

GUIDELINES FOR GOOD EXTERIOR LIGHTING PLANS

Prepared by: The Dark Sky Society (<http://www.darksksociety.org/>)

These guidelines have been developed in consultation with lighting professionals (with experience in developing good lighting plans), for communities wishing to control light pollution and preserve the star filled night sky.

Lighting should be carefully designed with thought given to placement, intensity, timing, duration, and color.

Good lighting practices will help to:

- **Promote Safety**

More light than what is needed for safety is wasted light and is not necessarily better. If the right fixtures are not designed and installed correctly, unsafe glare can result, reducing the effect of lighting, contributing to accidents by hindering visibility. Lighting that is too bright interferes with the eye's ability to adapt to darker areas.

- **Save Money**

Adhering to professionally recommended light levels provides adequate illumination. Many of the fixtures recommended for use are much more cost-effective in the long run because they are more energy efficient. See this website for cost comparisons: <http://www.netacc.net/~poulsen/lightcost.html>

- **Conserve Natural Resources**

Inappropriate or excessive lighting wastes our limited natural resources and pollutes our air, land, and water by burning fossil fuels for electricity.

- **Be Better Neighbors**

Excessive or misdirected lighting can intrude on the privacy of others where light or glare trespasses over property lines.

- **Retain Community's Character and Reduce Skyglow**

Our clear view of the stars in the night sky is a resource to be preserved and protected. Stray and excessive lighting contributes to "light pollution" and unnatural "sky glow".

- **Protect Ecology of Flora and Fauna**

Research studies indicate that artificial night lighting disrupts the migrating, feeding, and breeding habits of many wildlife species, as well as growth patterns of trees. See references on the website for the International Dark Sky Association:

