn on the controlled lighting at full controlled lighting power.

NA7.6.2.3.3 Multi-Zone Occupant Sensing Lighting Controls Functional Testing

This requirement applies to areas where multi-zone occupant sensing controls are required to comply with Section 130.1(c)6D for offices larger than 250 square feet.

(a) Occupied Control Zone Test. Simulate an occupied condition in the control zone controlled by the occupant sensor. Verify and document the following:

(i) Simulate an occupancy in a control zone. Immediately upon occupancy of the control zone, the occupant sensors turn on controlled lighting.

(ii) Measure the illuminance at a location in the control zone where the light output is from the controlled lighting at full light output.

(iii) Signal sensitivity is adequate to achieve desired control.

(iv) Status indicator or annunciator operates properly.

(b) **Unoccupied Control Zone Test.** Simulate an unoccupied condition in the control zone controlled by the occupant sensor. Verify and document the following:

(i) Simulate an unoccupancy in a control zone. Within a maximum of 20 minutes from the start of the unoccupied condition in the control zone, the occupant sensor uniformly reduces light output of the controlled lighting.

(ii) Measure the illuminance at the same location as in Step (a)1. Verify that the light output during unoccupancy is no more than 20 percent of the full light output measured in Step (a)1.

(iii) The occupant sensing control does not trigger a false on from movement outside of the control zone or from HVAC operation.

(Informational note: The field of view of occupant sensors in the adjacent control zones in offices greater than 250 square feet may overlap, but the field of view should stay away from an adjacent enclosed spaces that is not part of the large office, like conference rooms, and private offices.)

(iv) Signal sensitivity is adequate to achieve desired control.

(c) Control Zone Size Test. Follow the procedures described in either Method 1 or Method 2 below.

Method 1: Simulate an unoccupied condition in the control zone controlled by the occupant sensor while standing in an adjacent control zone. Determine the "edge" of the control zone controlled by the occupant sensor by moving toward the occupant sensor until the lights controlled by the occupant sensor turn on as in Step (a)1 – to simulate an occupied condition for that control zone. Measure, determine and document the following:

(i) Measure the distance (in feet) from the "edge" of the control zone to the spot that is directly below the occupant sensor. This is the radius of the control zone.

(ii) Determine the area of the control zone by using the formula: Area = π*radius2.

(iii) The area of the control zone must be less than or equal to 600 square feet.

Method 2: Simulate an unoccupied condition for the entire office space. Verify and document the following:

(iv) Walk thru the space and count the number of zones of lighting turned on automatically as walking thru the space.

(v) Document the number of zones being turned on. Determine the size of the office in square footage from construction plans or from other information source.

(vi) Divide the size of the office by the number of zones. This calculated value is the assessed control zone size (in square feet).

(vii) If the value is less than or equal to 600 square feet, it passes the test. Otherwise, it fails the test.

(d) Unoccupied Office Test. Simulate an unoccupied condition in all control zones controlled by all occupant sensors in the office. Verify and document the following:

(i) Within a maximum of 20 minutes from the start of the unoccupied condition of the entire office, all general lighting in the office shall turn off.

~~3.~~

NA7.6.2.4 Automatic Time Switch Lighting Controls Construction Inspection

~~**NA7.6.2.4.1 Construction Inspection**~~

Add "and is installed"

Prior to Functional testing, verify and document the following:

(a) The automatic time switch controls are shown on plan documents.

(b) Automatic time switch control is programmed with acceptable weekday, weekend, and holiday (if applicable) schedules.

(c) Document for the ~~owner~~ automatic time switch programming including weekday, weekend, holiday schedules as well as all set-up and preference program settings.

(d) ~~Verify t~~The correct time and date is properly set in the time switch.

(e) ~~Verify t~~The battery back-up (if applicable) is installed and energized.

(f) Manual ~~Override~~ override time limit is set to no more than 2 hours.

(g) Manual ~~Override~~ override switches located remotely from area with controlled luminaires ~~have annunciator lights~~allow the user to see the controlled luminaires or have a visually signal or display showing the current state of the controlled luminaires.

