4.5.7 Lighting Power Density

**Description**

This measure relates to installation of efficient lighting systems in new construction or substantial renovation of commercial buildings excluding low rise (three stories or less) residential buildings. Substantial renovation is when two or more building systems are renovated, such as shell and heating, heating and lighting, etc. State Energy Code specifies a lighting power density level by building type for both the interior and the exterior. Either the Building Area Method or Space by Space method as defined in IECC 2012 or 2015, depending on the IECC in effect on the date of the building permit, can be used for calculating the Interior Lighting Power Density[[1]](#footnote-1). The measure consists of a design that is more efficient (has a lower lighting power density in watts/square foot) than code requires. The IECC applies to both new construction and renovation.

This measure was developed to be applicable to the following program types: NC.

If applied to other program types, the measure savings should be verified.

**Definition of Efficient Equipment**

In order for this characterization to apply, the lighting system must be more efficient than the baseline Energy Code lighting power density in watts/square foot for either the interior space or exterior space.

**Definition of Baseline Equipment**

The baseline is assumed to be a lighting power density that meets IECC 2012 or 2015, depending on the IECC in effect on the date of the building permit.

**Deemed Calculation for this Measure**

Annual kWh Savings

ΔkWh = (WSFbase-WSFeffic )/1000\* SF\* Hours \* WHFe

Summer Coincident Peak kW Savings

ΔkW = (WSFbase-WSFeffic )/1000\* SF\* CF \* WHFd

**Deemed Lifetime of Efficient Equipment**

The expected measure life is assumed to be 15 years[[2]](#footnote-2)

**Deemed Measure Cost**

The actual incremental cost over a baseline system will be collected from the customer if possible or developed on a fixture by fixture basis.

**Loadshape**

|  |
| --- |
| Loadshape C06 - Commercial Indoor Lighting |
| Loadshape C07 - Grocery/Conv. Store Indoor Lighting |
| Loadshape C08 - Hospital Indoor Lighting |
| Loadshape C09 - Office Indoor Lighting |
| Loadshape C10 - Restaurant Indoor Lighting |
| Loadshape C11 - Retail Indoor Lighting |
| Loadshape C12 - Warehouse Indoor Lighting |
| Loadshape C13 - K-12 School Indoor Lighting |
| Loadshape C14 - Indust. 1-shift (8/5) (e.g., comp. air, lights) |
| Loadshape C15 - Indust. 2-shift (16/5) (e.g., comp. air, lights) |
| Loadshape C16 - Indust. 3-shift (24/5) (e.g., comp. air, lights) |
| Loadshape C17 - Indust. 4-shift (24/7) (e.g., comp. air, lights) |
| Loadshape C18 - Industrial Indoor Lighting |
| Loadshape C19 - Industrial Outdoor Lighting |
| Loadshape C20 - Commercial Outdoor Lighting |

**Coincidence Factor**

The summer peak coincidence factor for this measure is dependent on the building type.

**Algorithm**

**Calculation of Savings**

**Energy Savings**

ΔkWh = (WSFbase-WSFeffic )/1000\* SF\* Hours \* WHFe

Where:

WSFbase = Baseline lighting watts per square foot or linear foot as determined by building or space type. Whole building analysis values are presented in the Reference Tables below.[[3]](#footnote-3)

WSFeffic = The actual installed lighting watts per square foot or linear foot.

SF = Provided by customer based on square footage of the building area applicable to the lighting design for new building.

Hours = Annual site-specific hours of operation of the lighting equipment collected from the customer. If not available, use building area type as provided in the Reference Table in Section 4.5, Fixture annual operating hours.

WHFe  = Waste Heat Factor for Energy to account for cooling savings from efficient lighting is as provided in the Reference Table in Section 4.5 by buidling type. If building is not cooled WHFe is 1.