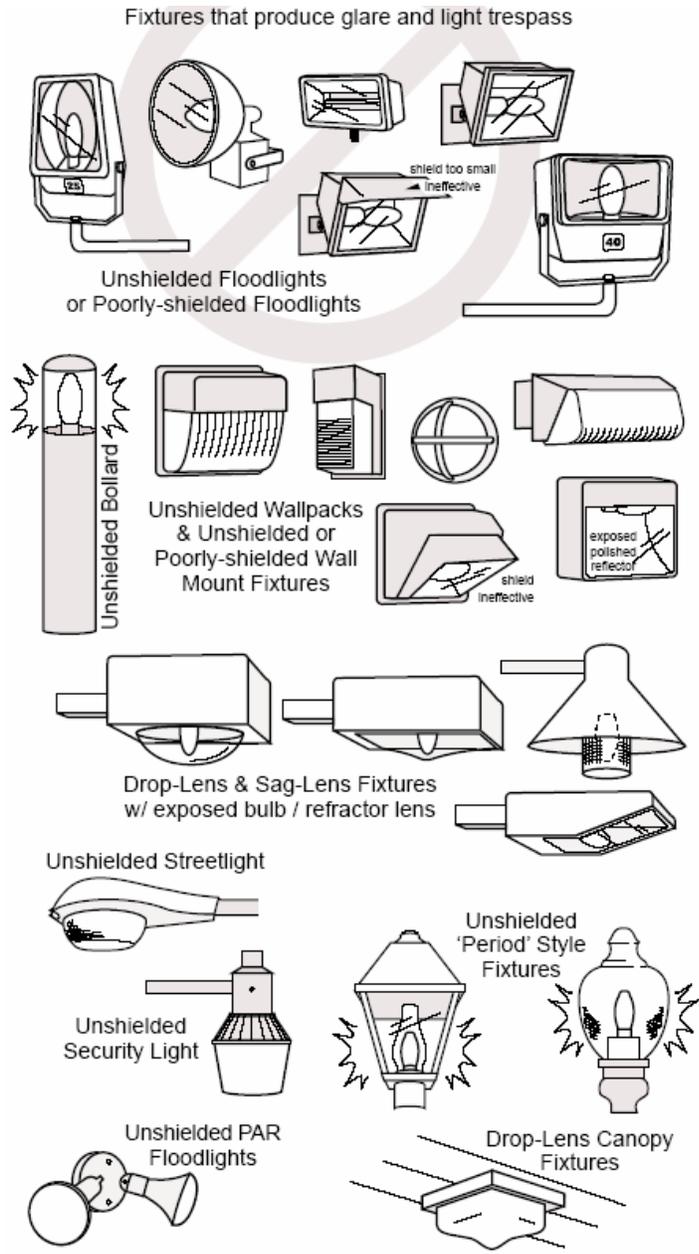
- **Reduce Health Risks**

Light at night not only disrupts your sleep but also interferes with your immune system. Recent research has also indicated that intrusive lighting may reduce the production of melatonin, a beneficial hormone.

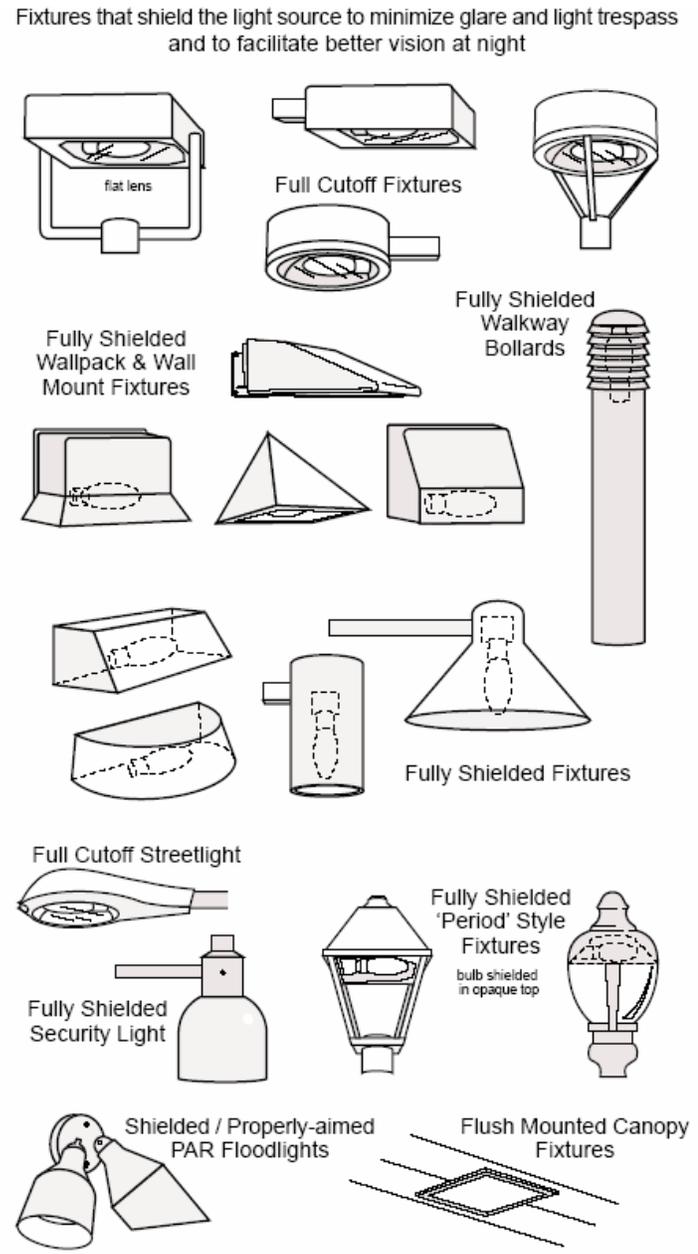
- Included:**
- 1. Diagrams of Acceptable/Unacceptable Lighting Fixtures**
 - 2. How to Develop an Acceptable Lighting Plan**
 - 3. Definitions of Full Cut Off, Shielded, and RLM sign lighting fixtures**
 - 4. Lighting Plan Submissions**
 - 5. Recommended Illumination Levels for various tasks**