NA7.6.2.5 Automatic Time Switch Lighting Controls Functional Testing

~~**NA7.6.2.5.1 Automatic Time Switch Lighting Control Functional testing**~~

(a) Occupied Test. Simulate an occupied condition in the controlled space. Verify and document the following:

1. ~~All lights can be~~The automatic time switch control turns ~~turned~~ on ~~and off by their respective area control switch~~the controlled lighting.
2. ~~Verify the switch only operates lighting in the enclosed space (ceiling-height partitioned area) in which the switch is located.~~
3. ~~For the area controlled by an automatic time-switch control with a time-override located in and for the area, verify the lighting can be turned on manually by initiating the time-override and the lighting is configured to remain ON for no more than 2 hours.~~
4. ~~For the area controlled by an automatic time-switch control with an automatic holiday shut-OFF feature, verify the lighting in the area can be turned off automatically by initiating the holiday shut-OFF.~~
5. ~~For the area controlled by an automatic time-switch control with manual-ON mode configured, verify the lighting in the area can be turned ON manually when it is manually activated.~~

(b) Unoccupied Test. Simulate an unoccupied condition in the controlled space. Verify and document the following:

1. The automatic time switch control turns off ~~All~~ all ~~non-exempt~~controlled lighting ~~turn off in accordance with the programmed time switch schedules~~.
2. During test, for the area controlled by an automatic time-switch control with a configured automatic holiday shut-OFF, the controlled lighting can be turned off automatically by the holiday shut-OFF. For exempt areas, the lighting is not required to be configured with automatic holiday shut-OFF.
3. For the area controlled by an automatic time-switch control with a time-override located in and for the area, verify the lighting can be turned on manually by initiating the time-override and the lighting is configured to remain ON for no more than 2 hours. For exempt areas, the lighting can be configured to remain ON for more than 2 hours and until the next scheduled shut off occurs.

   ~~Manual override switch allows only the lights in the enclosed space (ceiling height partitioned) where the override switch is located to turn on or remain on until the next scheduled shut-off occurs.~~

NA7.6.3 Demand Responsive Controls Acceptance Tests

NA7.6.3.1 Construction Inspection

Prior to Functional testing, verify and document the following:

(a) The demand responsive control is setup to communicate in one of the following communication protocols: Wi-Fi, ZigBee, BACnet, Ethernet or hard wiring. (~~That the demand responsive control is capable of receiving a demand response signal directly or indirectly through another device and that it complies with the~~ requirements ~~in~~ of Section 110.12). The demand responsive controls is setup to communicate for the functional testing of NA7.6.3.2. ~~130.1(e).~~

~~If the demand response signal is received from another device (such as an EMCS), that system must itself be capable of receiving a demand response signal from a utility meter or other external source.~~

NA7.6.3.2 Functional Testing

There are three methods to verify the reduction in lighting power due to the demand responsive lighting controls. For methods 1 and 2, buildings with up to seven (7) enclosed spaces requiring demand responsive lighting controls, all spaces shall be tested. For buildings with more than seven (7) enclosed spaces requiring demand responsive lighting controls, sampling may be done on additional spaces with similar lighting systems; sampling shall include a minimum of 1 enclosed space for each group of up to 7 additional enclosed spaces. If the first enclosed space with a demand responsive lighting control in the sample group passes the acceptance test, the remaining building spaces in the sample group also pass. If the first enclosed space with a demand responsive lighting control in the sample group fails the acceptance test the rest of the enclosed spaces in that group must be tested. If any tested demand responsive lighting control system fails it shall be repaired, replaced or adjusted until it passes the test. Method 3 tests the entire facility at once, does not require sampling, but requires the facility lighting to be disaggregated from other end-use loads.

Test the reduction in lighting power due to the demand responsive lighting control using one of the following three ~~two~~ methods.

Add " Or secondary sidelit area"

NA7.6.3.2.1 Method 1: Illuminance Measurement. Measure the reduction in illuminance in enclosed spaces required to meet Section 110.12(c)~~130.1(b)~~, as follows:

(a) In each space, select one location for illuminance measurement. The chosen location must not be in a skylit or primary sidelit area. When placed at the location, the illuminance meter must not have a direct view of a window or skylight. If this is not possible, perform the test at a time and location at which daylight illuminance provides less than half of the design illuminance. Mark each location to ensure that the illuminance meter can be accurately located.

