



Article #1573 -

## Comparing Commercial Lighting Energy Requirements

### Scope of lighting requirements

ASHRAE 90.1-2004 and IECC 2003 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. Note: changes recently proposed to ASHRAE 90.1-2004 regarding lighting are scheduled to be evaluated in September 2006 for possible inclusion in the 2007 IECC Supplement.

The application of the codes to alteration type projects has been mixed in the past, but as energy codes become more commonplace in states and local jurisdictions, these projects will be required to comply as well. Just as in new construction or additions, new or replaced lighting systems and control devices must meet code. Replacing components such as lamps alone does not constitute an alteration. The ASHRAE 90.1 standard (1999-2004) provides an exception for spaces where less than 50% of the luminaires in the space are replaced *and* there is no increase in the lighting power density (LPD).

### Mandatory individual space control

The energy codes 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 where safety or security is a concern. Both ASHRAE 90.1 and IECC require that controls to turn off permanently installed and switched receptacle lighting in hotel or motel guest rooms be placed at room entrances (IECC 1998 through 2006 exempts bathroom lighting).

The ASHRAE 90.1 standard (1999-2004) also requires individual control of display or accent lighting, case and task lights, and nonvisual and demonstration lighting. The 2004 version adds requirements for occupancy sensor controls in some classrooms, conference rooms, and employee break rooms. The IECC (1998 through 2006) 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 90.1 (1999 through 2004) and IECC (2001 through 2006) 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. IECC 2000 only requires this in spaces larger than 250 square feet.

Occupants should not be able to override the automatic shutoff control for more than 2 hours (IECC 2003 through 2006) or more than 4 hours (ASHRAE 90.1, 1999-2004). Exceptions to the entire automatic shutoff requirement include lighting for 24-hour operation (ASHRAE 90.1, 1999-2004), patient care spaces, areas with safety or security concerns (ASHRAE 90.1-2004, IECC 2006), areas controlled by occupancy sensors, corridors, storerooms, restrooms, public lobbies, and guest rooms (IECC 2003 - 2004).



### 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 4-hour battery backup. ASHRAE 90.1 (1989 through 2004)

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

ASHRAE 90.1 requires tandem wiring of fixtures when single-lamp magnetic ballasts are used. Most codes also limit exit signs to 5 watts per face.

## Interior lighting power limits

The mandatory requirements are only half the story. The other major requirement in the energy codes is the limitation of lighting power. Interior limits vary by building or space type and can be complied with in more than one way. The **performance option** requires the proposed building to be modeled for all energy use (heating, cooling, water heating, and lighting). If the modeled building meets a target energy use based on that expected of the same building built to the code, 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.

Most buildings comply with the simpler **prescriptive-tradeoff method** for lighting, which compares the actual interior LPD (watts per square foot) to the LPD allowance. The compliance process starts with determining the 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. This is done on a whole building basis (one LPD value for the building type) or a space type basis (LPD values for each different space type). In either method, the appropriate LPDs are chosen from the whole building table (32 choices in ASHRAE 90.1, 26 in IECC) or the space type table (91 choices in ASHRAE 90.1, 28 in IECC). These values are multiplied by the matching square footage, and the results are summed to determine the allowed lighting power. If the calculated installed watts is less than or equal to the total allowed watts, the project complies. Requiring only one calculation, the whole building method is simple but lacks flexibility. The space-type method requires more calculations but is more flexible and can allow more wattage.

The [COMcheck](#) software, available free at [www.energycodes.gov](http://www.energycodes.gov), provides compliance documentation with either the whole building method or the space-type calculation. The current version calculates compliance only for the interior lighting, but it is scheduled to support exterior lighting in 2007.

There is a large difference in stringency of whole-building and space-type values between previous and current versions of the codes and standards. The most stringent set exists in the ASHRAE 90.1-2004 and IECC 2003 through 2006. Previous publications of ASHRAE 90.1 and IECC contain similar listings of building and space types but less stringent LPD values.

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 process as well as a list of the values in the ASHRAE 90.1-2004 standard, visit the lighting power density link on the [IESNA LPD](#) website.

To ensure that the codes can accommodate the quality and art components in a variety of lighting designs, the codes provide **additional allowances** that must be used only for the designed purpose--not for general



illumination. These allowances can only be applied with the space-type method (IECC 2006 allows use with whole building). They prescribe additional wattage for decorative lighting at 1.0 watts per square foot, lighting specifically designed to meet the IESNA computer screen glare guidelines at 0.35 watts per square foot, and retail display lighting at 1.6 watts per square foot of display area, or 3.9 watts per square foot for fine merchandise display.

## Exterior lighting power limits and efficiency

Finally, ASHRAE 90.1-2004 and IECC 2006 have extensive power limits based on square footage of illuminated area or perimeter for all expected exterior applications such as entrances and exits, facades, building grounds, parking lots, and walkways. These requirements are split into tradable vs. non-tradable applications.

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

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