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Lighting Application Guidelines

This guide is designed to assist the user in identifying potential interior and exterior architectural applications for LEDs by giving specific design examples typically found in residential and commercial categories. Rather than provide lighting design “templates,” this guide identifies lumen packages that would be necessary for various applications.

Lighting applications are categorized as a function of lumens required for achieving the illuminance levels. The lumen values were derived from IES recommendations for horizontal and vertical illuminance on task areas. To calculate horizontal lumens, typical room dimensions were used to provide horizontal area in square feet. To calculate vertical lumens, typical task area heights were used to provide wall area in square feet.

As the amount of lumens per LED improves with time, this document will aid in identifying the potential applications for LED lighting.
Lighting Application Guidelines

This guide is divided into two main sections. Each main section is then divided into smaller sections and specific task areas.

• **Residential:** Bedroom, Kitchen, Living Room, Bathroom, Residential Exterior

• **Commercial:** Restaurant, Retail Store, Office
Sample format

Each section includes:

• Cover sheet with section identification image
• Graph illustrating the application as a function of required lumens
• Composite sheet: *
  • individual graph
  • plan
  • perspective
  • important design criteria chart (i.e. CRI may be important in jewelry display, but vibration resistance may be more important in an elevator)
• illustration of task areas

*Commercial section shows individual graph separately from composite sheet for readability
Bar graphs

Each individual bar on a graph represents a range of required lumens. The lower end of the bar represents the minimum amount of lumens required to meet the illuminance level recommended for the application by the Illuminating Engineering Society of North America (IESNA). In practice, most fixtures have efficiencies in the range of 50% to 95%. Therefore the higher end of the bar represents the required lamp lumens to meet the same criteria assuming a fixture efficiency of 50%.

NOTE: In practice, there may be situations in which the lumen levels may be lower for a given application. In such cases, the application will not meet the IESNA recommended illuminance levels.
Bar graph showing lumen ranges based on IES recommended levels at 100 percent efficiency down to 50 percent efficiency. Lumen values are arranged in ascending order and include a general area and its associated task areas.

Tabulated information describing recommended lighting levels, assumed horizontal and/or vertical area, minimum required lumens for that area, and important design criteria.

Color band relating to particular space
Residential Applications
All minimum lumen values are a product of IES recommended illuminance level values and the horizontal and vertical task areas.

<table>
<thead>
<tr>
<th>Task Area</th>
<th>Horiz Area (ft²)</th>
<th>Vert Area (ft²)</th>
<th>Horizontal (fc)</th>
<th>Vertical (fc)</th>
<th>Min Lumens</th>
<th>Dimming</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading</td>
<td>2</td>
<td>6</td>
<td>30</td>
<td>5</td>
<td>98</td>
<td>yes</td>
</tr>
<tr>
<td>Closet</td>
<td>15</td>
<td>102</td>
<td>5</td>
<td>3</td>
<td>381</td>
<td></td>
</tr>
<tr>
<td>Writing</td>
<td>24</td>
<td>0</td>
<td>30</td>
<td>3</td>
<td>720</td>
<td>yes</td>
</tr>
<tr>
<td>Dressing</td>
<td>32</td>
<td>144</td>
<td>30</td>
<td>3</td>
<td>1680</td>
<td></td>
</tr>
<tr>
<td>Bedroom (Gen)</td>
<td>192</td>
<td>308</td>
<td>10</td>
<td>NA</td>
<td>1920</td>
<td>yes</td>
</tr>
</tbody>
</table>

Recommended: CRI $> 80$  CCT 2800-3500K
Residential – Kitchen

All minimum lumen values are a product of IES recommended illuminance level values and the horizontal and vertical task areas.
Residential – Living Room

Typical Application

Task Areas

<table>
<thead>
<tr>
<th>Task Area</th>
<th>Horiz Area (ft²)</th>
<th>Vert Area (ft²)</th>
<th>Horizontal (fc)</th>
<th>Vertical (fc)</th>
<th>Min Lumens</th>
<th>Dimming</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading (Seating)</td>
<td>9</td>
<td>12</td>
<td>30</td>
<td>5</td>
<td>330</td>
<td>yes</td>
</tr>
<tr>
<td>Music</td>
<td>12</td>
<td>32</td>
<td>50</td>
<td>3</td>
<td>696</td>
<td></td>
</tr>
<tr>
<td>Filing</td>
<td>9</td>
<td>36</td>
<td>50</td>
<td>10</td>
<td>810</td>
<td></td>
</tr>
<tr>
<td>Living Room (General)</td>
<td>180</td>
<td>297</td>
<td>3</td>
<td>3</td>
<td>1430</td>
<td>yes</td>
</tr>
</tbody>
</table>