(b) Full output test

1. Using the manual switches/dimmers in each space, set the lighting system to full output. Note that for lighting system that has been task tuned, override the controls to allow the lighting system to go to full output. Note also that the lighting in areas with photocontrols or occupant ~~occupancy~~/vacancy sensors may be at less than full output, or may be off.
2. Take one illuminance measurement at each location, using an illuminance meter.
3. Simulate a demand response condition using the demand responsive control.
4. Take one illuminance measurement at each location with the electric lighting system in the demand response condition.
5. Calculate the area-weighted average reduction in illuminance in the demand response condition, compared with the full output condition. The area-weighted reduction must be at least 15% but must not reduce the illuminance below the minimum output condition ~~but must not reduce the combined illuminance from electric light and daylight to less than 50% of the design illuminance in any individual space~~.

(c) Minimum output test

1. Determine illuminance at minimum output condition:
    i. Using the manual switches/dimmers in each space, set the lighting system to minimum output (but not off). Note that the lighting in areas with photocontrols or occupant ~~occupancy~~/vacancy sensors may be at more than minimum output, or may be off.
    ii. Take one illuminance measurement at each location, using an illuminance meter.
2. Determine illuminance at demand response condition:
    i. Simulate a demand response condition using the demand responsive control.
    ii. Take one illuminance measurement at each location with the electric lighting system in the demand response condition.
3. Determine compliance:
    i. In each space, the illuminance in the demand response condition must not be less than the illuminance in the minimum output condition (but not turned off)~~or 50% of the design illuminance, whichever is less~~.

    EXCEPTION: In daylit spaces, the illuminance in the demand response condition may reduce below the minimum output condition~~, but in the demand response condition the combined illuminance from daylight and electric light must be at least 50% of the design illuminance~~.

NA7.6.3.2.2 Method 2: Current measurement. Measure the reduction in electrical current in spaces required to meet Section 110.12~~130.1(b)~~, as follows:

(a) At the lighting circuit panel, select at least one lighting circuit that serves spaces required to meet Section 110.12~~130.1(c)~~.

(b) Full output test

1. Using the manual switches/dimmers in each space, set the lighting system to full output. Note that the lighting in areas with photocontrols or occupant ~~occupancy~~/vacancy sensors may be at less than full output, or may be off.
2. Take one electric current measurement for each selected circuit.
3. Simulate a demand response condition using the demand responsive control.
4. Take one illuminance measurement at each location with the electric lighting system in the demand response condition.
5. Add together all the circuit currents, and calculate the reduction in current in the demand response condition, compared with the full output condition. The combined reduction must be at least 15%~~ but must not reduce the output of any individual circuit by more than 50%~~.

(c) Minimum output test

1. Using the manual switches/dimmers in each space, set the lighting system to minimum output (but not off). Note that the lighting in areas with photocontrols or occupant ~~occupancy~~/vacancy sensors may be at more than minimum output, or may be off.
2. Take one electric current measurement for each selected circuit.
3. Simulate a demand response condition using the demand responsive control.
4. Take one electric current measurement for each selected circuit with the electric lighting system in the demand response condition.
5. In each space, the electric current in the demand response condition must not be less than ~~50% or~~ the electric current in the minimum output condition~~, whichever is less~~.

   EXCEPTION: Circuits that supply power to the daylit portion of enclosed spaces as long as lighting in non-daylit portions of the enclosed space.

NA7.6.3.2.3 Method 3: Full facility current measurement. Measure the reduction in electrical current of the full facility on the lighting end-use disaggregated circuit for spaces that are required to meet Section 110.12, as follows:

(a) At the circuit panel, select the circuit that serves the lighting load of the entire facility.

(b) Full output test

1. Using the facility lighting controls, set the lighting system to full output. Note that the lighting in areas with photocontrols or occupant /vacancy sensors may be at less than full output or may be off.
2. Take one electric current measurement on the circuit. This is your pre-event current.
3. Simulate a demand response condition using the demand responsive control.

