

Lighting: Residential and Commercial Requirements

Residential Lighting Requirements

The 2009 International Energy Conservation Code (IECC) includes lighting requirements for residential buildings.

The requirement, found in Section 404.1, indicates that a minimum of 50% of the lamps used in permanently installed lighting fixtures must be high efficacy.

The IECC defines high-efficacy lamps as follows:

- Compact fluorescent lamps
- T-8 or smaller diameter linear fluorescent lamps
- Lamps with a minimum efficacy of:
 1. 60 lumens per watt for lamps over 40 watts,
 2. 50 lumens per watt for lamps over 15 to 40 watts, and
 3. 40 lumens per watt for lamps 15 watts or less.

Commercial Lighting Requirements

ANSI/ASHRAE/IES Standard 90.1-2007 and the 2009 IECC include requirements for interior



and exterior lighting in new construction, additions, and alterations for all commercial buildings, including residential structures with four or more stories above grade.

Just as in new construction or additions, lighting systems and control devices that are new or upgraded as part of an alteration must meet code requirements. Replacing components such as bulbs or ballasts alone may not constitute an alteration.

Commercial requirements include both mandatory minimum controls and Lighting Power Density (LPD) limits. The LPD requirements are most commonly met using the simpler **prescriptive tradeoff method**, which compares the actual interior installed



LPD (watts per square foot) to the LPD allowance. Alternatively, the **performance option** can be used, which also requires that minimum controls be implemented but then applies a whole-building energy model to the proposed building design that incorporates all expected energy use for heating, cooling, water heating, and lighting. If the modeled building energy use meets a target energy use based on the energy use expected for the same building built to the minimum code, then the proposed building complies. This method involves the use of detailed, whole-building software and is typically used for buildings with highly complicated systems or unusual design elements.

Mandatory space control

Both the 2009 IECC and ASHRAE Standard 90.1-2007 require at least one lighting control for each room or space enclosed by ceiling-height partitions. Generally, these must be readily accessible to occupants, but remote location is allowed for specific reasons. Both ASHRAE Standard 90.1 and the IECC require that controls to turn off permanently installed and switched receptacle lighting in hotel or motel guest rooms be placed at room entrances (bathroom lighting is exempt).

ASHRAE Standard 90.1-2007 also requires individual control of display or accent lighting, case and task lights, and nonvisual and demonstration lighting. There are also requirements for occupancy sensor controls in some classrooms, conference rooms, and employee break rooms. The 2009 IECC includes a “bi-level” switching requirement for all spaces with the capability to uniformly reduce the connected load by 50% with some exceptions.

Mandatory automatic shutoff

ASHRAE Standard 90.1-2007 and the 2009 IECC require automatic shutoff of all lighting for buildings larger than 5,000 square feet. This can be done with time-scheduling devices, occupant-sensing devices, or similar control systems that indicate the area is unoccupied.



Occupants should not be able to override the automatic shutoff control for more than 2 hours (2009 IECC) or more than 4 hours (ASHRAE Standard 90.1-2007). Exceptions to the entire automatic shutoff requirement include lighting for 24-hour operation (ASHRAE Standard 90.1-2007), patient care spaces, areas with safety or security concerns (ASHRAE 90.1-2007, 2009 IECC), and guest rooms (2009 IECC).

Mandatory exterior lighting control

Exterior building lighting must be controlled using photocells (for dusk-to-dawn lighting) or seven-day/seasonal programmable controls with astronomic correction and be capable of retaining the time setting during a loss of power for a period of at least 10 hours. ASHRAE Standard 90.1-2007 exempts covered vehicle entrances and exits from buildings or parking structures where lighting is required for safety, security, or eye adaptation.

Tandem wiring and exit signs

Both ASHRAE Standard 90.1-2007 and the 2009 IECC require tandem wiring of fixtures when single-lamp magnetic ballasts are used and the fixtures have an available pairing nearby (typically within 10 feet for recessed and 1 foot for pendant and surface mount). Most codes also limit exit signs to 5 watts per face.

Interior lighting power limits

Mandatory control requirements are only half the story. The other major energy code requirement is the limitation of lighting power. The power limits vary by building or space type and can be complied with in more than one way. The compliance process starts with determining the proposed installed lighting wattage for all lighted space(s). This includes interior lighting designed for general, ambient, or task illumination (with exceptions). The codes also provide some guidance on how certain fixture-type wattages are calculated, such as using the maximum labeled wattage for screw-in-type fixtures and a minimum of 30 watts per foot for line-voltage track lighting.

