

Don Johnson

11/17/03

From: John Murray
Sent: Thursday, October 30, 2003 6:16 PM
To: Board of Selectmen
Cc: Bernie Kosicki I; Bernie Kosicki II
Subject: FW: Meet with BoS Nov 17?

Mr. Chairman,

As noted below: OLAC would like to be placed on the BOS Agenda for Nov 17th.

-----Original Message-----

From: Bernie Kosicki II
Sent: Thursday, October 30, 2003 1:53 PM
To: John Murray
Cc: Terry Kennaugh; Bernie Kosicki I; Bernie Kosicki II; Martin Graetz; Hart Millett II; Hart & Nan Millett I; Roland Bartl; Gary Green; feinstein@feinstein.net; Dean Charter
Subject: Meet with BoS Nov 17?

John,

Christine mentioned that you were handling the agendas for the BoS meetings.

I'm requesting a short session for the Outdoor Lighting Committee on Nov 17. Our goals would be to discuss just the two memos that were sent to them recently. One of these you were copied on regarding the streetlights. The other was a summary and copy of the new bylaw draft for the BoS; I'll send you a copy of this one separately.

My plan would be to simply review the material in the memos of each, and receive any feedback that the BoS wanted to give us at that time. To keep time short, my advice would be that the BOS only give us a few general comments on the bylaw (if they prefer), and to provide any more detailed comments by email (last year, their verbal comments on the bylaw went on for a fairly long time).

Both these items are very timely; the streetlight study since it needs to make it into the budget, and their comments on the bylaw, since we are going to submit it to Town departments immediately after the 17th.

Please let me know whether this will fit into the agenda on Nov 17.

Bernie

Don Johnson

From: Bernie Kosicki I
Sent: Monday, October 27, 2003 9:17 PM
To: Board of Selectmen
Cc: Terry Kennaugh; Bernie Kosicki I; Bernie Kosicki II; Martin Graetz; Hart Millett II; Hart & Nan Millett I; Roland Bartl; gpgreen13@comcast.net; feinstein@feinstein.net
Subject: Outdoor Lighting Bylaw draft



Oct 27- send to
BoS.doc (748 K...

To: Board of Selectmen

From: Outdoor Lighting Advisory Committee Bernard Kosicki, Chair

Subject: New draft of outdoor lighting bylaw

The attached new bylaw draft has been written using feedback from conversations with several town committees and departments, discussions with residents, and input from the Board of Selectmen. The Outdoor Lighting Advisory committee has attempted to make the bylaw as simple as possible, considering the wide variety of applications of outdoor lights and the need to be realistic about their regulation. We received considerable guidance also from professional lighting designers, from study of bylaws enacted in other towns, from the recommendations of the Illuminating Engineering Society of North America (the primary lighting standards-setting organization in the US), and from the International Darksky Association (a respected international group of over ten thousand members, with backgrounds that range from lighting designers, lighting manufacturers, scientists and laypersons).

Significant changes from the previous version include:

- Exclusion of single-family residential lots from the provisions of the bylaw
- Removal of the sunset provision requiring that all lights be shielded within some period of time
- Simpler enforcement.

A priority has been to make the bylaw much simpler to enforce than the first version. Almost all inspection can be done in the daytime or by review of plans; there is only one night time number needed in measurement of light trespass. If so asked, the OLAC is willing to take on responsibility for plan review and night time measurements, and will provide written reports and recommendations to the Building Commissioner to help with his enforcement. We will also help with training of inspectors under the direction of the BC.

Our plan is to distribute a final bylaw draft to the Town Departments about November 15 for general comment.

ACTON OUTDOOR LIGHTING REGULATIONS.**1 PURPOSE:**

The purpose of these regulations is to provide specific OUTDOOR LIGHTING standards in the Town of Acton that enhance public safety, health and welfare by reducing GLARE and LIGHT TRESPASS on the Town's streets, roadways and private properties, reduce artificial sky glow, and encourage careful use of energy.

2 APPLICABILITY:

The following regulations shall apply uniformly throughout the Town of Acton to all lots except single-family residential lots as follows:

- 2.1 They shall apply to all new and replacement outdoor LUMINAIRES installed on or after April 10, 2004 whose output exceeds 900 LAMP LUMENS.
- 2.2 They shall apply to all existing, new and replacement LUMINAIRES on a LOT undergoing a major modification or expansion under a site plan or other special permit. A major modification shall mean that more than 25% of the LUMINAIRES on the LOT are modified, moved or replaced. A major expansion shall mean that the number of LUMINAIRES on a LOT increases by more than 25% of the original number.
- 2.3 LUMINAIRES installed before the effective date of this bylaw shall be maintained or, if necessary, modified, to meet the zoning bylaw applicable at the time of their installation.
- 2.4 By January 1, 2006, all non-residential OUTDOOR LIGHTING in Acton shall comply with Section 3.3 (Hours of Operation).