**Heating Penalty**

If electrically heated building:

ΔkWhheatpenalty[[4]](#footnote-4) = (WSFbase-WSFeffic )/1000\* SF\* Hours \* -IFkWh

Where:

IFkWh = Lighting-HVAC Interation Factor for electric heating impacts; this factor represents the increased electric space heating requirements due to the reduction of waste heat rejected by the efficent lighting. Values are provided in the Reference Table in Section 4.5. If unknown, use the Miscellaneous value.

**Summer Coincident Peak Demand Savings**

ΔkW = (WSFbase-WSFeffic )/1000\* SF\* CF \* WHFd

Where:

WHFd = Waste Heat Factor for Demand to account for cooling savings from efficient lighting in cooled buildings is as provided in the Reference Table in Section 4.5 by buidling type. If building is not cooled WHFd is 1.

CF = Summer Peak Coincidence Factor for measure is as provided in the Reference Table in Section 4.5 by buidling type. If the building type is unknown, use the Miscellaneous value of 0.66.

Other factors as defined above

**Natural Gas Energy Savings**

ΔTherms = (WSFbase-WSFeffic )/1000\* SF\* Hours \* - IFTherms

Where:

IFTherms = Lighting-HVAC Integration Factor for gas heating impacts; this factor represents the increased gas space heating requirements due to the reduction of waste heat rejected by the efficient lighting. This value is provided in the Reference Table in Section 4.5 by buidling type.