The second part of the process is to determine the allowed wattage for the building. For the 2009 IECC, this is done on a building area type basis (usually one LPD value for each primary building area type, but can be multiples). ASHRAE Standard 90.1-2007 offers both a whole-building and a space-type basis (LPD values for each different space type). In either method, the appropriate LPDs are chosen from the building area table (32 choices in both codes) or the space-type table (91 choices in ASHRAE Standard 90.1-2007). These values are multiplied by the applicable square footage, and the results are summed to determine the allowed lighting power. If the calculated installed watts are less than or equal to the total allowed watts, the project complies. Requiring fewer calculations, the building area method is simpler but can lack some flexibility. The space-type method requires more calculations but may provide a higher overall LPD allowance depending on the mix of spaces within the building.

For alteration projects, both ASHRAE Standard 90.1-2007 and the 2009 IECC provide an exception to LPD compliance for spaces where less than 50% of the luminaires in the space are replaced and there is no increase in the LPD.

The COM *check*[™] software, available free at www.energycodes.gov, provides compliance documentation with either the building area method or the space-type calculation.

The LPD values in the current codes and standards were not chosen by simple consensus or other limited selection processes. Instead, they were developed using an extensive space-type modeling process that incorporated the latest light-level recommendations, current energy-efficient product characteristics, applicable light-loss factors, and designer input on quality design metrics. To view details on the space-type modeling process, visit the lighting power density link on the Illuminating Engineering Society (IES) LPD website (www.iesna.org).

To make sure that the codes can accommodate the quality and art components in a variety of lighting designs, the codes provide additional allowances that may be used only for the intended decorative or retail merchandise highlighting purpose, not for general illumination. These allowances can only be applied with the space-type method (2009 IECC allows use with building area).

The allowances prescribe additional wattage for decorative lighting, lighting specifically designed to meet the IES computer screen glare guidelines, and retail display lighting. All come with conditions of application.

Exterior lighting power limits and efficiency

Finally, ASHRAE Standard 90.1-2007 and the 2009 IECC have extensive power limits for all expected exterior applications such as entrances and exits, facades, building grounds, parking lots, and walkways. The limits are expressed in units appropriate to the application type such as per square foot, per linear foot, or per installation. The 2009 IECC applies an additional zone categorization to the limits that specifies different limits based on the type of environment in which the building is being built. For example, buildings constructed in bright urban environments will require higher illumination for contrast purposes than those in rural areas and will therefore have higher allowances.

The requirements in both the 2009 IECC and ASHRAE Standard 90.1-2007 are split into tradable vs. non-tradable applications.

The tradable applications work like the interior lighting limits in that the total wattage for all tradable applications compared with the total allowance is the compliance criteria. Non-tradable applications are specific limits to a lighted feature and cannot be traded off with others. Earlier codes and standards have less involved requirements, including shorter sets of applications or simpler lighting efficiency requirements.

Compliance and Inspections

Compliance with the lighting requirements in the energy codes is part of the permitting process along with other electrical, mechanical, and structural code requirements. The building inspection department will review proposed design plans and verify that requirements are met with the proposed lighting equipment, installation, and set up. Because energy codes are not perfect, it is important for the builder and inspection officials to communicate clearly and early regarding how compliance is being achieved and to be able to resolve any potential issues. Many jurisdictions accept the output of software tools for initially verifying design compliance with energy requirements. The *COMcheck*[™] energy code compliance software (www.energycodes.gov/comcheck) is one such tool that is commonly used. It provides a method for showing compliance with the requirements and includes output of the proposed design elements and a checklist of code requirements for future compliance inspections.

The following tips can make the job of inspecting for lighting compliance easier.

- Rely on the lighting plans and specifications that were approved as part of the permitting process. These should contain the details on all equipment installed to meet the code requirements. However, it is also good to have a checklist of the code requirements to check against the plans.
- Expect to work with someone familiar with the building's lighting design. They should be available to help locate specific installed controls such as whole-building shutoff systems and provide verification of equipment types and wattages.
- Lighting will be found in all areas of a building, but just like other common energy-related building components such as windows, spot checking for compliance may be appropriate.
- For interior and exterior LPD compliance, refer to the lighting plans that were approved for energy code compliance as part of the permitting process. These will show the layout of lighting fixtures in each space (reflected ceiling plans) and indicate equipment type (lighting schedule sheet). Selected rooms can then be visited to verify fixture counts, as well as lamp and ballast types installed.
- Design plans should indicate which rooms include controls such as occupancy sensors. The plans can then be used to spot check installation. Verification that the controls are working as required can then be checked in randomly selected rooms.