Appendix 1:

Unacceptable Fixtures



Acceptable Fixtures



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See this website for links to manufacturers:

<http://www.darksky.org/mc/page.do?sitePageId=56422&orgId=idsa>

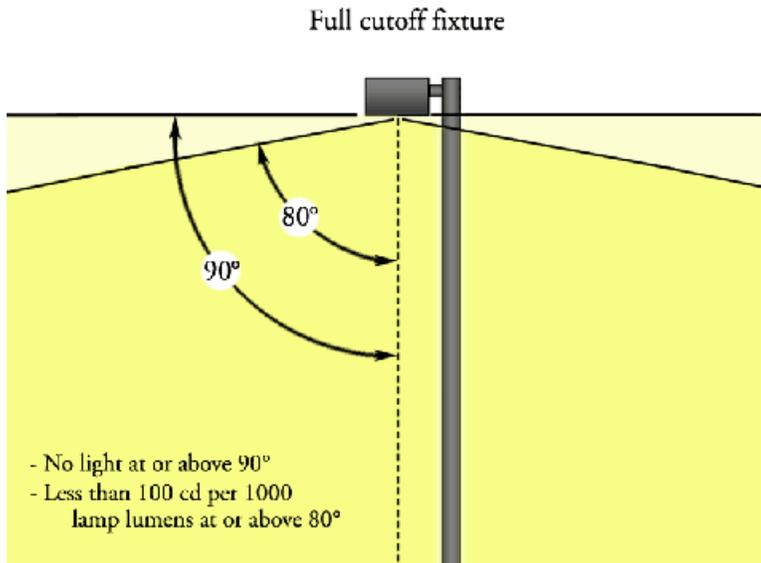
Ask your local electrical suppliers for "full-cut off" light fixtures or fixtures with the IDA Seal Of Approval.

Diagrams courtesy of Bob Crelin, <http://www.theglarebuster.com/>

Appendix 2: How to Develop an Acceptable Lighting Plan (for Environmental Zones 1 and 2 (rural and non-urban commercial)).

- 1. Identify where, as well as when, lighting is needed. Confine and minimize lighting to the extent necessary to meet safety purposes.** Plans should define the areas for which illumination is planned. Itemizing each area (e.g. parking lot, doorways, walkways, signage, foliage) with the anticipated hours of use. Commercial outdoor lighting should be used for safe pedestrian passage and property identification only during active business hours.
- 2. Control the direction and spread of light by choosing the correct type of light fixtures.** (See Appendix 3). Specify IES (Illuminating Engineering Society) "Full Cut Off" designated fixtures, so that no light is visible above the lowest light emitting part of the fixture. Top mounted sign lighting is recommended, with "RLM" (dish) type shields, provided that the light falls entirely on the sign and is positioned so that the light source (bulb) is not visible from any point off the property or into the roadway.
- 3. Select the correct light source (bulb type).** High Pressure Sodium is recommended unless the light is motion sensor activated, in which case incandescent or the instant start compact fluorescent bulbs can be used. Metal Halide (due to its higher costs, including energy use, impact on the environment, and greater contribution to "sky glow") is discouraged, and outdated Mercury Vapor bulbs are prohibited.
- 4. Utilize "shut off" controls such as sensors, timers, motion detectors, etc.** Install automatic controls or turn off lights when not needed for the safe passage of pedestrians. All lights should be extinguished no later than one half hour after the close of business to the public. Avoid "dusk-to-dawn" sensors without a middle of the night shut off control. Lights alone will not serve to "protect" property and are a poor "security" device. Examine other means of protecting property and to discourage criminal activity.
- 5. Limit the height of fixtures.** Locate fixtures no closer to the property line than four times the mounting height of the fixture, and not to exceed the height of adjacent structures. (Exceptions may be made for larger parking areas, commercial zones adjacent to highways, or for fixtures with greater cut off shielding behind the pole mount in commercial zones.)
- 6. Limit light crossing property lines.** Do not allow light to spill across the property lines. Light levels at the property line should not exceed 0.1 footcandles adjacent to business properties, and 0.05 fc at residential property boundaries.
- 7. Use the correct amount of light.** Light levels and uniformity ratios should not exceed recommended values, per IESNA RP-33 or RP 20. (See Appendix 5, Recommended Illumination Levels for various tasks. "Lumen caps" for areas to be illuminated are recommended as follows: for commercial properties in non-urban commercial zones, a lumen cap of 25,000 lumens per acre; and for projects in residential and LBO zones, a lumen cap of 10,000 lumens per acre is recommended.
- 8. Ask for Assistance** Your local lighting sales representatives can assist you in obtaining the necessary information. For large projects over 15,000 lumens: greater energy conservation and control of light pollution, light trespass and glare, may be achieved with the help of a professional lighting designer with "dark sky" lighting installation experience.
- 9. A post installation inspection should be conducted to check for compliance.** Substitutions by electricians and contractors are common and should not be accepted without review and approvals.
- 10. Design interior lighting so that it does not illuminate the outdoors.** Provide interior lighting photometrics for the building's perimeter areas, demonstrating that the interior lighting falls substantially within the building and not out through the windows. After closing, interior lighting that extends outdoors needs to be extinguished.