**Water Impact Descriptions and Calculation**

N/A

**Deemed O&M Cost Adjustment Calculation**

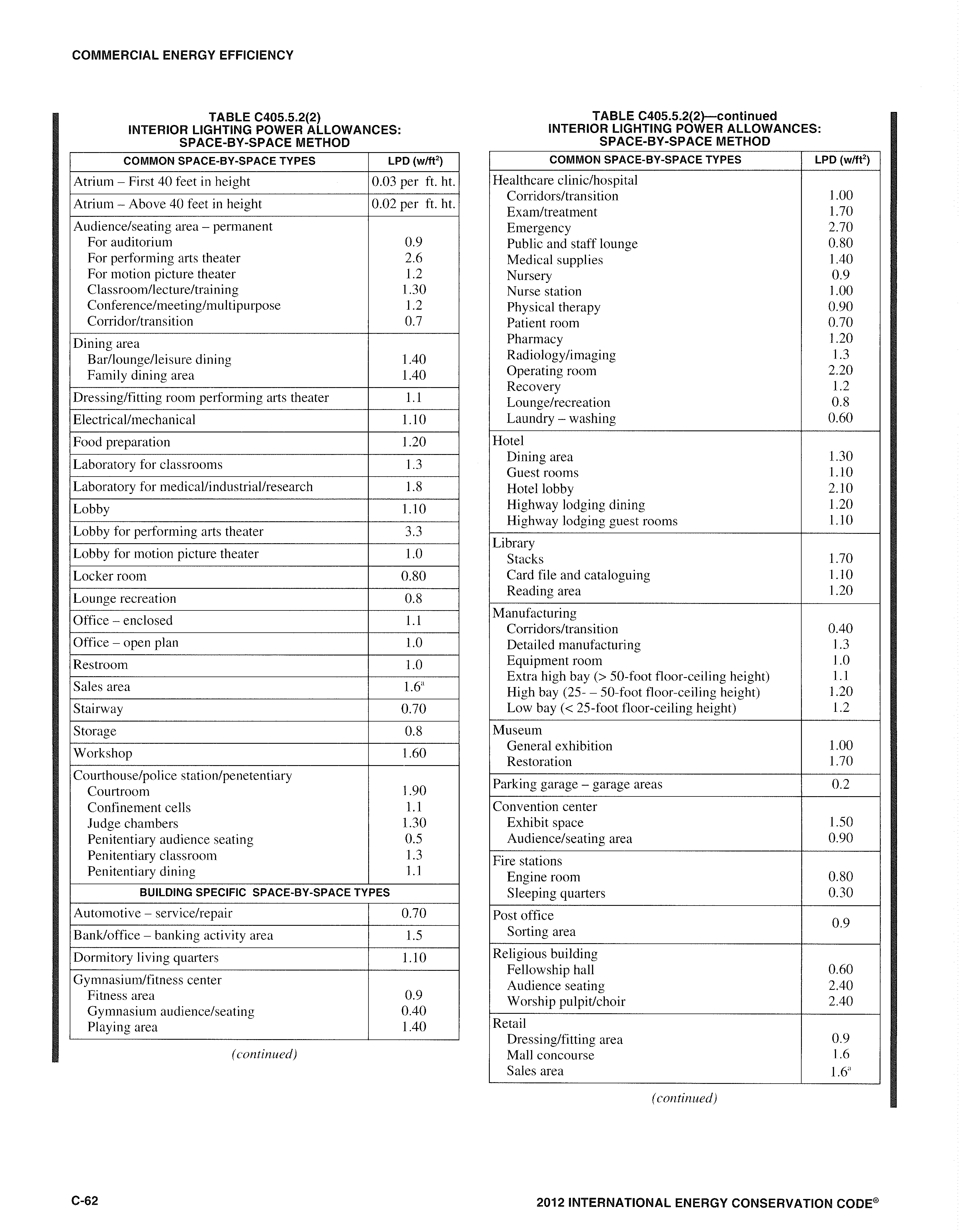
N/A

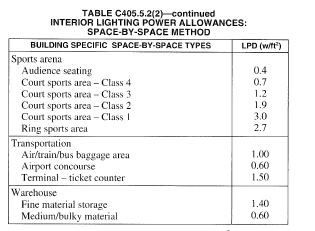
**Reference Tables**

Lighting Power Density Values from IECC 2012 and 2015 for Interior Commercial New Construction and Substantial Renovation Building Area Method:

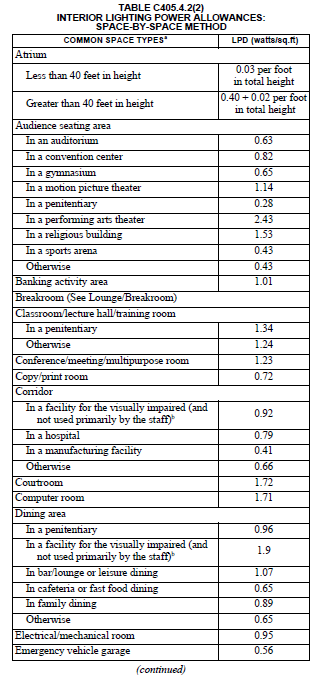
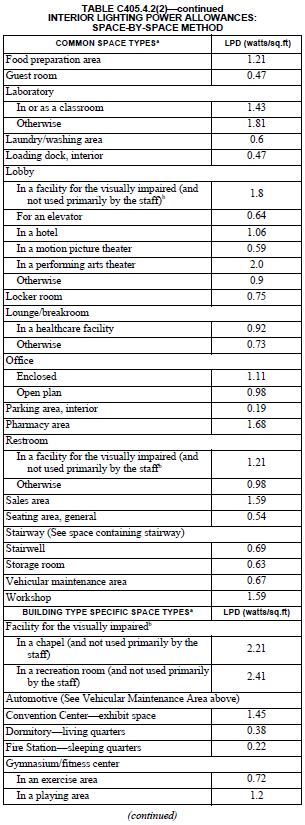
| **Building Area Type [[5]](#footnote-5)** | **IECC 2012**  **Lighting Power Density (w/ft2)** | **IECC 2015**  **Lighting Power Density (w/ft2)** |
| --- | --- | --- |
| Automotive Facility | 0.9 | 0.80 |
| Convention Center | 1.2 | 1.01 |
| Court House | 1.2 | 1.01 |
| Dining: Bar Lounge/Leisure | 1.3 | 1.01 |
| Dining: Cafeteria/Fast Food | 1.4 | 0.9 |
| Dining: Family | 1.6 | 0.95 |
| Dormitory | 1.0 | 0.57 |
| Exercise Center | 1.0 | 0.84 |
| Fire station | 0.8 | 0.67 |
| Gymnasium | 1.1 | 0.94 |
| Healthcare – clinic | 1.0 | 0.90 |
| Hospital | 1.2 | 1.05 |
| Hotel | 1.0 | 0.87 |
| Library | 1.3 | 1.19 |
| Manufacturing Facility | 1.3 | 1.17 |
| Motel | 1.0 | 0.87 |
| Motion Picture Theater | 1.2 | 0.76 |
| Multifamily | 0.7 | 0.51 |
| Museum | 1.1 | 1.02 |
| Office | 0.9 | 0.82 |
| Parking Garage | 0.3 | 0.21 |
| Penitentiary | 1.0 | 0.81 |
| Performing Arts Theater | 1.6 | 1.39 |
| Police Station | 1.0 | 0.87 |
| Post Office | 1.1 | 0.87 |
| Religious Building | 1.3 | 1.0 |
| Retail[[6]](#footnote-6) | 1.4 | 1.26 |
| School/University | 1.2 | 0.87 |
| Sports Arena | 1.1 | 0.91 |
| Town Hall | 1.1 | 0.89 |
| Transportation | 1.0 | 0.70 |
| Warehouse | 0.6 | 0.66 |
| Workshop | 1.4 | 1.19 |