3 STANDARDS:**3.1 LUMINAIRE design and shielding:**

Any LUMINAIRE rated at more than 900 Initial LAMP LUMENS shall be SHIELDED; any LUMINAIRE rated at more than 1800 Initial LAMP LUMENS shall be FULLY SHIELDED (Figure 1) as defined herein. Table 1 shows typical Initial and Maintained LUMEN output for various wattages of different types of LAMPS.

3.2 Control of LIGHT TRESPASS and GLARE:

- 3.2.1 Any outdoor LUMINAIRE whose distance from the LOT boundary is less than three times its height ($3xH$) shall be shielded so that all DIRECT LIGHT cast in the direction of neighboring residential or conservation LOTS and public rights-of-way is cut-off at an angle no more than 70 degrees measured from a vertical line directly below the LUMINAIRE (Figure 2A). This applies to all sides of the LUMINAIRE that emit light toward a LOT boundary less than $3xH$ away. (Figure 2B)
- 3.2.2 Additional shields shall be designed and installed as necessary to control LIGHT TRESPASS and GLARE as required herein (Figure 2). The parts of the shields that are exposed to the DIRECT LIGHT of the LUMINAIRE and visible from neighboring conservation or residential LOTS or public rights-of-way shall have a flat-black, low-reflectivity finish.
- 3.2.3 LUMINAIRES shall be shielded so that LIGHT TRESPASS onto neighboring residential or conservation property is less than 0.1 fc.
- 3.2.4 LUMINAIRES installed on one LOT to illuminate another LOT, or installed in a street, railroad, utility, or other right-of-way to illuminate an adjacent LOT, are prohibited.
- 3.2.5 No single LUMINAIRE shall employ LAMP(s) exceeding a total of 250 watts, exclusive of ballast or transformer loss.
- 3.2.6 Strobe and flashing lights, and laser illumination, are prohibited except as allowed under Section 6 (Exemptions).
- 3.2.7 Sections 3.2.1(Additional shields), 3.2.2(Flat black), 3.2.3(Light Trespass), 3.2.4(One LOT to another), and 3.2.5(Limit to 250 watts) shall not apply to STREETLIGHTS on a public right-of-way.

3.3 Hours of operation

- 3.3.1 All non-residential OUTDOOR LIGHTING, with the exception of STREETLIGHTS and safety or security lighting as defined herein, may be turned on no earlier than one hour before business hours and shall be turned off no later than 11 pm or one half an hour after close of business, whichever is later.

Business hours is defined as the period of time during which at least one person is present for the purpose of conducting business with the public on the lot or in a structure on the lot.

Safety lighting is defined as lighting to safeguard the movement of persons by foot or by handicapped or non-motorized vehicles over hazardous footing or in areas that conflict with vehicle traffic, or lighting for the purpose of aiding the visible detection and recognition other persons. Safety lighting includes lighting for stairs, pedestrian ramps and tunnels, and pedestrian routes that are reasonably expected to be used after business hours.

Security lighting is defined as lighting to protect buildings and property stored outdoors. Security lighting shall be reduced to no more than 50% of the lighting used before close of business for all LOTS with two or more lights.

- 3.3.2 Lighting controlled by motion detectors or infrared sensors with an on time no more than 5 minutes per activation is exempt from the hours-of-operation restriction.
- 3.3.3 Lighting of recreational facilities must be turned off no later than one half-hour after the end of use.
- 3.3.4 Sections 3.3.1(Business hours), 3.3.2 (Motion sensor) and 3.3.3 (Recreational facilities) shall not apply to STREETLIGHTS on a public right-of-way.

3.4 Special Provisions:

- 3.4.1 Lighting for externally illuminated signs shall be projected downward from above. The LUMINAIRE shall be SHIELDED and shall comply with Section 3.2 (Control of LIGHT TRESPASS and GLARE). It shall be focused directly at the sign display area and SHIELDED so that the LAMP is not visible from a neighboring residential or conservation LOT, or from a public right-of-way. (Figure 3).

