ENERGY CENTER OF WISCONSIN

Calibration and commissioning for energy savings from daylighting

GUIDANCE FOR CONTRACTORS AND BUILDING PROFESSIONALS

www.ecw.org

TIP SHEET

With funding from Minnesota Conservation Applied Research and Development (CARD) Grant program—a division of energy resources, Minnesota Department of Commerce.

Daylighting control—or daylight harvesting—has become a common energy-saving strategy in building design. Best practices suggest that successful implementation of automatic daylighting control requires a significant commissioning effort to reach full energy-savings potential. This tip sheet describes important commissioning tasks of startup, calibration and functional testing of the controls. While commissioning includes a broad scope, a recent Energy Center of Wisconsin research project quantified the specific importance of these tasks.

COMMISSIONING

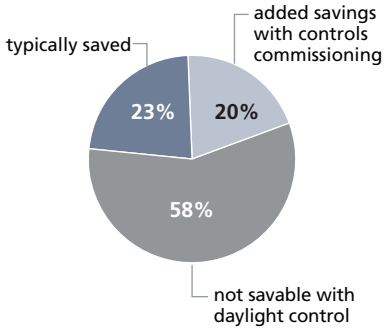
Commissioning ideally extends from the start of design through occupancy. However, the most critical steps in the process for daylighting control occur after installation—when the installation is verified, the system is started up and calibrated, and functional testing is complete. It is best to have a single person—a third party agent or a member of the construction team—responsible for verifying completion of these steps in accordance with design, manufacturer specifications and owner requirements. These and other commissioning tasks should be included in that person's contract, along with a budget to complete the tasks. It's easy to forget this line item when the contractor is tasked with commissioning.

The commissioning agent should also ensure both proper training of the building owner or operator to ensure persistent savings. User interfaces, calibration steps and equipment locations must all be taught and well documented for the operator during this training step. Many building operators do not understand the importance of these controls and may disable them if there is even a minor problem. Instead, building operators should be able to make ongoing adjustments for occupant complaints, changes in space use or furniture, and other modifications to the building. If no changes are made to the space, our study and others show that calibrated systems will maintain solid performance over time.

CALIBRATION AND FUNCTIONAL TESTING

Calibration and functional testing of controls are critical steps in the commissioning process to ensure successful implementation and energy savings. An ideal calibration process adjusts the daylight sensor and controller settings to achieve adequate light levels with minimum possible energy consumed. Calibration is sometimes blended into the functional testing task, though ideally the calibration would be finished and then separate tests completed—preferably by a different person—to ensure steps from installation

TYPICAL DAYLIGHTING SAVINGS
(out of total controlled lighting energy)



to calibration were done correctly. Calibration of each control system is different. However, with a basic closed-loop automatic control system, including a single sensor controlling a zone of luminaires or even a single luminaire, the following basic steps should be applied:

1. Obtain manufacturer instructions for the controls and a factory-calibrated light meter. When possible, have a manufacturer's representative present or on the phone.

2. Choose a critical workplane (where an occupant will work or reside) to conduct calibration. The critical workplane should be the location that receives the least daylight within the zone of controlled light. This zone extends from the window to the halfway point between the last controlled fixture and the first uncontrolled fixture.

3. At night, adjust the high-end trim (maximum output) of the system to achieve the design light levels at the critical workplane plus an allowance for lumen depreciation (see manufacturer recommendations).

4. During a moderately bright day—at a time with no direct sun on the workplane—adjust sensor and controller settings (see table below). Adjust according to design specifications where given, or use directions below. Attempt to test settings at a couple daylight levels and ensure design illuminance is met at each. Blinds can be used to simulate different daylight levels.

Tips for calibration and functional testing:

- Calibration should be performed after furniture, and even occupants, are in the space.
- Sensor location or orientation should be adjusted if new information regarding furniture or other interior items has become available since design.
- Do not assume that initial nighttime light levels equal the design-intended illuminance.
- Your body will interfere with light levels on nearby workplanes during calibration. Use a remote, or step away from the sensor and fixture for a period of time before taking illuminance readings and recalibrating.
- To save time, shorten the fade rate and deadband settings prior to calibration so controls respond immediately. Be sure to reset those values before completion (or prior to testing deadband and fade rate).
- An ammeter can also be used to measure the circuit electrical current during calibration so that proper power reduction is clearer.

Other calibration steps, such as zoning of fixtures, can also be completed for more advanced digital control systems (see resources below). Also, if the system uses stepped control, deadband should definitely be calibrated. It should be set to several minutes to ensure occupant comfort and monitored for a period of days following, since different weather conditions will affect the space differently.

ADJUSTMENTS DURING CALIBRATION	
sensor location	sensor should be located over a workplane
sensor orientation	sensor should see reflective, representative space
sensor shielding	sensor should not see direct light (electric or sun)
gain	tune to design light level + lumen depreciation
fade rate	fade rate should be long (~1 minute)
deadband (if stepped)	deadband should be long (several minutes)

RESOURCES

Full report from the Energy Center: www.ecw.org/mndaylighting

For general commissioning guidance: IES Design Guide 29, and publications by Francis Rubinstein

For specific functional testing instructions: Stroupe, R., The Development and Execution of Functional Tests for Lighting Controls, 19th National Conference on Building Commissioning, 2011

Overall controls guidance: LBNL's Tips for Daylighting with Windows