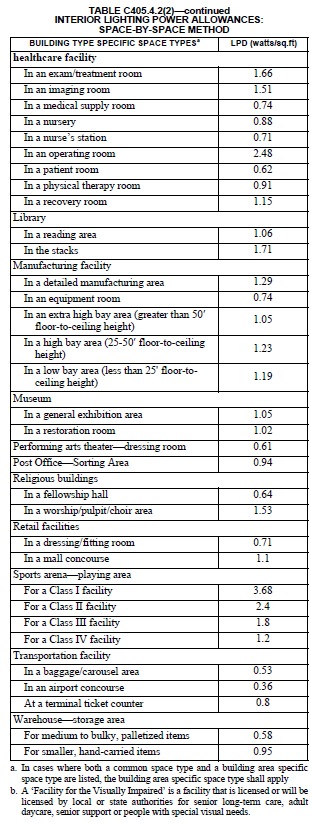
Lighting Power Density Values from IECC 2012 for Interior Commercial New Construction and Substantial Renovation Space by Space Method:



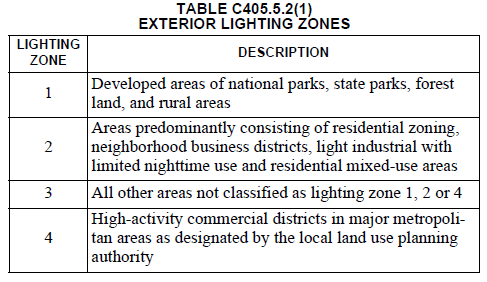


Lighting Power Density Values from IECC 2015 for Interior Commercial New Construction and Substantial Renovation Space by Space Method:

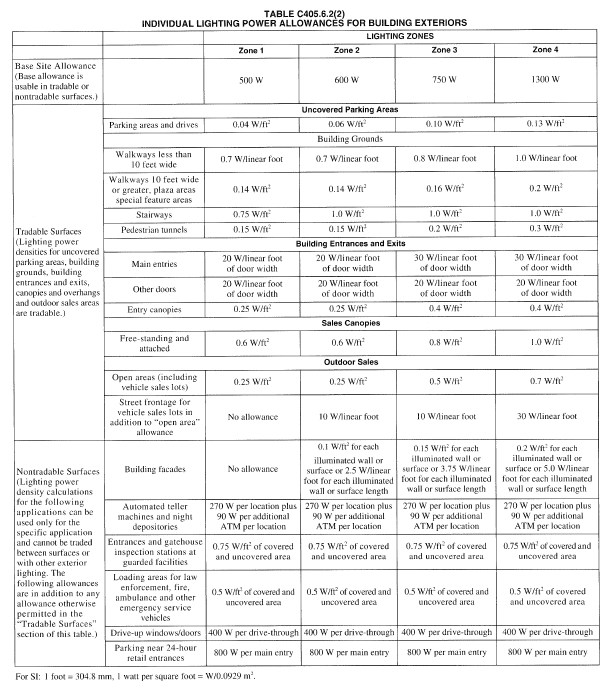


IECC 2015 Table C405.5.2(1) which follows. This table is identical to IECC 2012 Table C405.62(1).