- 3.4.2 UP-LIGHTING is prohibited, except for illumination of the United States Flag, a building façade or a monument. For any UP-LIGHTING, the LUMINAIRE shall be equipped with shields and shall comply with Sections 3.2.1(Additional Shields), 3.2.2(Flat black), 3.2.3(Light Trespass), 3.2.4(One LOT to another), 3.2.5(Limit to 250 watts) and 3.2.6(Strobe prohibition). It shall be focused directly at the area of the target and shielded so that the LAMP is not visible from a residential or conservation LOT, or from a public right-of-way. Building façade illumination is limited to no more than 0.25 watts of LAMP power per square foot of façade surface. A Lighting Plan certified by a Professional Outdoor Lighting Designer shall be submitted to the Town for any façade or monument UP-LIGHTING.

- 3.4.3 Illuminated outdoor recreational facilities: Notwithstanding the requirement of Section 3.1 (LUMINAIRE design and shielding), illumination of outdoor recreational facilities such as playing fields, pools, rinks, tennis courts, driving ranges, ski areas or skateboard parks shall be by either SHIELDED or FULLY SHIELDED LUMINAIRES. Such lighting is exempt from Sections 3.2.1 (Additional shields), 3.2.3 (LIGHT TRESPASS less than 0.1 fc) and 3.2.5 (LAMPS not to exceed 250 watts per LUMINAIRE).

Such SHIELDED LUMINAIRES shall be mounted at sufficient height and aimed so that the brightest part of the beam is elevated no more than 60 degrees above a point directly vertically below the LUMINAIRE (Figure 4). Light poles may extend beyond the 36-foot height limit to the extent necessary (but to no more than 85 feet in height) to adequately illuminate the facility in compliance with the maximum 60-degree elevation angle.

The LUMINAIRES shall be SHIELDED so that LIGHT TRESPASS onto any neighboring residential or conservation LOT is less than 0.2 fc.

The LAMP shall not be visible from any residential or conservation LOT or public rights-of-way.

- 3.4.4 LUMINAIRES located in a Local Historic District may be exempted from Section 3.1 (LUMINAIRE design and shielding) if the Historic District Commission specifically requires LUMINAIRES of a type that is not available that meets the FULLY SHIELDED criterion. In this case, such LUMINAIRES shall comply with IESNA CUTOFF light distribution standards.

Illumination for LUMINAIRES equipped with shielding so that the LAMP shall not be visible from neighboring residential or conservation LOTS or public rights-of-way, and shields shall comply with Section 3.2.2 (Visible part of shield has flat-black finish).

4 TOTAL SITE ENERGY (POWER) LIMITS:

- 4.1 This section regulates the total amount of lighting that may be used in a site. For simplicity, this is accomplished through regulation of the total amount of LAMP watts installed on the site, instead of the total LUMEN output. An outdoor lighting installation complies with this section if the actual Total Installed Watt Ratings of all LAMPS is no greater than the Allowed Lighting Power. Ballast and transformer loss is not counted in this total.

- 4.2 The Allowed Lighting Power shall be the sum of contributions calculated according to the following Use Areas: Sections 4.2.1 (Parking lot areas); 4.2.2 (Building entrance areas); 4.2.3 (Building canopies); 4.2.4 (Retail sales canopies); 4.2.5 (Retail sales frontage); 4.2.6 (Sales lots). All Use Areas shall be covered with an impervious surface.
- 4.2.1 Parking lots: 0.05 watts per square foot of the area of parking lots, drives, walkways, bikeways, and any other uncovered and paved or improved use area of the site. These areas include a 5-foot wide margin of grade or landscaping around the paved or developed area. A LUMINAIRE must be within 100 feet of any area that is included in the total.
- 4.2.2 Building entrance areas: 18 watts per linear foot of the width of all doors plus six feet per door.
- 4.2.3 Building canopies: 0.4 watts per square foot of the ceiling area of building entrance and walkway canopies, whichever is greater.
- 4.2.4 Retail sales canopies: 0.9 watt per square foot of the ceiling area of service station and retail sales canopies.
- 4.2.5 Retail sales frontage: 20 watts per linear foot of sales frontage. Sales frontage is measured along the viewed edge of paved or developed area used exclusively for the display of vehicles or other large objects for sale.
- 4.2.6 OUTDOOR SALES AREA: 0.8 watts per square foot times the area of the OUTDOOR SALES AREA. This area shall be specifically for the display and storage of vehicles, structures or other large objects and shall not include drives, walkways or other uses. A LUMINAIRE must be within 100 feet of any area that is included in the total.
- 4.3 In order to include an area of the site to determine the Allowed Lighting Power, the area shall be in an illuminated area of the site. An illuminated area of the site is defined as within 100 feet of a site LUMINAIRE, or, if under a canopy, then within 25 feet of a LUMINAIRE mounted under the canopy. Unilluminated areas of the site may not be used to calculate Allowed Lighting Power. An illuminated area of the site shall be counted for at most only one of the Use Areas. All areas included in calculation of Allowed Lighting Power shall be paved with an impervious surface.

