

LIGHTING COMMISSIONING IN A CODE-BASED WORLD

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| ASHRAE 90.1-2016 Lighting Systems Cx Requirement

Section 9.4.3 – Functional Testing

Lighting control devices and control systems shall be tested to ensure that control hardware and software are calibrated, adjusted, programmed, and in proper working condition in accordance with the construction documents and manufacturer's installation instructions.

The individuals responsible for the functional testing shall not be directly involved in either the design or construction of the project and shall provide documentation certifying that the installed lighting controls meet or exceed all documented performance criteria.

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Section 9.4.3 – Occupant Sensor Functional Testing

Occupant Sensors

1. Certify that the sensor has been located and aimed in accordance with manufacturer recommendations.
2. For projects with up to seven (7) occupancy sensors, all occupancy sensors shall be tested.
3. For projects with more than seven (7) occupancy sensors, testing shall be done for each unique combination of sensor type AND space geometry.

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Section 9.4.3 – Occupant Sensor Functional Testing (continued)

For each sensor to be tested, verify the following:

- 1) Status indicator (as applicable) operates correctly.
- 2) Controlled lights turn off or down to the permitted level within the required time.
- 3) For auto-ON occupant sensors, the lights turn on to the permitted level when someone enters the space.
- 4) For manual-ON sensors, the lights turn on only when manually activated.
- 5) The lights are not incorrectly turned on by movement in nearby areas or by HVAC operation.

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Section 9.4.3 – Automatic Time Switches Functional Testing

1. Confirm that the automatic time-switch control is programmed with appropriate weekday, weekend, and holiday schedules.
2. Document automatic time-switch programming, including weekday, weekend, and holiday schedules, as well as all setup and preference program settings.
3. Verify that correct time and date are properly set in the time switch.
4. Verify that any battery backup is installed and energized.
5. Verify that the override time limit is set to no more than two (2) hours.

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Section 9.4.3 – Automatic Time Switches Functional Testing (continued)

6. Simulate occupied condition. Verify and document the following:
 - a) All lights can be turned on and off by their respective area control switch.
 - b) The switch only operates lighting in the enclosed space in which the switch is located.
7. Simulate unoccupied condition. Verify and document the following:
 - a) All nonexempt lighting turns off.
 - b) Manual override switch allows only the lights in the enclosed space where the override switch is located to turn on or remain on until the next scheduled shut off occurs.

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Section 9.4.3 – Daylight Controls Functional Testing

1. All control devices (photocontrols) have been properly located, field-calibrated, and set for appropriate set points and threshold light levels.
2. Daylight controlled lighting loads adjust to appropriate light levels in response to available daylight.
3. The location where calibration adjustments are made is readily accessible only to authorized personnel.

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Section 9.7.2.2 – Manuals

Construction documents shall require for all lighting equipment and lighting controls that an operating manual and maintenance manual be provided to the building owner or the designated representative of the building owner within 90 days after the date of system acceptance.

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Section 9.7.2.2 – Manuals (continued)

These manuals shall include, at a minimum, the following:

- a. Submittal data indicating all selected options for each piece of lighting equipment, including but not limited to lamps, ballasts, drivers, and lighting controls.
- b. Operation and maintenance manuals for each piece of lighting equipment and lighting controls with routine maintenance clearly identified including, as a minimum, a recommended relamping/cleaning program and a schedule for inspecting and recalibrating all lighting controls.
- c. A complete narrative of how each lighting control system is intended to operate, including recommended settings.

| Minimum Expectations for Commissioning

- Owner's Project Requirements
- Commissioning Specifications
- Commissioning Plan
- Functional Performance Tests
- Operations Manual
- Commissioning Report

| Owner's Project Requirements (OPR)

Start with the end in mind

- ASHRAE 202 identifies the Commissioning Authority (CxA) to lead documentation of the OPR
- OPR should contain the following:
 - Expected number of occupants and occupancy schedule
 - Cost constraints – both first cost and life cycle
 - Expected equipment, system and building operating metrics such as:
 - Useful life
 - Energy performance
 - Maintenance requirements
 - Benchmarks for project success