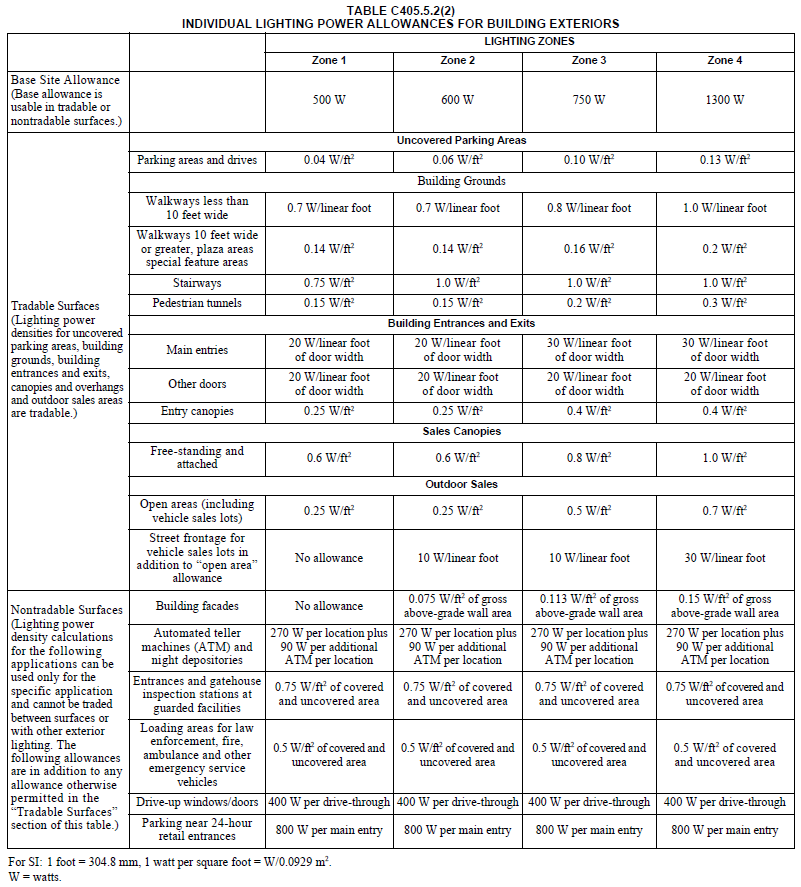


The lighting power density savings will be based on reductions below the allowable design levels as specified in IECC 2012 Table C405.6.2(2) or IECC 2015 Table C405.5.2(2).

Allowable Design Levels from IECC 2012



Allowable Design Levels from IECC 2015



**Measure Code: CI-LTG-LPDE-V03-160601**

1. Refer to the referenced code documents for specifics on calculating lighting power density using either the whole building method (IECC) or the Space by Space method (ASHRAE 90.1). [↑](#footnote-ref-1)
2. Measure Life Report, Residential and Commercial/Industrial/Industrial Lighting and HVAC Measures, GDS Associates, June 2007. [↑](#footnote-ref-2)
3. See IECC 2012 and 2015 - Reference Code documentation for additional information. [↑](#footnote-ref-3)
4. Negative value because this is an increase in heating consumption due to the efficient lighting. [↑](#footnote-ref-4)
5. In cases where both a general building area type and a more specific building area type are listed, the more specific building area type shall apply. [↑](#footnote-ref-5)
6. Where lighting equipment is specified to be installed to highlight specific merchandise in addition to lighting equipment specified for general lighting and is switched or dimmed on circuits different from the circuits for general lighting, the small of the actual wattage of the lighting equipment installed specifically for merchandise, or additional lighting power as determined below shall be added to the interior lighting power determined in accordance with this line item. [↑](#footnote-ref-6)