5 LIGHTING PLAN:

- 5.1 A Lighting Plan shall be included in all applications for a Site Plan or other Special Permit, Variance, or Electrical Permit that proposes new or replacement lighting installations. For initial developments of land, a major modification (more than 25% of LUMINAIRES being modified or replaced), or a major addition (more than 25% increase in the number of LUMINAIRES), this lighting plan shall be certified to be valid and correct by a Professional Outdoor Lighting Designer trained in and expert in the field. The lighting plan shall contain:
- 5.1.1 On the site plan: the location, height, shielding type and LUMEN output of all LAMPS in all existing and proposed outdoor LUMINAIRES, and the wattage rating of all LAMPS in each LUMINAIRE, including building or CANOPY mounted LUMINAIRES. Any existing off-site LUMINAIRES used to illuminate the site shall be included in the Lighting Plan.
- 5.1.2 Manufacturer's data: For all LUMINAIRES with output greater than 1800 Initial LAMP LUMENS, the manufacturer's specification data and technical drawings, including the LUMINAIRE LUMEN output, and photometric data showing that the LUMINAIRE is FULLY SHIELDED. Manufacturer's specification that the LUMINAIRE is rated IESNA FULL CUTOFF (FCO) is sufficient to show that it is FULLY SHIELDED. For all LUMINAIRES with total Initial LAMP output less than 1800 LUMENS but greater than 900 LUMENS, the manufacturer's specification data and technical drawings with estimates of the view angles at which the LAMP is shielded from view.
- 5.1.3 On the site plan: The Lighting Plan shall define the mounting angle and position of the LUMINAIRE and demonstrate that it meets the definition of a SHIELDED LUMINAIRE.
- 5.1.4 Calculation of the Allowed Lighting Power for the site according to Section 4(Total Site Energy [Power] Limits).
- 5.1.5 Calculation of the Total Installed Lighting Power from the LUMINAIRES proposed for installation on the Lighting Plan, and demonstration that Total Installed Lighting Power does not exceed the Allowed Lighting Power.
- 5.2 Submission and subsequent approval of a plan does not relieve the applicant of his responsibility to demonstrate conformance to all sections of this bylaw in the as-built LUMINAIRES individually and for the site as a whole. For a major modification or major addition, a Professional Outdoor Lighting Designer shall certify that the as-built installation correctly reflects the site plan.

6 EXEMPTIONS:

The following lights are exempt from the standards of this bylaw:

- 6.1 Internally illuminated signs.
- 6.2 Temporary holiday or decorative lighting.
- 6.3 Emergency lighting used by the Police, Fire Department, or other official emergency personnel. Placement of longer-term emergency lighting shall, to largest extent possible, take into consideration the detrimental effects of GLARE on passing motorists and pedestrians, and on residential LOTS.
- 6.4 Temporary lighting used on construction sites. All such lighting shall be placed and directed to minimize the detrimental effects of GLARE on passing motorists and pedestrians, and on residential LOTS.
- 6.5 Lighting during special events such as fairs, celebrations, or concerts sponsored by the Town of Acton or authorized by the Acton Board of Selectmen. Lighting for festivals and carnivals is exempt but should be in keeping with the intent of this ordinance.

7 ENFORCEMENT:

- 7.1 The Building Commissioner of the Town of Acton is hereby designated as the officer charged with the enforcement of this Bylaw.
 - 7.1.1 Enforcement Action – The Building Commissioner, upon a written complaint of any citizen of Acton, or owner of property within Acton or upon such Commissioner's own initiative, shall institute any appropriate action or proceedings in the name of the Town of Acton to prevent, correct, restrain or abate violation of this Bylaw. In the case where the Building Commissioner is requested in writing to enforce this Bylaw against any person allegedly in violation of same the Commissioner shall notify, in writing, the party requesting such enforcement of any action or refusal to act, and the reasons therefore, within 14 days of receipt of such request.
 - 7.1.2 Fine – Violation of this Bylaw shall be punishable by a fine of \$300.00 for each offence. Each day that such violation continues shall constitute a separate offence.
- 7.2 Other Laws or Regulations – This Bylaw shall not be construed to authorize the USE of any land or STRUCTURE for any purpose that is prohibited by any other provision of the General Laws or by any other Bylaw, rule or regulation of the Town; nor shall compliance with any such provision authorize the USE of any land or STRUCTURE in any manner inconsistent with this Bylaw, except as required by the General Laws.
- 7.3 Validity and Separability – The invalidity of one or more Sections, subsections, sentences, clauses or provisions of this Bylaw shall not invalidate or impair the Bylaw as a whole or any other part thereof.