4. Take one electric current measurement on the circuit. This is your post-event current.
5. Calculate the difference between the pre-event current and the post-event current to determine your wattage reduction.
6. Divide the wattage reduction by the wattage of general lighting required to meet Section 110.12. The percent reduction in wattage must be at least 15%.

(c) Minimum output test

1. Using the facility controls, set the lighting system to minimum output (but not off). Note that the lighting in areas with photocontrols or occupant /vacancy sensors may be at more than minimum output or may be off.
2. Take on electric current measurement on the circuit. This is your pre-event current.
3. Simulate a demand response condition using the demand responsive control.
4. Take one electric current measurement on the circuit. This is you post event current.
5. The post-event current must not be less than the pre-event current in the minimum output condition.

NA7.6.4 Institutional Tuning Power Adjustment Factor (PAF) Acceptance Tests

For buildings with up to seven (7) enclosed areas claiming the institutional tuning PAF (power adjustment factor), all areas shall be tested. For buildings with more than seven (7) areas claiming this PAF, random sampling may be done on seven of the larger enclosed areas with tuned dimming systems. If any of the areas in the sample group of seven areas fails the acceptance test, another group of seven areas must be tested. If any tested system fails, it shall be tuned until it passes the test.

NA7.6.4.1 Construction Inspection

Prior to functional testing, verify and document the following:

(a) 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.

(b) The controls or the methods of controlling the maximum output of luminaires is such that the maximum light output of the controlled lighting system can be limited and that normal operation of the controlled lighting does not override the maximum light output.

(c) The controls are not readily accessible to unauthorized personnel.

NA7.6.4.2 Functional Testing

For each area to be tested, follow the procedures in Method 1 or Method 2 below:

(a) The acceptance test technician shall either observe the first seven (7) systems being successfully tuned or shall verify systems that have already been tuned using the sampling protocol described in NA7.6.4.

(b) If the acceptance test technician is observing the tuning of the system, the party responsible for the tuning shall certify that the remainder of the system is tuned in a similar manner.

NA7.6.4.2.1 Method 1: Observation of the Systems During Institutional Tuning

Step 1: Determination of maximum power or light output prior to institutional tuning

(a) Set all lighting controls to provide maximum output of the tested system without applying the limits specified for institutional tuning.

(b) Measure the full light output at a location where the illuminance is due to the controlled lighting, or measure the power draw of the controlled lighting. Current measurements may be used instead of power measurements.

Step 2: Institutional Tuning and Post-tuning Measurement

(a) Apply the limits specified for institutional tuning to the lighting system. Do not alter any other control settings.

(b) Verify the light or power reduction after institutional tuning by measuring the light output at the same location as in Step 1 or measure the power draw of the same circuit as in Step 1. Current measurements may be used instead of power measurements.

(c) If the light output or power draw measured in Step 2(b) is 85% or less of the light output or power draw measured in Step 1(b), the system passes this test; otherwise the system fails this test.

NA7.6.4.2.2 Method 2: Verification of Systems Already Tuned

Step 1: Measurement of tuned lighting system

(a) Set all lighting controls except institutional tuning controls to provide maximum output of tested system. Controls set to maximum light output include but not limited to: manual dimmers, multilevel occupant sensing, and automatic daylighting controls.

(b) Measure full light output at location where most of the illuminance is due to the controlled lighting or measure power draw of the controlled lighting. Current measurements may be used instead of power measurements.

Step 2: Measurement of lighting system with institutional tuning overriden

(a) Reset institutional tuning controls to allow full light output. Set all lighting controls to provide maximum output of tested system including but not limited to: institution tuning control, manual dimmers, multilevel occupant sensing, and automatic daylighting controls.

(b) Measure full light output at the same location as in Step 1 or measure the power draw of the same circuit as in Step 1. Current measurements may be used instead of power measurements.

(c) If the light output or power draw measured in Step 1(b) is 85% or less of the light output or power draw measured in Step 2(b), the system passes this test; otherwise the system fails this test.