Owner's Project Requirements (OPR) FORM GRN 20 Compliance Form

2017 Los Angeles Green Building Code
and 2016 California Energy Code

COMPLETE AND INCORPORATE THIS FORM INTO THE PLANS

Project Address: _____ Permit Number: _____

ITEM #	OPR ITEMS	PAGE NUMBER IN OPR DOCUMENT
PROJECT PROGRAM		
1	General building information (size, stories, construction type, occupancy type and number)	
2	Intended uses and schedules	
3	Future expandability and flexibility of spaces	
4	Quality and/or durability of materials and desired building lifespan	
5	Budget or operation constraints	
ENVIRONMENTAL AND SUSTAINABILITY GOALS		
6	Level of compliance with the Los Angeles Green Building Code: Mandatory, Tier 1, or Tier 2	
7	Specific environmental or sustainability goals (e.g. water efficiency, water reuse, CO ₂ monitoring, xeriscaping, etc.)	
ENERGY EFFICIENCY GOALS		
8	Overall efficiency of building: meet California Energy Code or exceed by (%)	
9	Lighting system efficiency: meet California Energy Code or exceed by (%)	
10	HVAC equipment efficiency and characteristics	
11	Other measures affecting energy efficiency desired by owner (e.g. building orientation, shading, envelope and fenestration, roof, renewable power, net-zero energy use, etc.)	
INDOOR ENVIRONMENTAL QUALITY REQUIREMENTS		
12	Lighting	
13	Temperature and Humidity	
14	Acoustics	
15	Air quality, ventilation, and filtration	
16	Desired adjustability of system controls	
17	Accommodations for after-hours use	
18	Other owner requirements (e.g. natural ventilation, daylight, views, etc.)	

EQUIPMENT AND SYSTEMS EXPECTATIONS		
19	Level of quality, reliability, equipment type, flexibility, maintenance, and complexity desired	
20	Specific efficiency targets, desired technologies, or preferred manufacturers for building systems, acoustics and vibration	
21	Degree of system integration, automation, and functionality for controls (i.e. load shedding, demand response, energy management)	
BUILDING OCCUPANT AND O&M PERSONNEL EXPECTATIONS		
22	Description of how the building will be operated and by whom	
23	Level of training and orientation required to understand, operate and use the building systems for building operation and maintenance staff, as well as occupants	
24	Building operation and maintenance staff location and capabilities	
COMMISSIONING AGENT INFORMATION		
25	Name of Commissioning Agency:	
26	Address of Agency:	
27	Contact person(s) Name(s):	

Owner/Owner Representative Acknowledgement

Owner's Project Requirements (OPR). The expectations and requirements of the building appropriate to its phase shall be documented before the design phase of the project begins. The OPR includes the elements listed above and have been approved by the Owner or Owner Representative.

Name: _____ Owner Owner Representative

Company Name (if applicable): _____

Signature: _____ Date: _____

| Commissioning Report Contents

The report should include an executive summary, list of participants and roles, brief building description, and the following sections:

- Equipment Summary including asset information
- Design Review Reports (*optional*)
- Submittal Review Reports (*optional*)
- Field Observation Reports (*optional*)
- Completed Pre-functional Checklists (*optional*)
- Passed Functional Performance Test Results
- Testing, Adjusting & Balancing Report
- Complete Deficiency Log sorted by Discipline
- Open Deficiency Log sorted by Discipline
- List of any Deferred Functional Tests

| Plan Review Checklist

- Owner's Project Requirements
- Statement that the Designer's Basis of Design (BOD) meets the Owner's Project Requirements
- Commissioning Specifications
 - 01 91 13 General Commissioning Requirements
 - 26 08 00 Commissioning of HVAC Systems
- Operations Manual Specifications
 - Specify that the documents be provided to the building owner within 90 days of the date of receipt of the certificate of occupancy.
- Commissioning Plan

| Certificate of Occupancy Checklist

- Preliminary Cx Report
 - Organized with mechanical and service hot water findings in separate sections
 - Itemization of deficiencies found during testing that have not been corrected at the time of report
 - Deferred tests that cannot be performed at the time of report preparation
 - Climatic conditions required for the deferred tests.
- Lighting Systems Operations Manual (draft or table of contents)

| THANK YOU

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Shameless plug for Living Building Project at Georgia Tech:
<http://livingbuilding.kendedafund.org/>