8 DEFINITIONS:

CANDELA (cd) - Unit of luminous intensity. One LUMEN per steradian solid angle.

CUTOFF (CO) – A LUMINAIRE light distribution, specified by the IESNA, where the intensity in CANDELA per 1000 LAMP LUMENS does not numerically exceed 25 (2.5%) at a vertical angle of 90 degrees above nadir, and 100 (10 %) at a vertical angle of 80 degrees above nadir. Nadir is the point directly vertically below the LUMINAIRE. A FULL CUTOFF (FCO) LUMINAIRE is also a CUTOFF LUMINAIRE.

DIRECT LIGHT - Light emitted directly from the LAMP, from the reflector or reflector diffuser, or through the refractor or diffuser lens of a LUMINAIRE.

FOOT CANDLE (fc) - Unit of ILLUMINANCE; One LUMEN per square foot.

FULL CUTOFF (FCO) - A LUMINAIRE light distribution, specified by the IESNA, where zero CANDELA intensity occurs at an angle of 90 degrees above nadir, and at all greater angles from nadir. Additionally, the CANDELA per 1000 LAMP LUMENS does not numerically exceed 100 (10 percent) at a vertical angle of 80 degrees above nadir. Nadir is the point directly vertically below the LUMINAIRE.

FULLY SHIELDED: constructed in such a manner that no light emitted by the fixture, either directly from the lamp or a diffusing element, or indirectly by reflection or refraction from any part of the LUMINAIRE, is projected above a horizontal plane passing through the lowest DIRECT-LIGHT-emitting part of the LUMINAIRE. (Figure 1). Building canopies, overhangs, roof eaves and similar types of construction shall not be considered as the means for providing the light cutoff. The cutoff characteristics shall be achieved by the LUMINAIRE itself. (Figure 5)

GLARE -The sensation of visual discomfort or loss in visual performance and visibility produced by luminance within the visual field that is sufficiently greater than the luminance to which the eyes are adapted.

INDIRECT LIGHT - DIRECT LIGHT that has been reflected off surfaces other than the source LUMINAIRE.

IESNA - Illuminating Engineering Society of North America. A professional association of lighting engineers and lighting manufacturers generally recognized as the definitive source for illumination recommendations in the United States.

ILLUMINANCE - The luminous flux incident per unit area. Expressed in LUX (one LUMEN per square meter) or FOOT CANDLE (one LUMEN per square foot). Horizontal or vertical ILLUMINANCE is that measured with the photometer cell mounted horizontally or vertically.

LAMP - The light source component of a LUMINAIRE that produces the actual light.

LIGHT TRESPASS - DIRECT or INDIRECT LIGHT produced by an artificial light source and which shines outside the boundaries of the property containing the LUMINAIRE.

LUMEN - A unit of luminous flux. Luminous flux is radiant energy flux evaluated with respect to its brightness-producing capacity. For the purposes of this regulation, the LUMEN-output value of a LAMP shall be its INITIAL LUMEN output rating, and not the value to which it degrades in its mid-life.

LUMINAIRE - A complete lighting unit or fixture including a LAMP or LAMPS, together with the parts designed to distribute the light, to position and protect the LAMPS, and to connect the LAMPS to the power supply.

LUX - Unit of ILLUMINANCE; one LUX equals one LUMEN per square meter.

OUTDOOR LIGHTING - The night-time illumination of an outside area or object by a LUMINAIRE located outdoors or indoors. For example, lights under a gas station CANOPY are considered outdoor lights and are regulated by this bylaw.

OUTDOOR SALES AREA – A static display of goods for sale at night, such as automobile sales lots, landscaping and nursery businesses, outdoor construction materials sales lots, and outdoor activity areas such as miniature golf, family fun centers, and permanent swap meets. An OUTDOOR SALES AREA location is not covered by canopies or other structures.