Step 3: Restore Institutional Tuning settings

(a) If the tested system passed the test in Step 2, restore the institutional tuning settings.

NA7.6.5 Demand Responsive Controls – Controlled Receptacles

NA 7.6.5.1 Construction Inspection

Prior to functional testing, verify and document the following:

(a) That the demand responsive control is capable of receiving a demand response signal directly or indirectly through another device and that it complies with the requirements in Section ~~130.1~~(e). 110.12

(b) If the demand response signal is received from another device (such as an EMCS), that system must itself be capable of receiving a demand response signal from a utility meter or other external source.

(c) Verify that demand responsive controlled receptacles are installed.

(d) Verify if the receptacle has a permanent and durable marking for controlled receptacles or circuits to differentiate them from uncontrolled receptacles or circuits.

(e) Verify the receptacle is controlled by an automatic shut-off control.

NA 7.6.5.2 Functional Test

NA 7.6.5.2.1

For buildings with up to seven (7) enclosed spaces requiring demand responsive controlled receptacles, an Acceptance Test Technician shall test all spaces.

For buildings with more than seven (7) enclosed spaces requiring demand responsive lighting controls:

1. An Acceptance Test Technician may either:
    a. test all of the spaces; or
    b. test seven spaces and sample the additional spaces; with each sample to include a minimum of 1 enclosed space for each sample group of up to 7 additional enclosed spaces.
2. If the first enclosed space with a demand responsive controlled receptacle in a sample group passes the acceptance test, the remaining building spaces in the sample group also pass. If the first enclosed space with a demand responsive controlled receptacle in the sample group fails, the Acceptance Test Technician shall test rest of the enclosed spaces in that group.

NA 7.6.5.2.2

If any tested demand responsive controlled receptacle fails, it shall be repaired, replaced or adjusted until it passes the test.

NA 7.6.5.2.3

The acceptance test for each demand responsive controlled receptacle includes testing the reduction in receptacle power due to the demand responsive control using both of the following methods:

ON Test

1. Trigger the shut off control to turn the demand responsive controlled receptacle ON, or if the receptacle has a manual control turn the receptacle ON.
2. Verify each controlled outlet has full voltage (125v) present.
3. Simulate a DR condition.
4. Verify at each controlled outlet that zero voltage (0 V) is present (deenergized).
5. Verify the controlled receptacle cannot be overridden to turn ON by the automatic shut-off controls or any manual control.
6. Simulate a normal condition (non-DR condition).
7. Verify each controlled outlet has full voltage (125v) present.

OFF Test

1. Trigger the automatic shut-off control to turn the demand responsive controlled receptacle OFF or if the receptacle has an ON/OFF button, manually turn the receptacle OFF.
2. Verify at each controlled outlet that zero voltage (0 V) is present (deenergized).
3. Simulate a DR condition.
4. Verify at each controlled outlet that zero voltage (0 V) is present (deenergized).
5. Verify that the demand responsive controlled receptacle cannot be overridden to turn ON by automatic shut-off controls or any manual control.
6. Simulate a normal condition (non-DR condition).
7. Verify each controlled outlet has zero voltage (0 V) present.

NA7.7*Indoor Lighting Controls Installation ~~Requirements~~Verifications*

~~Lighting control installation inspection shall be performed on:~~

NA7.7.6 Lighting for a Videoconferencing Studio in Accordance with Exception to Section 140.6(a)3T

NA7.7.6.1 Installation Inspection

Verify and document the following:

(a) The videoconferencing studio is using only the Area Category Method for compliance. The extra lighting allowance shall not be taken when using the Complete Building Method or Tailored Method of compliance.

(b) The Videoconferencing Studio is a room with permanently installed videoconferencing cameras, audio equipment, and playback equipment for both audio-based and video-based two-way communication between local and remote sites.

(c) General lighting is switched in accordance with Table 130.1-A.

(d) Wall wash lighting is separately switched from the general lighting system.

(e) All of the lighting is controlled by a multiscene programmable control system (scene preset control system).

(f) If all of the above is not true, the installation fails, and the extra wattage for videoconferencing studio lighting cannot be used.