Appendix 3: Definition of Acceptable Fixtures: "Full Cut Off", "Fully Shielded"*, and RLM shield.



- "Full Cut Off" fixtures do not allow any light to be emitted above the fixture. The fixture controls glare by limiting the light output at 10 degrees below the horizontal, to less than 10% of the light output in lumens.
- Manufacturers and their representatives can provide photographs of light fixtures as "cut sheets" as well as literature confirming the independently tested "cut off" characteristics of their products.
- Photometric layouts for different heights, light sources, and wattages, are also available as "IES" files, upon request or through manufacturers' websites.
- "Full cut off" fixtures must be installed properly, so that the bottom of the fixture is level with the ground.
- "Fully Shielded" fixtures do not allow any light to be emitted above the lowest light emitting part, but do not restrict light output in the "glare" zone, 90-80 degrees below horizontal.

* If the manufacturer is unable to provide the "cut off" characteristics for a fixture (also called a "luminaire"), the following definition needs to be met: "Fully Shielded", which is a fixture constructed and installed in such a manner that all light emitted by it, either directly from the lamp (bulb) or a diffusing element, or indirectly by reflection or refraction from any part of the fixture, is projected below the horizontal. This can be determined by a "field test": a visual assessment of an operating sample.



This is a "RLM" sign lighting shield:

Appendix 4: Lighting Plan Submissions

Provide your municipality's reviewing board with the following information, which will enable them to evaluate the Site Plan for proper exterior lighting:

The Lighting Plan should be depicted on a site plan, indicating the location of each current and proposed outdoor lighting fixture. This plan will need to be stamped and certified by a licensed professional, such as an architect or engineer. Many lighting manufacturers can provide photometric layouts on prepared site plans, to conform to your local requirements.