SHIELDED – A LUMINAIRE employing a shield to prevent glare or obtrusive light by blocking direct view of the lamp from neighboring residential, conservation LOTS and public rights-of-way. The LUMINAIRE shall have a generally downward distribution of light and must have a top shield to minimize upward light.

STREETLIGHTS - LUMINAIRES installed within a street right-of-way and intended primarily for the illumination of the street.

UP-LIGHTING - DIRECT LIGHT illumination distributed above a 90 degree horizontal plane through the lowest DIRECT LIGHT emitting part of the LUMINAIRE.

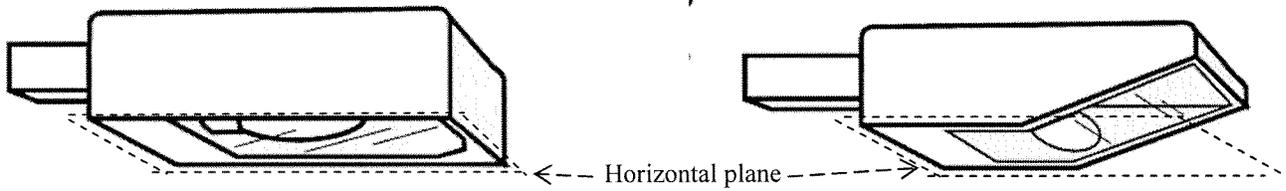
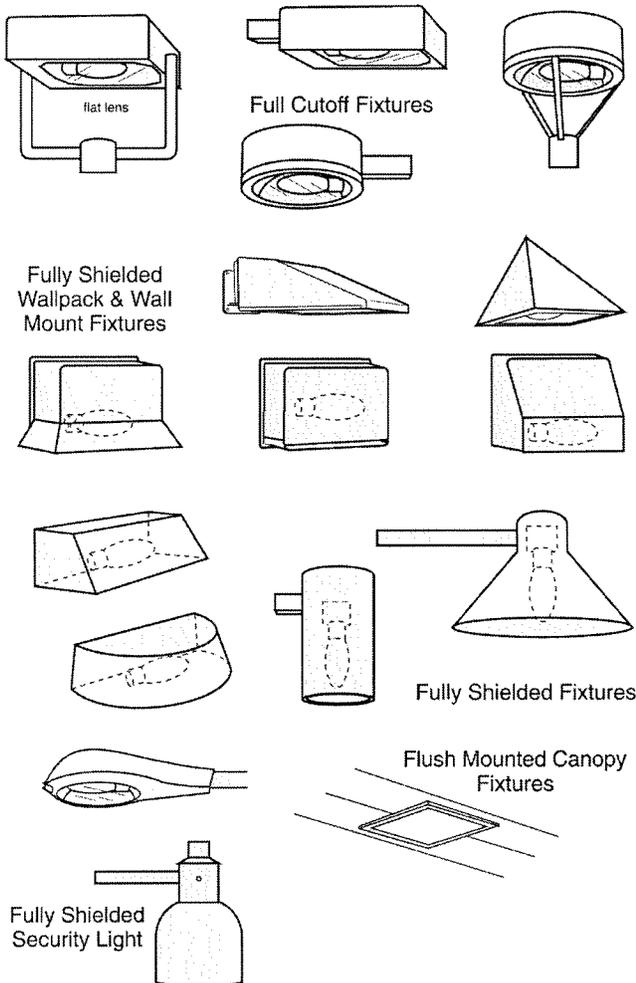