Recommended: CRI > 80  CCT 2800-3500

All minimum lumen values are a product of IES recommended illuminance level values and the horizontal and vertical task areas.
Residential – Bathroom

**Task Areas**

<table>
<thead>
<tr>
<th>Task Area</th>
<th>Horiz Area (ft²)</th>
<th>Vert Area (ft²)</th>
<th>Horizontal (fc)</th>
<th>Vertical (fc)</th>
<th>Min Lumens</th>
<th>Dimming</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toilet</td>
<td>10</td>
<td>3</td>
<td>25</td>
<td>20</td>
<td>45</td>
<td></td>
</tr>
<tr>
<td>Vanity</td>
<td>30</td>
<td>5</td>
<td>32</td>
<td>144</td>
<td>1680</td>
<td>yes</td>
</tr>
<tr>
<td>Bathroom (General)</td>
<td>96</td>
<td>220</td>
<td>30</td>
<td>5</td>
<td>3980</td>
<td></td>
</tr>
</tbody>
</table>

Recommended: CRI > 80  CCT 2800-3500K

All minimum lumen values are a product of IES recommended illuminance level values and the horizontal and vertical task areas
## Typical Application

**Task Areas**

<table>
<thead>
<tr>
<th>Task Area</th>
<th>Horiz Area (ft²)</th>
<th>Vert Area (ft²)</th>
<th>Horizontal (fc)</th>
<th>Vertical (fc)</th>
<th>Min Lumens</th>
<th>Dimming</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gardens</td>
<td>300</td>
<td>792</td>
<td>0.5</td>
<td>0.2</td>
<td>198</td>
<td></td>
</tr>
<tr>
<td>Entrance</td>
<td>48</td>
<td>3984</td>
<td>5</td>
<td>3</td>
<td>996</td>
<td></td>
</tr>
<tr>
<td>Paths</td>
<td>200</td>
<td>1189</td>
<td>1</td>
<td>0.3</td>
<td>297</td>
<td></td>
</tr>
<tr>
<td>Flower Beds</td>
<td>144</td>
<td>3888</td>
<td>3</td>
<td>3</td>
<td>972</td>
<td></td>
</tr>
</tbody>
</table>

Recommended: CRI > 75  CCT 2800-3500K
Commercial Applications
Commercial – General Applications

- Open office
- Conference room
- Show windows
- Deli display area
- Library-stacks
- Circulation
- Deli dining area
- Feature display area
- Pantry
- Private office
- Sales transaction
- General merchandise area
- Library
- Food cutting
- Cashier
- Reception
- Food preparation
- Refrigerated display case
- Copy room
- Wall display

Lumens
Commercial – Restaurant

- Deli display area
- Deli dining area
- Food cutting
- Cashier
- Food preparation
- Refrigerated display case

Lumens

0 20000 40000
## Commercial – Restaurant: Deli Displays & Dining

### Typical Applications

<table>
<thead>
<tr>
<th>Task Area</th>
<th>Horiz Area (ft²)</th>
<th>Vert Area (ft²)</th>
<th>Horizontal (fc)</th>
<th>Vertical (fc)</th>
<th>Min Lumens</th>
<th>Dimming</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deli Display</td>
<td>456</td>
<td>774</td>
<td>50</td>
<td>NA</td>
<td>22800</td>
<td>yes</td>
</tr>
<tr>
<td>Deli Dining Area</td>
<td>546</td>
<td>282</td>
<td>30</td>
<td>3</td>
<td>17226</td>
<td>yes</td>
</tr>
<tr>
<td>Food Cutting</td>
<td>70</td>
<td>68</td>
<td>50</td>
<td>10</td>
<td>4180</td>
<td></td>
</tr>
<tr>
<td>Food Preparation</td>
<td>70</td>
<td>68</td>
<td>30</td>
<td>5</td>
<td>2440</td>
<td></td>
</tr>
<tr>
<td>Cashier</td>
<td>112</td>
<td>88</td>
<td>30</td>
<td>3</td>
<td>3624</td>
<td></td>
</tr>
<tr>
<td>Refrigerated Display Case</td>
<td>4</td>
<td>32</td>
<td>NA</td>
<td>50</td>
<td>1600</td>
<td></td>
</tr>
</tbody>
</table>