- (1) A lighting plan with a KEY to the proposed lighting that provides the following information:
 - Type and number of luminaire equipment (fixtures), including the "cut off characteristics", indicating manufacturer and model number(s).
 - Lamp source type (bulb type, i.e. high pressure sodium), lumen output, and wattage.
 - Mounting height indicated, with distance noted to nearest property line for each luminaire.
 - Types of timing devices used to control on/off and the hours set for illumination, as well as the proposed hours when each fixture will be operated.
 - Total Lumens for all fixtures, and total square footage of areas to be illuminated. For projects that are in commercial zones, the lumens per net acre to be lit, should not exceed 25,000 lumens. For projects in residential or LBO zones: 10,000 lumens.
 - For all plans of three or more fixtures: A Calculation Summary indicating all footcandle levels on the lighting plan, noting the maximum, average and minimum, as well as the uniformity ratio of maximum to minimum, and average to minimum levels*.
- (2) Lighting manufacturer-supplied specifications ("cut sheets") that include photographs of the fixtures, indicating the certified "cut off characteristics" of the fixture.
- (3) Isometric Footcandle Distribution Diagram* plotting the light levels for the fixtures at the designated mounting heights. Maximum illuminance levels should be expressed in footcandle measurements on a grid of the site showing footcandle readings in every ten-foot square. The grid shall include light contributions from all sources (i.e. pole mounted, wall mounted, sign, and street lights.)
- (4) If requested by the reviewing agency, a statement from a lighting professional that a plan, other than that set forth, is needed to meet the intent of these standards.
- (5) An environmental impact statement may be required as to the impact of the exterior lighting proposed on flora, fauna, and the night sky. Location of species sensitive to light at night or the proximity to nature preserves or astronomical observatories or "Dark Sky Parks", needs to be indicated.

* This information can be obtained from the manufacturer, your lighting supplier, or the manufacturer's representative.

Appendix 5:

Recommended Illumination Levels for various tasks*

I. Table of Limits of Illumination, measured in footcandles (fc) at ground level, unless noted:

<u>Task Area</u>	<u>Avg.</u>	<u>Not to exceed:</u>
1. Active Building Entrance	2. fc	5. fc
Approach	0.2 fc	
2. Gas Station Approach		2. fc
3. Gas Station Pump Area		avg: 5. fc
4. Gas Station Service Area		avg: 3. fc
5. Sidewalks	0.5 fc	5. fc
6. Surface of signs		2. fc

II. Average/Minimum/Uniformity Ratio Limits for Parking Lots:

I. Public Parking Lots -- not to exceed:

<u>Average</u>	<u>Minimum</u>	<u>Uniformity Ratio (Max to Min/Avg to Min)</u>
0.8	0.2	20:1 / 4:1

II. Private Parking Lots -- not to exceed:

<u>Average</u>	<u>Minimum</u>	<u>Uniformity Ratio (Max to Min / Avg to Min)</u>
0.5	.13	20:1 / 4:1

OR:

III. If illuminance grid lighting plans cannot be reviewed or if fixtures do not provide photometrics and bulbs are under 1800 lumens, use this guideline:

Pole height no greater than four times the distance to the property line and maximum Lumen Levels, for different fixture heights:

<u>Mounting Height (Feet)</u>	<u>Recommended Lumen Maximums</u>
6	500 - 1000 lumens
8	600 - 1,600 lumens
10	1,000 - 2,000 lumens
12	1,600 - 2,400 lumens
16	2,400 - 6,000 lumens

FOOTCANDLE: ("FC") – Is the basic unit of illuminance (the amount of light falling on a surface). Footcandle measurement is taken with a light meter. One footcandle is equivalent to the illuminance produced on one square foot of surface area by a source of one candle at a distance of one foot. Horizontal footcandles measure the illumination striking a horizontal plane. Footcandle values can be measured with certain handheld incident light meters.

LUMEN– A unit used to measure the actual amount of light that is produced by a light source (bulb or “lamp”). The lumen quantifies the amount of light energy produced by a lamp, not by the energy input, which is indicated by the "wattage". For example, a 75-watt incandescent lamp can produce 1000 lumens while a 70-watt high-pressure sodium lamp produces 6000 lumens. Lumen output is listed by the manufacturer on the packaging.

* **IES, Recommended Practices, (RP-33-99): Lighting for Exterior Environments and (RP-20) Parking Lots.** The Illuminating Engineering Society of North America (IES or IESNA), is an organization that establishes updated standards and illumination guidelines for the lighting industry.