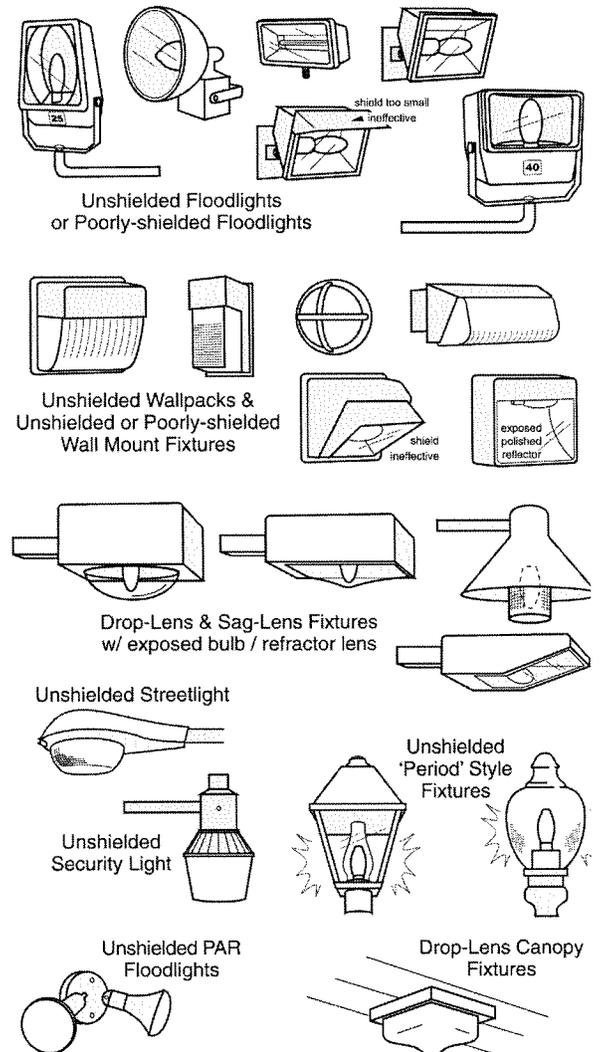
Figure 1A. FULLY SHIELDED. No light emitted above a horizontal plane through the lowest DIRECT-LIGHT-EMITTING part of LUMINAIRE.

Figure 1B. Not FULLY SHIELDED. Light is emitted above a horizontal plane through the lowest DIRECT-LIGHT-EMITTING part of LUMINAIRE.

Examples of FULLY SHIELDED LUMINAIRES



Examples of LUMINAIRES that are NOT FULLY SHIELDED



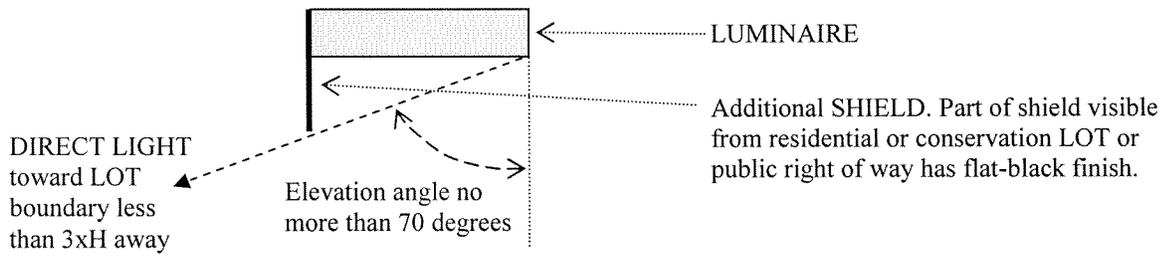


Figure 2A. Any outdoor LUMINAIRE whose distance from the LOT boundary is less than three times its height shall be shielded so that all DIRECT LIGHT cast in the direction of residential or conservation lots and public rights-of-way is cut-off at an angle no more than 70 degrees measured from a vertical line directly below the LUMINAIRE.

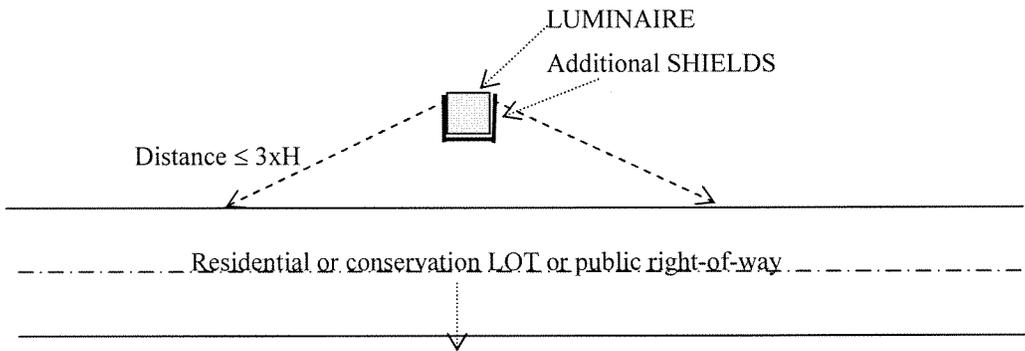


Figure 2B. This applies to all sides of the LUMINAIRE that emit light toward a LOT boundary less than 3xH away. (Figure 2)

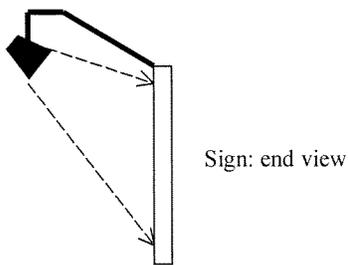


Figure 3. Lighting for externally illuminated signs shall be projected downward from above. The LUMINAIRE shall be SHIELDED and shall comply with Section 3.2 (Control of LIGHT TRESPASS and GLARE).