Recommended: CRI > 80  CCT 2800-3500K

CRI > 80  CCT 5300-6500K  for Refriger. Display Case
Commercial – Retail Store

- Show windows
- Circulation
- Feature Display
- Sales Transaction
- General Merchandise
- Wall Display

Lumens
## Commercial – Retail Store: Displays & Show Windows

### Typical Applications

<table>
<thead>
<tr>
<th>Task Area</th>
<th>Horiz Area (ft²)</th>
<th>Vert Area (ft²)</th>
<th>Horizontal (fc)</th>
<th>Vertical (fc)</th>
<th>Min Lumens</th>
<th>Dimming</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales Transaction</td>
<td>176</td>
<td>10</td>
<td>30</td>
<td>NA</td>
<td>5280</td>
<td></td>
</tr>
<tr>
<td>Circulation</td>
<td>1898</td>
<td>10</td>
<td>10</td>
<td>NA</td>
<td>18975</td>
<td></td>
</tr>
<tr>
<td>Display - Jewelry</td>
<td>72</td>
<td>2</td>
<td>100</td>
<td>30</td>
<td>9630</td>
<td></td>
</tr>
<tr>
<td>Handbags/Gift Items</td>
<td>72</td>
<td>2</td>
<td>10</td>
<td>10</td>
<td>4410</td>
<td></td>
</tr>
<tr>
<td>Wall Display</td>
<td>2</td>
<td>2</td>
<td>100</td>
<td>30</td>
<td>496</td>
<td></td>
</tr>
<tr>
<td>Show windows</td>
<td>44</td>
<td>8</td>
<td>300</td>
<td>50</td>
<td>27050</td>
<td>yes</td>
</tr>
</tbody>
</table>

Recommended: CRI > 80  CCT 2800-3500K

All minimum lumen values are a product of IES recommended illuminance level values and the horizontal and vertical task areas.
Commercial – Office

- Open office
- Conference Room
- Library-stacks
- Pantry
- Private office
- Library
- Reception
- Elevator
- Copy room

Lumens

0 30000 60000 90000 120000
Commercial – Office Spaces

Typical Applications

<table>
<thead>
<tr>
<th>Task Area</th>
<th>Horiz Area (ft²)</th>
<th>Vertical Area (ft²)</th>
<th>Horizontal (fc)</th>
<th>Vertical (fc)</th>
<th>Min Lumens</th>
<th>Dimming</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reception</td>
<td>228</td>
<td>434</td>
<td>10</td>
<td>3</td>
<td>3582</td>
<td>yes</td>
</tr>
<tr>
<td>Private Office-Intensive VDT Use</td>
<td>90</td>
<td>266</td>
<td>50</td>
<td>5</td>
<td>5830</td>
<td>yes</td>
</tr>
<tr>
<td>Open Office-Intensive VDT Use</td>
<td>1530</td>
<td>1106</td>
<td>30</td>
<td>5</td>
<td>51430</td>
<td>yes</td>
</tr>
<tr>
<td>Conference Room-Video</td>
<td>464</td>
<td>630</td>
<td>50</td>
<td>30</td>
<td>42100</td>
<td>yes</td>
</tr>
<tr>
<td>Library Book Stacks</td>
<td>252</td>
<td>640</td>
<td>0</td>
<td>30</td>
<td>19200</td>
<td>yes</td>
</tr>
<tr>
<td>Library Reading Area</td>
<td>140</td>
<td>96</td>
<td>30</td>
<td>0</td>
<td>4200</td>
<td>yes</td>
</tr>
<tr>
<td>Pantry</td>
<td>224</td>
<td>600</td>
<td>30</td>
<td>3</td>
<td>8520</td>
<td></td>
</tr>
<tr>
<td>Elevator</td>
<td>25</td>
<td>180</td>
<td>5</td>
<td>3</td>
<td>665</td>
<td></td>
</tr>
<tr>
<td>Copy Room</td>
<td>24</td>
<td>140</td>
<td>10</td>
<td>3</td>
<td>660</td>
<td></td>
</tr>
</tbody>
</table>

Recommended: CRI > 80   CCT 2800-3500K

All minimum lumen values are a product of IES recommended illuminance level values and the horizontal and vertical task areas.
Conclusion

Although an LED lighting solution may not be practical for the overall application at the present time, it may be an excellent choice for a portion of the application. Compared to traditional light sources, for example, LEDs may provide a better lighting solution for areas such as elevators, refrigerated display cases, and jewelry displays.

NOTE:
This document does not cover all possible lighting applications within residential and commercial sectors. However, those selected and described here can be used to infer the lighting requirements for other similar applications.