NA7.8 *Outdoor Lighting Controls Acceptance ~~Test~~ Tests*

~~**Verify that outdoor lighting controls qualify as one of the required control types, are installed, and are fully functional in accordance with each applicable requirement in Section 130.2(c), or that the application meets one of the exceptions. List each specific exception claimed, from Section 130.2(c).**~~

NA7.8.1 Motion Sensing~~or Construction Inspection~~Controls Acceptance Tests

NA7.8.1.1 Construction Inspection

Prior to f~~F~~unctional testing, verify and document the following:

(a) The motion sensing controls are shown on plan documents and are installed.

(b) Motion ~~Sensor~~ sensor ~~has been~~is located to minimize false signals.

~~(c) Sensor is not triggered by motion outside of adjacent area.~~

(d) Desired sensor coverage is not blocked by obstructions that could adversely affect performance.

NA7.8.1.2 Functional Testing

For building sites with up to seven (7) ~~outdoor~~ motion sensors, all ~~outdoor~~ motion sensors shall be tested. For ~~buildings~~ sites with more than seven (7) ~~outdoor~~ motion sensors ~~for outdoor lighting system~~, sampling may be done on outdoor areas with similar sensors that cover similar unobstructed areas; sampling shall include a minimum of 1 ~~outdoor~~ motion sensor for each group of up to 7 additional ~~outdoor~~ motion sensors.

If the first sensor in the sample group passes the acceptance test, the remaining outdoor areas in the sample group also pass. If the first motion sensor in the sample group fails the acceptance test, the rest of the sensors in that group shall be tested and any failed sensor in the sample group shall be repaired or replaced and retested until the sensor passes the test.

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

(a) Status indicator operates correctly.

(b) ~~Lights~~ Luminaires controlled by sensors turn on immediately upon entry into the area lit by the controlled ~~lights~~ luminaires near the sensor.

(c) Signal sensitivity is adequate to achieve desired control.

Step 2: Simulate no motion in area with lighting controlled by the motion sensor.

Verify and document the following:

(a) ~~Lights~~ The controlled luminaires are turned off or the lighting power of each controlled luminaire ~~by the sensor reduces light output~~is reduced by at least 50 percent and no more than 90 percent within a maximum of ~~30~~ 15 minutes from the start of an unoccupied condition.

(b) The sensor does not trigger a false "on" from movement outside of the controlled area.

(c) Signal sensitivity is adequate to achieve desired control.

NA7.8.2 Photocontrols ~~Construction Inspection~~Acceptance Tests

NA7.8.3.1 Construction Inspection

Verify and document the following:

The photocontrols are shown on plan documents and are ~~is~~ installed.

NA7.8.3.2 Functional Testing

For building sites with up to seven (7) photosensors, all photosensors shall be tested. For sites with more than seven (7) photosensors, sampling may be done on outdoor areas with similar photosensors that cover similar unobstructed areas; sampling shall include a minimum of 1 photosensors for each group of up to 7 additional photosensors.

If the first photosensors in the sample group passes the acceptance test, the remaining outdoor areas in the sample group also pass. If the first photosensors in the sample group fails the acceptance test, the rest of the photosensors in that group shall be tested and any failed photosensors in the sample group shall be repaired or replaced and retested until the photosensors passes the test. ~~Photocontrol Functional Testing~~

Verify and document the following:

~~(a)~~ (a) During daytime simulation, all controlled ~~outdoor lights~~ luminaires are turned off.

(b~~b~~) During nighttime simulation, all controlled ~~outdoor lights~~ luminaires are turned on.