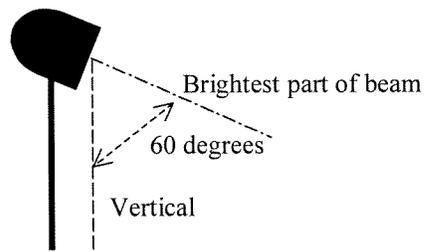


Figure 4. Illumination for outdoor recreational facilities shall be SHIELDED LUMINAIRES and shall be mounted at sufficient height and aimed so that the brightest part of the beam is elevated no more than 60 degrees above a point directly vertically below the LUMINAIRE (Figure 4)

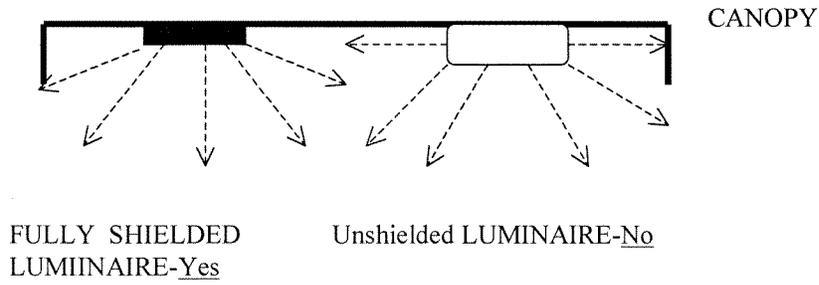


Figure 5. Building canopies, overhangs, roof eaves and similar types of construction shall not be considered as the means for providing the light cutoff. The cutoff characteristics shall be achieved by the LUMINAIRE itself.

Table 1. Table of typical LUMEN output for various wattages of different types of LAMPS. Both Initial and Maintained (after age degradation) output is shown. Manufacturer’s actual data takes precedence over the values in this table.

Lamp Wattage	Lumen output		Lamp Wattage	Lumen output	
	Initial	Maintained		Initial	Maintained
Incandescent (standard) (INC)			Tungsten Halogen (Quartz) (TH)		
15	120	98	75	1400	1302
25	210	172	100	1800	1674
40	490	402	150	2800	2604
60	855	701	200	3600	2952
75	1180	968	250	5000	4650
100	1750	1435	300	6000	4920
150	2800	2296	500	10100	9393
200	3850	3157			
Low-Pressure Sodium (LPS)			Standard Metal Halide (MH)		
18	1800	1800	150	13500	
35	4800	4800	175	15000	9348
55	8000	8000	250	23000	14333
90	13500	13500	360	36000	22434
135	22500	22500	400	40000	24928
180	33000	33000			

Table 1, continued.

Lamp Wattage	Lumen output		Lamp Wattage	Lumen output	
	Initial	Maintained		Initial	Maintained
High-Pressure Sodium (Clear) (HPS)			Pulse Start Metal Halide (MH)		
35	2250	1643	50	3400	1496
50	4000	2920	70	5600	2464
70	6300	4599	100	9000	3960
100	9500	6935	150	14000	8000
150	16000	11680	175	17500	11000
200	22000	16060	200	21000	13800
250	29000	21170	250	25000	16500
310	37000	27010	320	33000	21000
350	46500	33945	350	37000	24000
400	50000	36500	400	44000	28500
430	51500	37595	450	50000	33000
T12 Cool-White Fluorescent (FL)			T8 Fluorescent (FL)		
21	1190	952	17	1400	1260
30	2050	1640	25	2225	2003
36	2450	1960	30	2900	2610
39	3000	2400	32	3100	2790
50	3700	2960	40	3725	3353
52	3900	3120	44	4000	3600
55	4600	3680	55	5050	4545
70	5400	4320	65	6100	5490
75	6300	5040	59	5950	5355
			86	8200	7380
T12 High-Output Fluorescent (800 ma) (FL)			Compact Fluorescent (PL)		
75	5150	4120	7	400	320
80	5600	4480	9	600	480
85	6900	5520	13	900	720
95	8625	6900	18	1250	1000
110	9500	7600	23	1500	1200
			26	1710	1368
			32	2400	1920
			42	3200	2560