NA7.8.3 RESERVED~~Astronomical Time-Switch Control Construction Inspection~~

~~Prior to Functional Testing, confirm and document the following:~~

~~(a) Verify the astronomical time-switch control is installed.~~

~~(b) Verify the astronomical time switch control is programmed with ON schedule and OFF schedule that matches the schedules in the construction documents. If the schedule is unknown, verify that the programmed schedule matches the default schedule where the OFF schedule is from midnight to 6am and the ON schedule is all other night time hours, seven days per week.~~

~~(c) Demonstrate and document for the lighting control programming including ON schedule and OFF schedule, for weekday, weekend, and holidays (if applicable).~~

~~(d) Verify the correct time and date is properly set in the control.~~

NA7.8.4 RESERVED~~Astronomical Time-Switch Control Functional Testing~~

~~Verify and document the following:~~

~~(a) During daytime simulation, all controlled outdoor lighting is turned OFF.~~

~~(b) During nighttime simulation, all controlled outdoor lighting is turned ON in accordance with the astronomical schedule.~~

~~(c) During nighttime simulation, power of controlled outdoor lights is turned OFF or reduced by at least 50 percent in accordance with the programmed schedule.~~

NA7.8.5 Automatic Scheduling -Controls ~~Construction Inspection~~Acceptance Tests

NA7.8.7.1 Construction Inspection

Prior to f~~F~~unctional t~~T~~esting, confirm and document the following:

(a) ~~Verify the~~The automatic scheduling controls are shown on plan documents and are ~~is~~ installed.

(b) ~~Verify the~~The control is programmed with ~~ON~~ on schedules and ~~OFF~~ off schedule that matches the schedules in the construction documents. If the schedule is unknown, ~~verify~~ confirm that the programmed schedule matches the default schedule where the ~~OFF~~ off schedule is from midnight to 6am and the ~~ON~~ on schedule is all other night time hours, seven days per week.

(c) ~~Demonstrate and document for t~~The lighting control programming including both ~~ON~~ on schedule and ~~OFF~~ off schedule, for weekday, weekend, and holidays (if applicable).

(d) ~~Verify the~~The correct time and date is properly set in the control.

~~Prior to Functional Testing for occupancy-based control type, verify and document the following:~~

~~(a) Sensor has been located to minimize false signals.~~

~~(b) Sensor is not triggered by motion outside of adjacent area.~~

~~(c) Desired sensor coverage is not blocked by obstructions that could adversely affect performance.~~

NA7.8.6 ~~Automatic Scheduling Control Functional Testing~~**Functional Testing**

Verify and document the following:

(a) During daytime simulation, all controlled ~~outdoor lighting~~ luminaires are ~~is~~ turned ~~OFF~~off.

(b) During nighttime simulation with the programmed occupied period, all controlled ~~outdoor~~ luminaires are ~~lighting is~~ turned ~~ON~~on ~~in accordance with the programmed schedule~~.

(c) During nighttime simulation with the programmed unoccupied period, ~~power of~~the controlled ~~lighting~~ luminaires ~~is~~ are turned ~~OFF~~ off or the lighting power of controlled luminaires is reduced by at least 50 percent and no more than 90 percent~~in accordance with the programmed schedule~~.

~~For automatic scheduling control used in conjunction with motion sensing control, verify and document the following:~~

~~(a) During daytime simulation, all controlled outdoor lighting is turned off.~~

~~(b) Simulate motion in area under the luminaire controlled by the motion sensing control. Verify and document the following:~~

~~i. Status indicator operates correctly.~~

~~ii. Luminaires controlled by the sensor turn on immediately upon entry into the area lit be the controlled luminaires near the motion sensing control.~~

~~iii. Signal sensitivity is adequate to achieve desired control.~~

~~(c) During simulation of normally occupied schedule, simulate no occupancy in area with lighting controlled by the motion sensing control. Verify and document the following:~~

~~i. The outdoor lighting power controlled by the motion sensing control is reduced by at least 50 percent within a maximum of 15 minutes from the start of an unoccupied condition. Fraction of light output reduction is an acceptable proxy for reduction in lighting power.~~

~~ii. Signal sensitivity is adequate to achieve desired control.~~

~~(d) During simulation of normally unoccupied schedule, simulate no occupancy in area with lighting controlled by the motion sensing control. Verify and document the following:~~

~~i. The outdoor lighting power controlled by the motion sensing control is reduced by at least 50 percent within a maximum of 15 minutes from the start of an unoccupied condition. Fraction of light output reduction is an acceptable proxy for reduction in lighting power.~~

~~ii. Signal sensitivity is adequate to achieve desired control.~~